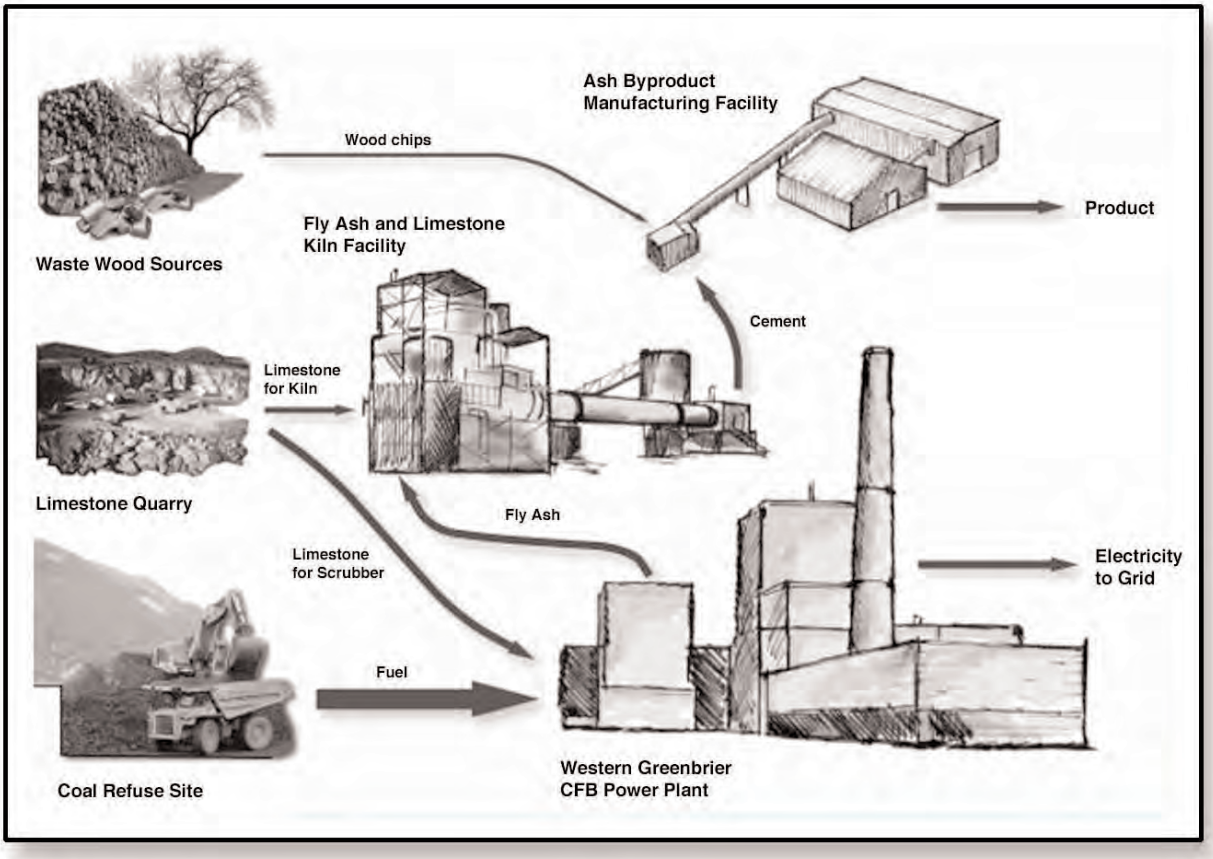
U.S. Department of Energy

WESTERN GREENBRIER CO-PRODUCTION DEMONSTRATION PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 OF 3

DOE / EIS-0361



NOVEMBER 2007

Office of Fossil Energy
National Energy Technology Laboratory

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Public Scoping - Transcript and Comments Received

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U.S. DEPARTMENT OF ENERGY
PUBLIC SCOPING MEETING
Western Greenbrier
Co-Production Demonstration Project
Charmco, West Virginia
June 19, 2003

* *

APPEARANCES:

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The U.S. Department of Energy conducted a Public Scoping Meeting in preparation of an Environmental Impact Statement regarding the Western Greenbrier Co-Production Demonstration Project in Rainelle, West Virginia. This meeting was held at 7:00 p.m., June 19, 2003, at the Greenbrier West High School, Charmco, West Virginia, before Michele G. Hankins, Court Reporter.

P R O C E E D I N G S

MR. McKOY: Let the record show that the public meeting began June 19, 2003, at 7:00 p.m., at the Greenbrier West High School.

As part of NEPA compliance with the National Environmental Policy Act, U.S. Department of Energy has decided that there is a need for an Environmental Impact Study for the proposed project.

One of the first steps in this EIS process is to conduct a Public Scoping Meeting.

What is a Public Scoping Meeting?

A Public Scoping Meeting is about a meeting for the public to participate in the evaluation of the possible environmental consequences of a proposed project.

More importantly, it is an opportunity for the U.S. Department of Energy to hear from you; to hear your concerns about the proposed project.

You might have environmental concerns,

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you may be concerned about where it will be, in terms of the impact of pollutants coming out of the stacks, or what would be the levels of concentration of those for you.

Or you may be concerned about

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environmental impacts, or, say, economic impacts, such as: How many jobs would be created? What would those jobs pay? What would be the amount of income coming into the community?

Or maybe you are concerned about the area of social issues, or safety and health issues.

Any of those topics are fair topics that we are here to talk about tonight, or that you are concerned about.

On tonight's agenda, there will be a brief overview of the National Environmental Policy Act, which is what we are doing here in terms of the scoping meeting.

There will be an overview of the Department of Energy's action in terms of what the Department of Energy hopes to gain from this project. That would be provided by Thomas Sarkus, from the Department of Energy in Pittsburg.

That would be followed by a project overview by Wayne Brown. Wayne will give us an introduction to the entire project in terms of what we have done.

Wayne is a local person, and he is in charge of production of Western Greenbrier

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Co-Generation, Limited Liability Company.

Then finally we will go into a formal comment period. That is the point in time when we will hear from you.

Visiting with us tonight, we have a few people that I want to recognize. We have Senator Anita Caldwell.

Can you please stand for just a moment, and then you can have a seat?

(Anita Caldwell stands.)

MR. McKOY: Thank you very much.

We have Delegate Ray Canterbury.

Can you please stand for just a moment?

(Ray Canterbury stands.)

MR. McKOY: Thank you.

I am not sure if we have Senator Jesse Guills?

(No audible response.)

MR. McKOY: Do we have Delegate Tom Campbell?

(No audible response.)

MR. McKOY: I guess maybe the rain has kept them away.

We have tonight, Mayor Eugene Wright,

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City of Quinwood.

Would you please stand, sir?

(Mayor Eugene Wright stands.)

MR. McKOY: Thank you.

We have Mayor Charles Mundy from the City of Rupert.

(Mayor Charles Mundy stands.)

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MR. McKOY: Thank you.

You have Mayor Adams from The City of Rainelle; is he here?

(No audible response.)

BY MR. McKOY: I hear we have Steve Malcolm from the local County Commission is here.

(Commissioner Malcolm stands.)

MR. McKOY: Thank you very much.

You have Betty Crookshank, of the County Commission.

(Commissioner Crookshank stands.)

MR. McKOY: Thank you.

You have Lowell Rose from the County Commission.

(Commissioner Rose stands.)

MR. McKOY: Okay. From the U.S. Department of Energy here tonight is Mike Eastman

with the DOE in Pittsburg. Mike is the DOE park manager for the Clean Coal Power Initiative.

Mike is sitting here in the front. He is going to field people's questions, taking notes.

We have with us tonight, Tom Sarkus, here from the DOE in Pittsburg. Tom is the DOE Director for the Division of Coal Power Project.

We have John Rockey with the DOE in Morgantown.

John, is the DOE project manager.

John, would you please stand up?

(John Rockey stands.)

MR. McKOY: Thank you.

We have Pete Farrington, DOE,

Morgantown. He is the DOE contract specialist.

I am Mark McKoy. I am the DOE/NEPA document manager.

We have with us tonight Lori Dorinski, from the DOE in Pittsburg.

Lori is the DOE/NEPA Compliance Officer.

Thank you, Lori.

Now for a few presentations.

I want to give you a little bit of an

overview of the National Environmental Policy Act and the scoping process.

We will be referring to the National Environmental Policy Act as NEPA.

It is a Federal law that became effective January 1, 1970, and it applies to all Federal agencies.

Basically, we refer to it as a look-before-you-leap-type of effect.

In other words, Federal agencies are required to consider the potential environmental consequences of their proposed actions before they undertake those actions.

Of course, for them to make an informed decision about their actions, we have to have high quality information and accurate information.

The National Environmental Policy Act, also requires public participation. The purpose of that public participation is to ensure the accuracy of the information, and to ensure that we are

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covering all of the topics of concern.

That is primarily what we are here for tonight is to try and find out what are these issues that you want to see addressed in the Environmental

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Impact Statement.

Under the National Environmental Policy Act, there are going to be three levels of environmental review. Obviously, not all the projects have the same amount of environmental impact.

Some projects are very small and have no noticeable impact, and those are covered by Category III.

There are other projects for which we suspect that there might be some significant environmental impact, but we are not quite certain at the time, of what those are. For those, we conduct an Environmental Assessment.

If in the process of performing the Environmental Assessment, we determine that there are, in fact, significant impacts to the environment, we are required by NEPA to do an Environmental Impact Statement; which is what we are here to complete stepwise.

A typical Environmental Impact Statement will include a statement of purpose and need for the agency's action.

It will also include the identification

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of reasonable alternatives to accomplish in the agency's purpose.

When it comes to reasonable alternatives, the Department of Energy is not always free to consider all possible alternatives.

In the case such as the one we have here, (indicating), for example, it is a non-Federal applicant seeking funding for a particular project.

The Department of Energy is limited to simply reviewing the application before it, and based on the information in that application, deciding to whether or not to provide funding.

If the Department of Energy is not free to say, Well, we like this project, but we really would rather have this project in another location.

So, there are some limitations in terms of what can be considered there.

Of course, the Environmental Impact Statement will include a description of the environment that could be impacted by this project, and most importantly, it will include a detailed analyzes of the potential consequences of the project, should it be undertaken.

Of course, the purpose of our meeting

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tonight is to hear from you. To get your comments, and your concerns on the proposed project on the additional issues to be addressed, the data to be collected, the analyzes to be performed.

Please remember that we are very early in the process. The detailed designs have not been worked out at this point in time.

We have not collected data, we have not

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done studies, so we probably could not answer a lot of the questions that you might have.

In particular, as we are going through the formal comment period tonight, we will not respond to your questions here tonight.

We will be happy to respond to your questions as best we can, after the formal comment period, or at some other point in time, but during the formal comment period, while we are taking a transcript, we want to hear from you. We do not want to hear ourselves.

There are a lot of people here who might want to speak. In order to ensure that everyone has time to speak, we are not going to tie up the time by responding to everybody during the formal comment period.

The proposed Federal action here is to provide financial assistance to the Western Greenbrier Co-Generation, LLC, for the design, construction, and the operation of the demonstration facility.

That demonstration facility is intended to test the commercial viability of new technology.

The Department of Energy is not in the business of producing electricity for any given community.

What the Department of Energy aims to do is to bring new technology to the point of commercialization, and demonstration that they are commercially viable for the benefit of the entire United States.

And, of course, we obviously want your participation in this process. We want for you to tell us, the best you can tell us, what you are concerned about.

If you are shy, to get up here and speak in front of a crowd, like I am, and you are too shy to come up here to speak, you can make your oral comments in writing. You can provide written comments to us, and mail them to me, e-mail them to

me, fax it to me.

Please try to get your comments to me by Thursday, July 3, 2003.

Okay. Now it is time for a few presentations to provide you with a little background.

The first presentation will be by Tom Sarkus, which will be regarding the DOE goals and objectives.

MR. SARKUS: Good evening.

I am Tom Sarkus. I work at the U.S. Department of Energy's National Energy Technology Laboratory, where I manage the Project Management division, which implements the department's Clean Coal Demonstration Projects.

Western Greenbrier Co-Generation's proposal is one of eight proposals that were selected competitively from among 36, that were submitted under the Clean Coal Power Initiative, or as we somehow abbreviate it, CCPI.

This was the first of four competitive

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solicitations that we hope will run toward Clean Coal Power Initiative over a 10-year period. So there could be three additional solicitations coming up in the future.

The Clean Coal Power Initiative is a cost-shared program between government and industry.

That is important because Western Greenbrier Co-Generation has developed and proposed this project.

They may finance 50 percent of the project cost, and are requesting that DOE fund the remaining 50 percent cost share, under the Clean Coal Power Initiative.

The Clean Coal Power Initiative is an important part of the National Energy Policy, which recommends that we increase the use of coal; America's most abundant fossil energy resource.

New technology demonstrates that these projects are key to preserving and expanding the use of coal throughout the United States.

The Clean Coal Power Initiative not only supports the National Energy Policy, but also supports several other national goals. Including, the Clear Sky Initiative, which sets more stringent future goals for air pollution emissions of sulphur dioxide, nitrogen oxide, and mercury.

The CCPI seeks to address environmental and economic issues affecting old and new coal-based power plants.

The high-efficiency systems eventually

capable of keeping near-zero emissions is one of our targets and clean coal promotes energy and economic security back home, here in the United States.

As I have already stated, in addition to Clean Coal Power Initiative will be implemented through four rounds for competitive solicitations; we have conducted the first of those four rounds.

This map, (indicating), shows the locations around the country where the eight projects that were selected under that first round; including, of course, the Western Greenbrier Co-Production Demonstration Project.

The Western Greenbrier Co-Generation project is proposed as the anchor tenant in an environmentally balanced eco-park.

Basically, Western Greenbrier Co-Generation, Limited Liability Company, will construct and utilize an 85-megawatt fluidized bed power plant to generate electricity from waste coal, which is commonly called, "gob".

Shown here, (indicating), it is a simplified somatic drawing of the power plant.

This won't be just any old power plant; rather, it will by equiped with advanced pollution control system, to help preserve the local environment. That is why DOE is involved.

This program funds advanced technologies. If there were nothing new about the power plants, it simply would not be eligible for funding.

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The eco-park, will through the used gobs, both during construction, and longer term when the power plant becomes operational.

Hopefully, this power plant will be a good thing for this area. And the availability of clean, affordable electricity, could attract other things to the eco-park.

We are also hoping to take care of the reclaiming of gob piles in coal mining regions throughout the United States, and that we may even be able to export the technology and equipment for use abroad.

Gob piles, as you know, can be unsightly. They can be an environmental liability in terms of water problems, and they are not safe for

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children, or anyone else to play, or to really be around.

Unfortunately, there is not much you can do with a gob pile.

Generally, it does not make economic sense to transport the waste material really over very far distances.

It is a problem because there are about 1- to 2-billion tons of coal waste in the United States, and about 400-million tons of gob in West Virginia alone.

Western Greenbrier Co-Generation Power Plant will produce an ash by-product.

This by-product will be used locally to remediate acid mine drainage, and will also be utilized, along with wood wastes, to produce

Woodbriks, to be used in building material.

Planning is already under way for the second Clean Coal Power Initiative, though we do not yet have a firm schedule.

We hope to begin our scoping meetings, our planning meetings for that process in August.

As information becomes available, we will post it on our website.

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The website address is shown here and I thought if anyone needs to write it down, I will repeat it.

Basically, it is www, dot, netl -- which stands for National Energy Technology Laboratories, dot, D-O-E, which stands for Department of Energy, dot, G-O-V, which stands for Government.

I will repeat it one more time, www.netl.doe.gov.

You could also find information at our website on a variety of other clean coal demonstration projects, many that we have already completed; including the world's largest fluidized bed combuster, sized at 265 megawatts, which started up last year in the city of Jacksonville, Florida.

To recap the Department of Energy's action to be considered here, is to whether to provide financial assistance to the project proposed by Western Greenbrier Co-Generation, Limited Liability Company, in the form of a 50 percent government profit share.

DOE and Western Greenbrier

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Co-Generation, are in the midst of negotiating a cooperative agreement for the project.

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Negotiations are going well, but there are some issues; including, a requirement that the participants repay the DOE cost shares from future revenues.

Another concern is the commercial potential for replicating the technology elsewhere, in order to broaden the use of coal, and coal waste in an environmentally responsible manner, not only here, but throughout the country, and as was mentioned before, we could even export the technology abroad.

With that, I thank you, and I look forward to your comments.

MR. McKOY: Our next speaker tonight is Wayne Brown with the Western Greenbrier Co-Generation, Limited Liability Company.

Wayne is a local person. I am sure most of you know him. He will provide you with a project overview.

MR. BROWN: Thank you, Mark.

Good evening, everyone.

Let me see if I can handhold this microphone. I think it might work better -- in my case anyway -- since I am not one who tends to stand

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still very much.

Can I have the first slide, please?

First, I think most of you may know, but we want to make sure that everyone understands that

Western Greenbrier, Limited Liability Company, is a public entity, that is owned 100 percent by the three municipalities that make up western Greenbrier County; Rainelle, Rupert and Quinwood.

It is a nonprofit entity.

The intention of these municipalities are findings that we hope will close the bottom line. From this operation, over the 20 years of operation that we do financial planning for, we will be reinvested in the community, and through economic development. It will become a substantial ongoing stimulus for economic development beyond the existing power plant itself.

It is really a regional development that we are focused on.

The scope of the project, literally, that the DOE is sharing with us on, includes both the 85-megawatt power plant, and the Woodbrik factory. As well as the gob pile remediation that is an essential part of the firing of the fuel to feed the

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plant.

In terms of just generally, the plan is for an 85-megawatt generator of electricity, that can also produce large amounts of steam. 30,000 pounds an hour, is our present design point.

If we wanted more steam, we can certainly generate it, but our ability to generate electrical power would be reduced.

We will be generating in excess of 400-million BTU's per hour of waste being in the form

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of hot water.

Those of you who have looked at the displays, and heard the earlier discussions, we are planning to use that hot water for greenhouses and a high-proposed fuel, will be heating warm beds, and a fish farm growing tilapia, et cetera.

So, part of our objective here is an integrated system that makes full use of what would typically be wasted.

Everything about the plant is state-of-the-art.

The fluidized-bed combuster itself, with all the power it produces -- in which we have display items that address it -- it is a very innovative

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design.

The process of equipment which follows it to clean up the gas stream that goes down to a culvert, the coal pit has the filters, the selected mine site's emissions reduction system, are all aiming to produce the cleanest flue gas that we can achieve with today's top technology.

The combuster itself is called an inverted cyclone. One of its major attributes is the structural efficiency of the design.

On the left here, (indicating), is a traditional circulating fluidized-bed plant. It consumes three days and 100 percent, in terms of five years; just a relative comparison.

This design has a much smaller footprint on the two mains. It is 83 percent in terms of height. The structural steel, we are at about a 40

percent savings in steel that goes into the construction.

It is very important, we do not need overhead cranes to build it, it locks, and supports itself. You start building from the bottom, and you build to support it as you are going, so it is much less expensive to construct in rural areas.

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If we had waterways, we could bring prefabricated pieces right to our door, that would be one thing, but we don't.

The future plans here for this technology, in terms of southern West Virginia, is that a family of systems is good for somewhat of the larger ties, but that there are no waterways, or at least ones to use to reach those spots. So this attribute is a very important one.

There is also a very efficient combuster, and it has designed, in effect, to let us integrate it with the calcine that we need for our Woodbrik.

Emissions is a very important subject to all of us. The technology that we are incorporating is absolutely state-of-the-art.

What you see in this slide is the history of the three major emission problems. The sulphur compound, the nitrogen compounds, and other particulates.

You can see, (indicating), that over the last two decades, in all areas, the technology has improved dramatically.

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If you notice, our green bars are about

half of the blue bars. And the blue bars represent the current controls. We are jumping another step in terms of emission cleanliness.

The best reference that I can give you is the Morgantown power plant, in the middle of West Virginia University.

Which for those of you who have lived around it -- and I and my family have, you hardly even know it is there -- and we are substantially better than that plant.

So that is why, on a very practical level, I am very confident that our power plant is not going to be an emission hazard to our community, and I think you have good reason to share that thought.

With regards to the Woodbrik facility, you have seen demonstrations of it tonight. It is one of a family of ash by-product that we think can create a whole new construction material industry here in West Virginia.

The basic component of the Woodbrik is a mixture of saw dust and essentially formulated ash that we are provided.

The ash that is first produced, is

relatively passive and not very useful as a building material.

By reprocessing it, using essentially a lime kiln, you transform it chemically and it becomes very useful. It is a lot like cement, used to make molded products like Woodbriks.

We are initially planning 300-tons per day of Woodbrik product and productions. 15,000 bricks a day of the 35-pound variety.

The ash, ultimately -- when we are processing all of the ash -- it can be made into either more Woodbrik, or other ash by-products.

That is just a starting point.

The kiln that converts the ash chemically is a rotary-fired kiln, that fires with powdered coal, finely ground coal.

The waste heat pump is captured back into the boiler, which maximizes use efficiency, and the gasses from the kiln come back into the boiler and are cleaned up by the entire emissions control system.

So, we have one stack, one flue gas and it is super clean.

The Woodbrik is a demonstrative

product.

In Colorado, several homes have been built with it. One of those homes that you can see here, (indicating), is about 2,500 square feet.

I can best describe the Woodbrik as an adobe-like material. It is 12 inches thick, 24 inches long and four inches high.

It is has a "R" value of about an R-19. It is a wall system that replaces the wood stud. For example, you can replace a wood stud wall with the Woodbrik. You put stucco on the outside, plaster on

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the inside, and you are done.

So, we think it can be a very valuable addition to the building, and power cleaning system.

The gob pile remediation is a very important objective.

The Anjean waste pile is a 4-million-ton problem.

The acid run-off from it is -- the poisons, both tributary and mediatory, are somewhere between -- over $300,000 a year, just treating the water.

Our intentions over a six-year period is to remove all of that waste. Take a sufficient

amount of ash back, and remove the residual acidity and convert it into a regional park.

That plan was pretty much endorsed today by the bankruptcy court.

Through the Western Greenbrier Business Development Corporation, purchased the 400 acres at Anjean today to ensure that it would be available for this project, and to ensure that when we are done that there will be a public park.

The next slide, (indicating).

There is a shot of Anjean, (indicating). You may not have seen it from the air before, but it is a black mountain that you see in the rear with most of the 4-million tons.

The pond that is here -- the frequent pond -- is what the West Virginia DEP is currently manning 24 hours a day, 7 days a week, 365 days a year to treat that water.

In terms of the schedule, the way things are going to happen on the project, we hope to complete the critical NEPA process, and the parallel objective permitting process, to actually begin construction on the plant and run from March of this year, to be completed in November of next year; 2004.

The design stage will begin just as soon as we sign the contract with DOE. It is roughly a 17-month design period, that will be completed in 2005. The construction will begin, with operations in 2007 -- in the Summer of 2007.

In terms of quantitative emissions from this plant, there is a table showing all of the emissions, the pounds per hour, tons per year, the amounts of megawatts and run-off.

Those numbers may mean very much to you, but you can trust us to say that it is absolutely state-of-the-art, and I suggest that in comparison with Morgantown, it is the best practical way of saying, that is good enough. We are doing half, again, better than Morgantown.

With regard to how we are going to get the waste coal from Anjean to Rainelle, our basic plan is to use rail.

When we are done in Anjean in about six years -- we will completely remove the gob from the Anjean area -- and then the Green Valley area, is our next major probability, with an option of approximately 10-million tons of waste coal in the Green Valley area.

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That, too, will be delivered by rail.
We are talking about operating 22 rail cars a day of waste coal coming in and a little bit of high-quality coal, most likely in the form of coal calcine.
Several rail cars of ash, will return to the mine sites, but you can think of it as one round-trip per day of a 20-car train, is roughly what it amounts to.
We use a substantial amount of limestone, seven truckloads a day, roughly, will be coming from the -- most likely from the Lewisburg area. There were several quarries every day bringing it in, approximately 10 cars pulled back with ash to the Anjean site, or other sites.
Our plan is to return as much of the calcine ash as needed to be used at the mining sites that we are extracting the waste coal from.
The remaining ash will be used for ash by-products.
Water may have crossed your mind in terms of looking at potential difficulty. We are going to use the better part of 700,000 gallons a day of water.

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Most of it, 500-and-some thousand gallons will come from the sewage water treatment plant in Rainelle, instead of going directly into the river.
We will divert it, and it for the cooling towers, and return what we do not evaporate

back to the public sewage plant.
We will not be extracting any water from any river.
The remaining is well water. We will be using roughly 170,000 gallons a day of made-up water for the plant operations.
The wells in the industrial park in Rainelle, we tested one of them at a flow rate of over 1,000 gallons a minute.
We are blessed in Rainelle with active wells that are just incredible, four or five different active wells under Rainelle.
We don't think that we have a water problem at all. That is one of the unique attributes of Rainelle.
That is an overview, and I hope from the previous discussions that I heard this afternoon, that you got a good feel for the project and that the

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Western Greenbrier staff is available to you at any time to answer questions.
I wanted to introduce Gary Skidmore.
Gary, where are you?
Gary is our chief financial officer, and my co-manager of the LLC.
Gary and I are really the two responsible managers for LLC, and you will be seeing lots of us around the project in Rainelle.
Please don't be bashful.
Contact us if you have any questions.
Thank you.

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MR. McKOY: Thank you, Wayne Brown for tonight's presentation.

This is the time to begin the formal comment period where the public is invited to provide comments regarding the scope, the content, and the various issues to be addressed in the EIS.

It is important to make your views known, either now in oral statements, or in writing. There are a number of handouts that are available back in the back.

One of the handouts is a comment card that looks like this. (Indicating). There is a

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space here where you could write some comments, and put your address on there and then mail it back to me.

If you need more space, feel free to write a letter to me; of course, you could e-mail it.

My e-mail address and my fax number are also on the card. So, please pick up one of these cards and take it with you.

Perhaps, more importantly, as we go through the process of producing the Environmental Impact Statement, we will produce a draft document. That draft document, we make available to you.

If you would like to have a copy of the Draft Environmental Impact Statement, please pick up one of these cards and at the bottom there is a place where you can check indicating that you would like to receive a copy.

You do not have to write any comments if you do not want to. You can also turn these cards in

tonight, or you can mail them later.

But if you would like to receive a copy of the Draft Environmental Impact Statement, please indicate on here that you would like to receive a copy.

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There is another handout at the back that is entitled Public Scoping Meeting and the National Environmental Policy Act.

You may also want to pick this one up. This also has various ways that you can contact me with your comments and your concerns.

Also it lists the libraries that will be the reading areas for the NEPA documents.

We will use the Rainelle Public Library, and the Greenbrier County Public Library in Lewisburg, as a reading area. And we will make the various NEPA documents available in those libraries for you to take a look at.

Okay, there are a few points for providing comments tonight: Try to limit your comments to five minutes per speaker.

There are a lot of people here who may want to speak; in order to ensure that everybody has an opportunity to speak, we will limit this to five minutes.

We were hoping to have some sort of courtesy timer to let you know when your five minutes were up. We do not have that, so if you are up here, I may have to come up and just tap on your shoulder

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and say your time is up.

Please indicate to me if you have more to say than you are able to say in five minutes. Once we go through getting everybody at least one chance to speak, if they wish to speak, then I will start a second round.

The way it will work tonight, I will take the preregistered speakers first, and then those speakers who registered at the door, then I will open up the floor to anybody who wants to provide comment. Once we have given everybody one chance, then we will begin a second round.

We have a transcriptionist who is recording all of your comments tonight.

So please when you give comments first state your name, and spell your name for the transcriptionist, and please, for the benefit of everybody, speak loudly and clearly.

Again, if you are uncomfortable, speaking in front of a crowd and want to provide comments, please use your comment card.

Okay. I am not sure about this list of speakers, but I am told that Delegate Tom Campbell is now here and that Tom Campbell would like to speak

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for a minute.

Please come up.

DELEGATE CAMPBELL: Good evening. My name is Tom Campbell, C-A-M-P-B-E-L-L.

Your delegation has been working on this project -- your state delegation -- for quite some time for the past year. For the Federal

government -- or at least I would like to say -- that we look forward to trying to work with you to see that a project is done in a responsible manner, that hopefully can alleviate some environmental concerns that we have, as well as provide very needed employment to this area and to this state.

We have some struggles to overcome, but I just received word from the Governor's office today, that they are willing to meet with us at 1 p.m. on Monday.

So we will be meeting with some of those folks that speak today to discuss the current situation with them.

I will be here for the rest of the evening, and if you do have comments you wish to direct to me, please do so.

We think that there is an opportunity

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here, if it is done right, to address the environmental concerns, and do a project, and to do a project that will provide needed employment here, as well.

So I look forward to continuing to work on this. I see in the back -- I know Bill Sharpe is here, and Senator Guills just walked in, as well. Your whole delegation is here, and we look forward to working with you.

Thank you.

MR. McKOY: Thank you Delegate Tom Campbell.

The next speaker is Delegate Ray

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Canterbury.

DELEGATE CANTERBURY: Certainly the entire delegation understands the vital importance of economic benefits of this project to work for the western end of the county, but since this is an Environmental Impact Study -- such as I understand it to be -- I will kind of limit my comments to that one specific problem that was alluded to earlier -- specifically, the widespread problem with gob in the State of West Virginia and the waste water problem.

I know that you are all familiar with

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the site at Anjean, which has a tremendous amount of gob. I think you know that there is run-off on this site that poses a significant industrial or environmental hazard to this area.

If that water is allowed to run off untreated, I think it runs off at a Ph of about three or four, which is acidic. It kills all of the fish in the streams, and it also gets into the ground water. So if you depend on wells for water, certainly that is an environmental quality of life issue.

The Anjean site is not the only site like that around the State of West Virginia.

There are something on the -- as I understand it -- hundreds of such sites, in which the State of West Virginia is currently paying -- not only to clean up the Anjean site, but several other sites around this state.

Here at Anjean, I think the cost is between 200- and $250,000 a year. You are paying

taxes on this site. Statewide, it is several million dollars a year.

It is my understanding, that if we clean up that mess statewide -- and it would cost the State

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of West Virginia somewhere between 2- and 3-billion dollars to completely alleviate some of the groundwater contamination problems posed by gob piles all over the State of West Virginia.

Right now we have significant economic problems in West Virginia.

As is, we have a $4-billion unfunded liability in our employee pension programming, we have a $5-billion unfunded liability in Workers' Comp that we just addressed.

Now the bottom line is that we simply don't have the funds for this.

Let's break this down, $2 billion, 1.8 million people, that is $1,100 a head to clean up this problem.

Clearly, if the technology like this proves to be viable, there is an opportunity to try to find investments that will help us alleviate this particular problem, is certainly something that we need to explore.

I would further encourage you, as a committee, the environmental study committee, to study this specific project very carefully, because it is very important to the whole state, and it is

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very important to the taxpayers in this city, as

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well.

Thank you.

MR. McKOY: Thank you, Delegate Ray Canterbury.

The next speaker will be Senator Jesse Guills.

SENATOR GUILLS: Good evening.

I will be very brief.

I want the audience to be aware of how serious I think this matter is, and how important it is for this county, both in terms of employment, as well as from an environmental standpoint.

I didn't know prior to the beginning of the session that was completed back in March, much about this project. But I have had the opportunity to meet with several individuals who have worked with it, and it appears to me that it is a project that could be beneficial for the State of West Virginia, but in particular, Greenbrier County, and more particularly, western Greenbrier County.

This project will provide jobs for a long time.

One of the most irritating things to

me -- as most of you have been aware through reading the paper -- about a bond issue that went through the legislature last year, $200 million.

There was monies that had been designated to go to certain areas, not of which came to Greenbrier County, none of which came to the 10th District, which includes Greenbrier, Monroe, Summers, most of Mercer, and a part of Fayette.

It is disturbing to me to see and watch money being distributed to areas, and areas that need money, need jobs, are ignored.

In this particular instance, this project will provide jobs for a long time, and will provide jobs for not only for those who are in this room, but will provide them for your children, and your grandchildren.

To think that the State is willing to sink $70 million into a retail strip mall in Wheeling, but won't look to this District, and look to what we need here and what we cannot have.

I think Delegate Canterbury and Delegate Campbell -- although I just walked in -- addressed some environmental issues.

As taxpayers, we need to be aware that

this State is paying $250,000, plus, annually to keep your streams safe. And when you look at the cost of this project, and the fact that we can clean up streams, and eliminate the threat of polluted and contaminated water, then it is time we stand up, and we go to Charleston and we tell them what we want.

It is going to take people like you to do that.

You can come to us, and we will help you any way we can, but we have got to voice, and voice quick, because time is running out.

What I would ask you to do is to get behind us, and let Charleston know that we are not going to stand by and let the Federal government give

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us $107 million, and we can't find $4 million in this state, but they can sink $70 million in a retail mall.

Enough is enough.

Let's get excited and let's do something for western Greenbrier County, and for the future of this state and this county.

Thank you.

MR. McKOY: Thank you, Senator Jesse Guills.

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Next we will hear from Senator Anita Caldwell. She is from Princeton, West Virginia.

SENATOR CALDWELL: I am Senator Anita Caldwell, and I am the rest of the delegation.

Because we are the 10th District, the new district when this end of Greenbrier County was put in with Mercer and other counties, I became your city senator when that happened.

Like Jesse -- first let me say that I totally agree with him completely and totally, and was applauding because he is so accurate in the fact that the 10th District did not get any money.

So I am here tonight first to tell you that I am a part of the 10th District, and he represents Greenbrier County, also. I just wanted to show you that I do have support for this project.

When I was told about it, I was absolutely amazed that so much work has been done to get it ready.

As your "other" Senator, I will do whatever I can to help the local Greenbrier

Development Authority bring it to reality.

It is just unbelievable that we have made it as far as we have and we are one of the

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eight.

A major reason to support the plan, is the opportunity to revitalize this county that once relied so heavily on coal.

Because when you do that, you not only help this county and state, but all of those other southern counties that have this to look forward to, possibly even transporting their waste right up here, too, eventually, if they cannot build one of their own.

The concept is so environmentally positive, that it has created a real buzz in the political circles in Charleston, where there are officials that could make this happen, once they quit concentrating on the northern panhandle, and start realizing that there is a southern West Virginia.

I have had conversations as recently as today with Senator Walt Helmick, the finance chair, and a couple of days ago with David Satterfield of the West Virginia Economic and Development Authority.

They know this exists. They realize that we need that money for the bridge. They are looking for ways to find it, and I suspect that is one of the reasons they are willing to meet with the delegation

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again next week.

They cannot write this off. It is just

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too good of a deal.

Too good of a deal for Greenbrier County, and too good of a deal for the State of West Virginia.

So you are on their radar screen. You are on it to the point that I really think it is going to happen.

But I cannot sit down without telling you that you have got the secret weapon, it is former Senator Ralph Williams.

This man knows whose buttons to push, and where to go, and what to do to get people to pay attention, and I want you to know that he has been doing it.

So I think that after the studies are finished, and Greenbrier wants to go forward with this -- and I know you do -- I believe that we are going to find the funding and it is going to be reality, and I want to be a part of it, as your "other" Senator.

Thank you for letting me speak to you this evening.

MR. McKOY: Thank you, Senator Anita Caldwell.

Our next speaker will be, Steve Malcom, president of the local County Commission.

MR. MALCOM: This is going to be impromptu. I didn't know I was supposed to speak tonight.

The Commission has put some money forth in this project because I believe that you have got

to spend money to make money.

I had the honor to work at Lackey, and know all about the gob piles, there are many gob piles up there.

As we sit here tonight, you all know that we have got an environmental problem, but we have an economical problem.

Look around you: We are all seniors, or mid-seniors, like myself. Most of our children have left. Hopefully they can come back and work. Children that are in high school, maybe they will be able to stay.

Ms. Caldwell, mentioned Senator Helmick. I went with a group to Charleston a few weeks ago. The Governor didn't think we had any

money, and Senator Helmick came up with a million dollars. So if they want to call us back, maybe we can come up with a way that we can come up with another couple 2- or 3- million dollars; I don't know.

It is imperative that you get this for western Greenbrier County, and for Greenbrier County.

There is a little stigma between western Greenbrier County, and eastern Greenbrier County, and I talk to a lot of business people in Greenbrier County, and the eastern end is all for this project because they want to see something happen in the western Greenbrier County.

I made the statement before that people in the west end of the county, are kind of treated

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like a third-world country.

It has got kind of turned around on me, but when you get out here and work in the western end of the county, we are like a third-world country over here and it is time to turn that around.

Like I said, I was not planning on speaking tonight, I know the County Commission is behind this project. I would like to applaud Mr. Wayne Brown, and what he has tried to do to make

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this thing go. And Mr. Bill Shiffer, I don't know if he is here tonight, but your heart is in the right place to try to get this thing off the ground and going -- with Mr. Williams -- with no time, too.

Thank you.

MR. McKOY: Thank you, Mr. Steve Malcom, and I apologize. I was looking for you earlier to confirm that you wanted to speak, but I was told earlier that you didn't.

Would Mayor Eugene Wright like to speak?

MAYOR WRIGHT: I have been in the county a long time.

I understand what your economic problems are.

In a real small town -- I have been Mayor, I have had two other terms -- and it is very hard for a real small town, with a very small tax base, and not much employment, to really be -- to really get the benefits for small towns that we need.

But there are roughly 450 people up there. But this would make a tremendous difference -- and we should probably start thinking

about getting some of these benefits for our people.

It just amazes me about what has been

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done for this project. And to me, when we turn the first shovel of dirt on this project, let's just say that it will be the most exciting thing that happened to this county in 100 years.

Thank you, Mayor

MR. McKOY: Would Mr. Charles Mundy like to speak?

(No response.)

MR. McKOY: Would Mayor Pete Adams like to speak?

(No response.)

MR. McKOY: Would Betty Crookshank like to speak?

Betty is with the County Commission.

MS. CROOKSHANK: It is really good to see so many people out tonight.

It is a time for us to come together and find out what information -- I know some people have had some questions, so I hope those questions have been answered, and if not, there will be a time for question and answer.

I also would like to thank the ladies from Quinwood that prepared the nice food that we had before this meeting.

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When Wayne Brown mentioned to me -- back a year ago in February -- I ran into him at a party, and he told me he was working on a study about this

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co-generation, and I was very enthused.

I thought, well, gosh, this is a great opportunity to clean up the gob pile at Anjean, and also have some economic development for the western end of the county.

The western end of this county does get left out. And although there may be a few little details that need to be worked out, I think it is a great project.

I agree whole heartedly with what our legislators have said, that this end usually does get left out, and we need to work together and try to get this to go.

It is too close to let it slip through our fingers. So I hope that it will be looked upon favorably in your-all's report.

Thank you all for coming.

MR. McKOY: Thank you, Betty.

Fred Patterson?

MR. PATTERSON: I get up here in the hopes that if somebody else that has other ideas will

say it.

I came here tonight with a prepared statement. After talking to a number of people, and listening to what has been said, I would like to just almost entirely throw that out.

The reason I came is that I heard the word, "mitigation".

I don't know how many pay attention to I-64, between Sam Black Church and Laurel, with results of wetlands in our type of topography.

Everybody in the various agencies that speak to, about, and for the environment, say they don't know why those trees died out -- and I do mean every one of them.

Pin oak loves the water, you can't kill a pin oak, you sure can if you flood its roots. It cannot breath.

I got involved in this stuff about five years ago. I personally have lost about $50,000 in equipment cost because of the water that has been pushed back at us.

Now why I came is the intentions seem to be in Rainelle to start with a very small little bit requirement for mitigation.

We ran into that problem, starting back at about 1991. We finally found out that not only had they forced the sale of about 323 acres of land to compensate for 18 acres of land.

The design of the Interstate made an 11-mile-long dam across it.

And they put -- "they," the environmentalists, advocates -- had put in culverts three feet above the forest floor.

Now all of a sudden, the land gets wet, takes longer to drain.

We are talking about, I believe, 18 acres -- I heard someone mention -- that may require mitigation.

Well, that undoubtedly will come in at a habitat unit value. A number that the EPA, and your

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various environmentally-friendly groups use to tell you how many frogs are supposed to be on it.

Most of them wouldn't know the difference between a hellgrammite and a moth, but they want wetlands.

We have a state, too many people. We have mountains, and I am surprised, mountains cause valleys. Water runs off mountains, and makes wet

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spots that eventually turn into streams, and logs fall into streams, and you have got a temporary wetland.

The problem that we ran into took 11 years to get them to remove an illegal dam across Meadow River.

This goes back to a 1967 study. In 1985, there is no problem. I have the books right here they say, No environmental problem.

In 1988, they discovered a 1967 study, that was supposed to clean up Meadow River. Supposed to get those 20's to 30's logging tops out, fill and silt out, so that the water could.

But this study that was supposed to clean Meadow River, all of a sudden, was called the Upper Meadow River Wetland Compound, 137,000 acres of meadow, a 20,000-acre dam that would have flooded the farmland of Meadow River to the head waters.

Now all I ask is that someone on this project tell me that they will put that plant where there is not a square inch of mitigation required, because now we are up to 2,200 acres, and they are still going.

I know I am starting to sound like a

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preacher now, but I can get mad about things. About things that really matter to individuals.

I will just go ahead and shut up, and let somebody tell me that you are not going to mitigate an inch of property.

I don't care who owns it, or why it is being considered for the plant, look across the road a quarter mile there, 80 percent of this state is forest. 10 percent is in agriculture, and that is why -- they want to make everything a wetland.

I would like to leave you with this thought: I am not against jobs, and I am sure this plant -- there will be some fallout to the community, somehow, or another, and a few people will get some bucks here and there, but fight if you believe.

As someone said several years back, "The most important political office is that of a private citizen."

Get active.

We will get some jobs.

(Mr. Patterson attached written comments to the record, as an addition to his oral statements.)

MR. McKOY: Thank you, Fred.

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It is very important that you tell us these things, and that we consider the problems that you have had in the past, in planning what to do in the future.

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If you would like to enter your written statement into the record, please hand that to me after the meeting and I will have it entered into the transcript.

MR. PATTERSON: I have a feeling I will be seeing a lot more of your office.

MR. McKOY: That will be fine.

Okay. Would Dave Cowan like to speak? I am not certain that he had indicated that he would like to.

You would like to?

MR. COWAN: Yes, I would.

MR. McKOY: Okay.

MR. COWAN: Dave Cowan is the name. I am with Greenbrier River Watershed Association; however, there are those people here from the Greenbrier River Watershed Association, who do not agree on everything. So please, just consider this to be my personal opinion.

Basically I am in favor of the concept

of this thing, and I think it would be great if all of the environmental concerns are actually taken care of.

Basically the environmental community has been at war with the coal companies for years, and years, and years.

And the State has been sort of our enemy because of their going along with whatever the coal companies want. And so that is scary in that this project is set up to burn more coal.

And burning the gob pile up seems like

an excellent thing to do, but there is other water pollution, and air pollution.

We want to make darn sure that those things, pollution permits by the State are not issued for those things which allow water pollution and air pollution to happen like it does in many, many, other coal burning projects and coal extraction projects.

The other thing is the valley fill.

For every truckload of coal that comes out of a strip mine where they use valley fill, you have got more valley fills. And everybody knows about the environmental degradation caused by valley

fill.

Federal Judge Haden issued a ruling on that in which he said that it was entirely against the Clean Water Act, and I think that the State DEP, spent more money trying to overcome his ruling, than they probably spent on mitigation, and other environmental things in all of southeastern West Virginia.

The other problem is the overweight trucks for all of the trucking of coal. In fact, after they use up the gob pile, and so forth, there may be coal trucks running up and down. There are certainly going to be limestone trucks running up and down the highway.

Again, the State allows these 140,000-ton -- or whatever it is -- trucks, which are way above Federal standards, to run on our highways.

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The Federal government won't allow it. They won't run on Highway 64 because the Federal government has control of the weight, and will not allow that type of weight.

The other problem is limestone quarries.

Limestone quarries, in themselves, are

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very poorly regulated in this state, because of our State, of course, and there is going to be use of limestone for this project, which will come out of these quarries.

It is poorly regulated, and it allows a lot of pollution to happen from quarry sites themselves.

So these are peripheral things that this project is going to impact the environment.

So I would ask that the Federal government, whichever -- the DOE, or whoever is going to be in charge from a Federal standpoint, that they become the ultimate overseers of the project, to make sure that the State does not -- that the State regulations, or the State's weak regulations, are not considered for this particular project.

This is a demonstration project. And we should demonstrate with this project, all of the costs, all of the environmental costs, and other costs like a project like this would cost.

I feel like, for example, in the quarries, and the valley fills, and I would hope that the Federal government would not permit coal from areas that do valley fills.

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That they would not purchase, or allow coal to be purchased, from producers that use valley-fill techniques. That can be written into the authorizing projects, the authorizing agreement.

Also the same thing with the pollution permits, that they oversee that, and make sure that no pollution permits are allowed, which are less environmentally -- whatever -- than what the Federal standards are.

The same thing with air pollution. That the Federal standards be the ones that are in control, and not something issued by the State.

Same thing with the trucks, that they not allow coal purchased from overweight trucks.

Another thing that I mentioned to several of the people who can control the project, is that we do seem to have a radon problem in some of the basements in the Greenbrier valley and other areas.

I don't think that any of the aggregate has ever been tested to see whether that is the source of the radon.

I would ask that radon tests be done on the limestone, that it can be used to make these

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bricks, so that if it is used in a house, they knock off the radon problem in any housing that we have.

Other standards for safety, are the overweight trucks, and so forth, as a safety issue, that I think should be addressed.

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That is about all I have.

Thank you.

MR. McKOY: Thank you, Dave, for those very good points.

Would Roger Ash like to speak?

MR. ASH: Roger Ash. I would like to let everyone know that I am 100 percent behind this project.

Coal has been very good to me and my family, and gives to our people, and our community.

Coal put my children through school, it has paid for my home, and has paid for my vehicles.

I bet you that not one of them environmentalists here rode a mule, or a horse, that they rode a vehicle that coal helped produce.

It keeps the lights on, and I want to see the coal flow.

We have got one significant problem that can be resolved, and that is mitigation.

I agree whole-heartedly with Mr. Patterson, that we cannot have mitigation, because then that empowers not this project, but that empowers the people who want to destroy this project. The liberal people will come in and say we want hundreds of acres, possibly.

Now, I am of the opinion that I want this project, and after seeing this property I am thinking that it can be solved without any mitigation. That all mitigation can be handled onsite.

What we do not want from this project,

is 30 more acres of swampland, to breed mosquitos and filth that we do not need on this earth, so our liberal friends have no bite on us.

I also want to say that if we stop it now, we do not need mitigation.

Thank you.

MR. McKOY: Thank you, Roger.

Gary Graham?

We were not sure if Gary wanted to speak.

There seemed to be some indication on the sign-in sheet.

(No response.)

MR. McKOY: Would Ralph Williams like to comment?

MR. WILLIAMS: I am glad to see so many people at this project tonight.

It is possibly the only opportunity that has arisen in several years that might bring some technology development to western Greenbrier County.

Your grandchildren, and some of your children, they have an opportunity to see and really get a reasonably good job if this entity gets completed.

It hasn't been mentioned why the location of this project was selected in Rainelle.

Briefly, it was done so because you could not take water out of any of the clear creek streams; you could not take water out of Meadow River, and you had to have an opportunity to connect

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your power source in a high-price line that could carry the power line.

We solved the water problem by looking around this end of the county, and narrowing it down to where a site might be selected.

The site in Rainelle pretty much met

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those characteristics.

A sewer plant, which was built in 1981, has about a discharge of about 500,000 gallons of cleaned up water a day. And the old Meadow River Lumber Company well that still exist on the old Meadow River property, which is now an industrial park, was one of the finest wells that produced city water for the old town of Rainelle.

When the towns worked them mines, that water source -- and when Meadow River left the community, that water source was discontinued, and the old town of east Rainelle becomes Rainelle, and they use a different well, which still supplies plenty of water.

That cured the water problem, and you had to be close enough that you could connect into a power line. Well, right up above Rainelle Junior High School crossing up on Sewell Mountain, is 65 feet of line which can be connected into and run up to Lackey.

Appalachian Power Company will upgrade that line with three connectors, and we can hook the power system into the grid. That means that we just have to improve a very few miles to accomplish that.

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The other thing is that you had to have a bunch of level land if you were going to build a bunch of greenhouses, and have agricultural products. But there is about 100 acres, more or less, that is available that fits that category, right here around Rainelle.

So, that is basically the reason why this site was selected by these people to build this facility.

Mr. Patterson, yes, we are probably going to mitigate five- or six acres of ground, they are probably going to do that, and that ain't going to kill anybody.

What you need to do is join the committee that is going to be formed by this group of people in the next 17 months, and work towards developing all of those assets, while providing dwellings for people to live in.

There are going to be about 350 workers on that plant site for two years. They are going to require houses, they are going to require their children to go to your schools, and these kinds of plans have to be looked into and some provision made.

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There is a lot of work to be done by all of you who are willing to contribute to this project.

I thank you for giving me a chance to speak tonight.

MR. McKOY: Thank you, Ralph.

Would Buck Williams like to comment?

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MR. WILLIAMS: My name is J.C. Williams, III, most commonly known as just plain Buck Williams to most people.

We have heard from the engineers, we have heard from the scientists, we have heard from our elected officials, we have heard from some persons with concerns about our environment.

I would like to share my thoughts with you as a business person.

My wife and I own a small business located here in Charmco.

Any business class that you go to, number one they tell you: Find a need, you will make money.

Everything that I have read, heard on the radio, seen on T.V., tells you that electric, oil, and gas, are going to become very, very, scarce and in high demand within the next 10- to 15 years.

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We have witnessed the brown-outs of California, so we have electric.

Now our concern is environmentally, and our friend from DOE is here, and DEP, to keep a very tight watch on things. They are helping to do business very clean, and in an environmentally safe way through modern technology.

The one thing that I really like about it is that if you are in a business situation, you want to look for a win/win situations; right?

Win/win, is the fact that here we are, we have a product we can sell, and we also have the -- shall we say, a disaster, that we need to

clean up, the gob piles.

The gob piles. You can talk about West Virginia's beauty and try to forget about the gob piles. The local citizens know about the gob piles. But here we are, we are going to clean those gob piles up.

The other portion that I like about it is the project brings numerous opportunities.

I have attended several meetings, and I am pretty confident that even though I am not an engineer, or a scientist, that people have a pretty

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good handle on this thing, and I think that it looks like we are very fortunate that we can do it in an environmentally safe manner.

The other thing that I like is that it has to be cost-effective.

This is not a government handout here. This is a partnership deal where down the road here for 20 years, we are going to have something that will produce a commodity that we can sell, and we are going to clean the environment up all in one run.

This project gives jobs.

We all know what jobs mean to everyone. The thing I like about the jobs for this project is the fact that they are not seasonal. They are not six months, they are not nine months, they aren't minimum wage. These jobs are manufacturing jobs that you can raise your family on, and raise your family on well.

The other thing that I really like is

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that -- it has been alluded to here before, is the fact that other parts of the state you hear about -- in other states -- you hear about all the tax deals and incentives, to bring companies in and the whole thing.

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Since we have moved here, my wife, my family and I -- I always come last when it comes to those three -- when we moved here, one of the first things I heard was that everybody says all the big corporations come to West Virginia and they take their money and they go home.

All of a sudden, here we are with a project, a limited liability company, that we will own with the three communities that are here. So it will belong to the people in West Virginia, and the bulk of the money will stay here.

Thank you.

MR. McKOY: Thank you, Buck.

It is a little uncertain if the next person really wanted to comment, but would John Perez like to comment?

There seems to be some indication on the sign-in sheet that John Perez might want to comment.

(No response.)

MR. McKOY: Okay. Would Tina Persinger like to comment?

MS. PERSINGER: I am one of the people that left here, I live in Rainelle now.

My name is Tina Persinger.

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I am one of the people that left the

Rainelle area, and moved somewhere else because of the economic development that we have here.

My children, my husband, and I, moved back because we wanted to come home.

We were away for a while. My kids are doing well now, but I commute 77 miles one way to go to work. I have to do that in order to make ends meet.

I am for this 100 percent. I thank Ralph Williams, and all of the supporters, for allowing us to have this time to speak.

I hope that everybody in Rainelle, Rupert, and Quinwood, and the surrounding communities, support all of this.

Thank you.

MR. McKOY: Thank you, Tina.

We have another person who is a maybe based on their sign-in; does Charles Meadows wish to speak?

MR. MEADOWS: My name is Charles Meadows. I am a local businessman.

I was raised in Quinwood, born in Rupert, and now live in Rainelle, so I have a

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connection with all three of these towns.

I moved away from this area for most of my adult life and returned in 1983, because of an ill mother and wanting to be with her in the last years of her life.

I stayed here until she departed this life, and I found that I still loved this area.

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I came back and I found that there was a lack of hope and faith of anything ever happening in the area.

All of the people that sort of gave up hope of anything coming in after the coal mines just sort of played out. We relied on timber, and a few other things, to maintain our livelihood.

But isn't it good to have faith, and look forward to something that may happen?

I am glad that this group of men have got together and give up a ray of hope for this area, and I sure applaud them for their efforts.

Thank you very much.

MR. McKOY: That concludes everyone that I have listed to speak, if they had registered.

At this point in time I want to open the floor to those who did not preregister to speak, but

would like to speak.

Is there anyone out there who would like to comment?

(Response.)

Come on up.

Please state your name for the transcript.

MS. LEWIS: My name is Lynn Lewis. I live in Rainelle.

I am not originally from West Virginia, I am from Houston, Texas. I spent 22 years in the military.

My last duty station was in Beckley, West Virginia, and when I retired, I had fallen in

love with West Virginia -- except for the month of February -- and I decided to stay.

I am currently employed at Davis Stuart, working with youth that are placed out of the home.

A couple of comments very briefly: When I am working with youth in West Virginia -- ages mostly 15 through 18 -- the subject of what are we going to do when they grow up?

Unfortunately, I have to tell these kids who are in small towns, that they may have to

consider relocating to larger areas because of employment.

So it is really nice to see that there is a possibility of getting some employment, especially in the local area.

The other thing is that we are now in a new millennium. We are post the year 2000. It would be very, very, nice to have the rest of the nation point to West Virginia as a leader in environmentally friendly technology.

Thank you.

MR. McKOY: Thank you for your comments.

Is there anyone else who would like to comment?

MR. HAZELETT: Even though I am having a bad hair day, I will take my hat off.

My name is Vernon Hazelett. I am from Clintonville. My family has deep roots in this county, in Rainelle, Quinwood, and Kieffer.

I have been following this project since

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it first became public, and I have some definite concerns about it.

I agree with my good friend, Roger Ash. I am for this project. I am for anything that will

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bring economic development and jobs to Greenbrier County.

I also agree with my good friend, Fred Patterson.

We have been told all along, and even early in the evening, that this was a nonprofit entity and operation.

But we learned one other thing tonight, there is a new entity here that this entire project now hinges on, and that is the Western Greenbrier Development Corporation.

I would pose a question to the promotors of this project as to who owns the Western Development Corporation, who, by the way, if you caught it tonight, these people will own the gob piles, so the gob piles are not free.

So would anybody like to tell me who owns Western Greenbrier Development?

MR. WILLIAMS: Western Greenbrier Development Corporation was organized in 1958. It is a nonprofit corporation that developed the industrial park in Rainelle.

It has a got a Board of Directors, and we bought the gob pile in Anjean today at a

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bankruptcy sale to prohibit the land falling into private hands. So that we would have public

ownership of this land when it is cleaned up so that it can be developed into a public park.

MR. HAZELETT: Thank you, very much.

Are you saying that the Western Greenbrier Development Corporation is the Greenbrier Valley Economic Development Corporation?

MR. WILLIAMS: No, sir. We were organized long before they came into existence.

MR. HAZELETT: "We"? Can you tell us who "we" are?

MR. WILLIAMS: Western Greenbrier Business Development Corporation has been in business since 1958.

MR. HAZELETT: Just one more thing that concerns me.

The Department of Energy wants their $107 million back over the next 20 years. That is $5 million a year, beginning this year.

It looks like we are not going to have any income out of this project until at least 2007, or 2008.

One more thing: Do we know who owns the

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land that the power plant will be built on?

MR. WILLIAMS: Yes, we do. My wife and I own the 20-some acres, and the industrial park owns the other 38.

MR. HAZELETT: Thank you very much.

MR. McKOY: Thank you.

Those are excellent comments.

Do we have anyone else that would like

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to speak?

MR. McCLELLAND: Yes, sir.

MR. McKOY: State your name, please.

MR. McCLELLAND: My name is Gary McClelland. I was born and raised in Hines, West Virginia, 65 years ago.

I live in Quinwood. I love Quinwood. I lived at Crawley, I graduated from school in Rupert. I have kinfolks in every town, and I love all three of them. I love Greenbrier County.

I was not planning on getting up and speaking, but I am an irish man, and irish men like to talk once in a while.

But I do love my state, and I love my county.

In 1955, I graduated from Rupert High

School in Rupert, West Virginia. I left here and went into the military and stayed four years. I came home for three months, and I stayed gone until 1985.

The fellow that spoke about his mother got sick, and he came back. I lost my father, and I came back to be with my mother.

I moved back, but I stayed on the road. From 1955, until 1959, (sic, 1989). I built power houses, called generation plants, chemical plants, oil refineries. I built them all over the country, from California to Maine.

When I say, "I", I mean "we".

I was out of the building trade with these fellows up here who are representatives. But everywhere I went and everywhere I built, they shoved

the people.

I see about a 95 percent here are for this thing, and I am thrilled. I am very thrilled to see that this county -- folks, it is going to make it. This is not going to get stop, it is going to make it, folks.

We have got young people. I have got young children, who are trying to stay here. Most of them are in Texas, Houston, Dallas, Michigan. I have

got some of my children, but I want the McClellands to stay here, and I think that we will get it done.

I am looking forward to this project. I am really for it, and I am glad to see a positive action here.

I thank all of you folks, every one of you, our delegates and our senators, and our former senators, and these men that dream.

One of my favorite mayors, Mr. Monday. I quit five years ago, and I am 45 years younger than this fellow. No, I am not. I was just joking. But he is still working, and I do pray that this thing is going to go.

I just wanted to say that I appreciate it.

Thank you.

MR. McKOY: Thank you for the comments.

Do we have anyone else from the floor that would like to speak?

I had a request from Delegate Tom Campbell. So if we can start the second round, we

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will do that, if people want to speak again.

DELEGATE CAMPBELL: Thank you.

I will be very brief.

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I was recognizing some of the folks when I started off today.

I certainly want to recognize Senator Caldwell. She did speak to you as a very important member of the team here working for Greenbrier County.

Also, I mentioned former Senator Shirley Love, who has been very active working for us.

Senator Wright has come up on the project, and all three delegates in Fayette County, Bobby Pino, Delegate Louisos, and Delegate Perry have all signed off on this project, too.

It is important, I think, for all of Greenbrier County, all of Fayette County, and all of this area, and I think all of Greenbrier County is behind you.

I would like to close by asking you a favor: I would like to harness some of this energy, if you would do me a favor -- I think some of those from the delegate mentioned from conversations that we have had that there will be a meeting right here from the Chief of Staff of the Governor of West Virginia, indicating that he will be working with us Monday morning. He is out of the office this week,

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but he took the time to get back to us.

I would like to ask you if you have a chance, just to take a minute and call the Governor's

office and -- you probably won't get a chance to talk to him -- but call the Governor's office and tell them that you are interested in this project. That word will get to the Governor and to Mike Garrison, who we will be talking to next week.

The number is: 558-2000.

It is easy to remember, 558-2000. If you can't remember it, call me and I will give it to you.

Like I mentioned earlier, a few people can make a difference, and that is how you can. There is a lot of positive energy in this room tonight. And I think that if we harness that, we can get something for this town, and you can help us do that.

So, if you would do that, I would appreciate it.

Thank you.

MR. McKOY: Thank you, Delegate Campbell.

If there is anyone who would like to add

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comments?

Okay. There are several people.

MR. MEADOWS: Charles Meadows.

I would like to address the fact that we may have had some comments about certain problems that we may address.

I noticed that some said that some people may profit from this venture privately; I hope we all profit.

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AUDIENCE MEMBER: Amen.

MR. MEADOWS: And if someone else profits along with it, good for them. I hope to profit from it myself.

Secondly, it has been talked about coal trucks being overweight.

I, and my family, are very much connected with coal trucking, and the coal-trucking vendors, and they don't go overweight in any state, or any highway in West Virginia.

If you don't believe it, look at the fines that are leveled against them if they catch you that way anywhere. So that is not a concern in this project of overweight trucks, that is darn for sure.

I think that we have got something --

the Bible says that if where there is no vision, that people parish. There are too many people perished in this area. We need a vision, let's keep it alive.

MR. McKOY: Thank you very much for those comments.

The person over here who wanted to speak?

State your name.

MS. MUNDY: My name is Stephanie Mundy. I am 27-years old, and the only reason I am standing up here is just to say that I have kept in touch, and stayed up on this, and my dad has given me a lot of information, and I am totally for this, 100 percent.

I moved away in '93, when I graduated, and just recently moved back. I just started a business here and it was only with God's help that

I was able to do that.

There is a lot of people my age out there who want to stay in West Virginia, who want to be around their families, they love their communities, they want to raise their children in this community.

I have a 4-year old that I want to raise here. But, unfortunately, because of the jobs, you

have to go somewhere else in order to support your family.

I want to encourage everybody to support this, but especially people my age because we are the ones with the big mouths and we can get a lot of things heard. Just support it.

Thank you.

MR. McKOY: Thank you for those comments.

Are there any other people that would like to speak?

AUDIENCE MEMBER: (Female.) I just wanted to make a comment that Governor Wise will be at Tamarack Saturday evening.

So I think everyone in this room should go to Tamarack Saturday evening.

AUDIENCE MEMBER: (Male.) I just have a suggestion, give the Governor a copy of the transcript, and make sure he reads it.

DELEGATE CAMPBELL: Individual contact is still great, individual contact.

MR. McKOY: Thank you, sir.

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Any other comments?

AUDIENCE MEMBER: (Male.) Sir, I invest

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a little bit of money in the stock market, would I be able to invest any money into this?

MR. McKOY: I cannot answer that question.

MR. WILLIAMS: No, this is not a stock corporation. You cannot buy stock in this corporation.

MS. CROOKSHANK: But, now, I thought the County Commission -- I thought that we were going to issue bonds, so that they could buy bonds. Is that not right, Mr. Brown?

MR. BROWN: That is true, yes, bonds.

MS. CROOKSHANK: So, that is not the stock market, but it is a way that everybody can invest money, and make some money, hopefully.

MR. BROWN: Right, revenue bonds.

MS. CROOKSHANK: Revenue-sharing bonds.

MR. BROWN: Revenue bonds will be on sale roughly two years from now, 17 months to two years. It will be tax free, and they will be marketed very much like stocks. You can purchase them and it has all the benefits that a bond would.

MR. McKOY: When you say tax-free, does that mean no State tax, as opposed to Federal tax?

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MS. CROOKSHANK: I think that is State tax, unless we could get qualified for the Federal, but the State tax for sure.

MR. McKOY: Is that both the State and

the Federal?

MS. CROOKSHANK: Don't we have to get certified? I think we have to get certified -- but I know for sure it's State.

MR. WILLIAMS: It is both for Federal and State.

MS. CROOKSHANK: Is it? Okay.

MR. McKOY: Do you have any other comments?

AUDIENCE MEMBER: (Female.) Why does this take so long, it seems like an awful long time?

MR. McKOY: Power plants are very complex.

AUDIENCE MEMBER: But you already know what you want to build, how you want to build it, basically where you want to build it; why is it taking 17 months to build it?

MR. McKOY: The details are pretty complex.

MR. BROWN: The details, and the

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permitting process, and the NEPA process that we just launched here, all pretty much consumes the better part of two years to bring it to reality.

MR. McKOY: Any other comments?

Would you like to speak, sir?

MR. WALBECK: Luke Walbeck, Rainelle.

Most of you know that I have a roadside park up here, just outside of Charmco, between Charmco and Rainelle.

Like one of the previous speakers said

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that she came from Texas, well I came from Wisconsin. Anyway, I have been to just about all 48 states, and I decided that it was either this state, or one other, but I wanted to stay here, and retire here, and everything else.

West Virginia looked so pretty. We came here. I love it.

We have the Roadside Park, and I try to help out several of the surrounding communities, I have noticed quite a few things.

We have the Midland Trail coming down and I get maybe about nine, or ten people throughout the world that actually come right down the Midland Trail stop here, and say how beautiful it is.

Oh, you have such a nice area. Be it Germany, Sweden, Italy, whatever. I don't know that walking up to them because their car says New York, or Florida. When I find out that it is a rental car they tell me.

I am happy. I am happy that they love West Virginia; okay?

Roadside Park sees everybody -- no, this is not a commercial -- but I wanted to help out the community as much as I could. I see so much going on and you people can see it, too.

Between the school, and everything else, the east gets most of it, the west gets what seems to be handouts. We can, with this plant, start getting something on the west end.

Not only thinking about what you were talking about before about economic, and everything

else, but what about the travelers that are coming through here, up and down the Midland Trail? If they see something like this, word is going to start spreading. Everybody is going to know about it.

They are going to start saying, Hey, I went through this little town in West Virginia, they are making something called Woodbrik. It is

insulated, and everything else, and I had a chance to take a look at it and watch it.

They are going to start talking about this all over the place.

The three towns -- actually the whole area around here -- need this very badly. We need the jobs. We don't have to go running around, and everything else, we need to have it here. The western end needs it, and the world, hopefully, will find out about it.

Thank you.

MR. McKOY: Thank you for your comments.

Would anyone else like to speak?

MAYOR WRIGHT: I am Gene Wright, Mayor of Quinwood.

While we are on the subject of electricity, we are so used to using electricity. Most of the time, we don't think about it. We turn on the T.V., microwave, coffee pot to make our coffee.

There is a site on the Internet, Urban Observatory -- and if anyone ever wants that address,

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you can get a hold of me at my place in Quinwood, and I will be glad to get you that Internet address.

There is a picture that is made from one of those satelites of the earth at night -- completely around the earth, covers all countries, all of it -- it is a very amazing picture.

If you ever look at that, you need to compare it with other countries on this globe, and you will see an amazing difference. Absolutely amazing difference.

We don't think about it, how it touches our lives and it how it affects the rest of this earth.

A friend of mine and I were coming in at 40,000 feet one night coming in from Florida, and we could see many, many, cities -- a beautiful clear winter night. I made the remark about what would happen if somebody hit the master switch and there was no electricity.

Think about it.

Think about what would happen to you, to your family, and the rest of this world. It is amazing what we are accustomed to, and can't do without.

What happens if the power goes out?

Look at Iraq, the war. What happened over there? Those people, the whole country, not only do not have a power problem now, but they have had this problem for years, it is sporadic. Look how poor they are. They are industrialized people poor.

Think about it; what would happen if the big switch goes off?

Thank you.

MR. McKOY: Thank you, Mayor, for those comments.

Would anyone else like to speak?

MR. ASH: Roger Ash. I would not be able to sleep with myself tonight, and poorly for the rest of my life, if I allowed it to be unsaid, and not wishing to say it myself, I was hoping someone else would do it.

No one has, but I know there are others here that feel the same.

I do not understand how one government agency can give money to another one. It is against the Constitution.

Government cannot be in business. I am 100 percent for this project, but private industry must have their hands in it.

Private industry must build brick. The Government, and the three mayors of the three cities, they are exactly that, they are a government.

The government cannot -- if this happens, it is my understanding that there is to be a senior citizen's apartments. So now they are building apartments.

What if, on down the road, some other company says, Hey, let's do the same thing. Some other Government agency decides to go into business, maybe they want to start bottling coal.

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What if some other Government agency wanted to start building automobiles.

I am for this project, but it must somehow be privatized, and not owned by three cities, which is government. That is not Constitutional.

We all want this -- well, basically all of us -- we need it, and it is a good thing, but good things can turn out wrong.

If this cracks the Constitution, if those goes, and it will, government cannot give money to another government, and that is basically what is happening.

They are going to grant money -- give --

to another government, and they are going to build and go into business.

We have got block companies here in this area, Houchins' in Beckley, Snider's in Caldwell; how are they going to build about 15 homes worth of brick a day, that is basically what it would bill out to. Enough bricks to build 15 new homes a day.

Folks, we are on dangerous ground.

The project can still go forward and be Constitutional. We cannot break private ownership in this country. Government cannot do all things for us, and must not. It is communistic, and it is basically wrong.

It was one of two things that scared Thomas Jefferson that Government would become the producer for us.

Private ownership. Somehow, work it out, where you and I, if we choose to own stock, we

are private. It has got to be privatized. It cannot be owned by the Government, and that is what a city is, a government.

MR. McKOY: Thank you for those comments.

I have another person that wants to

speak.

Please come up and speak your name for the transcript.

MAYOR ADAMS: I am Pete Adams, the Mayor of Rainelle.

I am sorry I didn't speak earlier.

I would like to say thank you to everyone that has come out to support us tonight.

I listen to these things that are spoken by the eastern end of the county people, that spend a lot of time babbling at the courthouse; I would really appreciate it if you don't have anything good to say about this, then stay over there and do it over there, not here.

Thank you.

MR. McKOY: I have another comment.

Please state your name.

MS. WALBECK: My name is Patricia Walbeck, and I just wanted to come up here and let you guys know that I was born in Rainelle in 1951.

You can do the math, I don't care.

I was the oldest of seven children. My mother and dad, my family, moved away to Virginia in 1960, because there was no work.

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The day I left, I said that I would be back to West Virginia. I am home. I am the only one out of seven kids that even thought about returning to this area. The rest of them won't even going to attempt it.

I live here now, my children are gone to another state because they can't find work here.

My opinion? I want them back. I want them home.

Thank you.

MR. McKOY: Thank you.

Do we have any other comments?

MR. BROWN: With regard to ownership interest and private ownership issues, and that subject. There is a big part of me who is very sensitive to that subject.

I think there is a proper role for government, and a proper role for private industry, with a proper level of regulation and whatnot.

And if we look at how our society gets involved in the effects of regulation, it is obvious that it is a very complicated matter, to get those guidelines properly setup.

But I believe that there are many

entities, the water company, the sewer company, there is a legitimate role for government in certain service areas.

What we are attempting to do with this eco-park is a public/private partnership. Where the catalytic engine, the power plant, and the Woodbrik

factory are the catalysts, but all of these businesses which surround the catalysts are privately owned, absolutely normal stocked companies in every sense of the word.

It is our firm belief that that catalytic element is missing, and that is why I would say we have not made more progress than we have.

I believe that it will work, that will be an effective catalyst. Now, we will have to look back on it 10 years from now to be sure, but I think it will work.

I think there is a trim line throughout our society of public/private partnerships that can do things that neither can do alone.

As much as we would like to be a black and white world, in this area, it is not.

I really think that we have got to embrace the idea of working closer together on a

public/private basis, and we are seeking to do exactly that on this project.

But I admit to great sensitivity to this issue, and all of us should be sensitive to it, but there is a logical solution, and that is what we are trying to create.

Thank you.

MR. McKOY: Thank you, Wayne Brown.

MR. ZOPT: My name is Ed Zopt, Z-O-P-T.

I have listened very patiently tonight -- and I hope you will bear with me, I have got a little thing here that the Mayo Clinic calls

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chronic degenerative -- and I said, Stop right there.

I just want to take a moment.

I mean, there has been so many wonderful things said here tonight, by-and-large, but I represent some of the old timers.

My brother and I grew up in Rainelle. Just for a moment, I would like to look back for a minute.

I remember when Meadow River Lumber Company was the largest hardwood mill in the world.

It had about 6- or 700 hard-working people. My dad was one of those people. He ran a

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flooring machine that made tongue-and-groove flooring that was sold all over the world; maple, cherry, walnut.

Today they have it in the Waldorf-Astoria in New York City. There is a parquet floor from Meadow River Lumber Company.

Meadow River Lumber Company was ahead of its time.

Really, two men, by the name of John and Tom Romey came in here in the late 1910, '11, '12, '13, somewhere along in there -- but they came in and opened up this Meadow River Lumber Company.

By the way, my father, running that flooring machine at Meadow River Lumber Company, got 35 cents an hour, for running that flooring machine and it was not uncommon for him to work two weeks and have $60.

He would tell my mother when he came home, he said, Ethel, we have got to make ends meet.

And he would take his buckle and do like this (indicating) he was an old tongue-and-groover man.

But the point was, we only had a limited amount of money to do things.

After all of these years, this area,

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western Greenbrier County -- and I have talked to Wayne so many times about there is a lot of man-made things going on in this world, but I am sort of naive, I guess, I have got to believe that this is a devine appointment from our heavenly Father.

I think that it will offer an opportunity for young people of this area that -- you know back in the World War II, some of our people went to Ohio, that is when they named it GTO, that means, "Gone To Ohio".

The opportunity that exists here today for people to raise their families here with the three little communities of Rainelle, Rupert, and Quinwood to advance.

I would like to just take a moment, if I may, if I have your permission; do I have your permission?

Quinwood's annual budget is $27,000, a year, of which about 8- or $9,000 goes to the Appalachian Power Company for electricity.

All of our utilities in the Town of Quinwood, including the Mayor, the Council, everyone, donates their time there. They don't even take a check for being mayor, or for being councilmen.

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Everything is volunteer. And it is amazing what the people of Quinwood, West Virginia, have done up in Quinwood.

If you don't believe me, just come up to Quinwood. They have rolled up their sleaves and gone to work. And by the way, that wouldn't be a bad idea for a lot of people in this world. To roll up our sleeves and go to work.

I am getting a little bit emotional. There are a lot of things that I really wanted to say.

First and foremost, I do want to compliment the people that have come in here today because I believe in my heart that this is really the only opportunity that we are going to have in western Greenbrier County for a lot of years.

And it is not fair for us to sit around and talk about it, we have a got to band together as people. We have got so many things going today that is in favor of this.

Someone said earlier that it is a win/win proposition.

I know that there is some other things that I would like to say, but overall, I just simply

want to say that we just need to continue to work as a group, and I am very indebted to all of these people who have come in here from the Department of Energy all of the engineering people, and all the people that come in and get this many people together. So let's continue to work together.

Thank you.

MR. McKOY: Would anyone else like to speak?

MR. WILLIAMS: Buck Williams.

I know you all are getting saddle sores like I am, but I just wanted to remind you of two things: Number one, they gave you the Governor's phone number. Don't be afraid to dial the number.

When you call up, someone is going to ask who you are, and where you are from. All you need to do is give your name, date, date of birth, whatever they want. Tell them where you are from, and tell them in very simple words, I want this, and I am in favor of this co-generation plant, period.

You do not have to get into a big long deal. Usually, they get enough calls where they say, Yes, sir, we will give the Governor, personally, your regards, if you believe that. But that is

important.

The other thing is: The NEPA process is very, very, time consuming, and it is very lengthy.

So I would encourage you before this project, when you go out, you don't have to talk to anyone, but take one of the written cards. One for you, and one for your wife, and one for all of your people, and whatever you do, go home, fill them out, and send them in.

It is very important that you get the mass of information that you want from them.

And if it is the wrong thing, you need to tell them.

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Thank you.

MR. McKOY: Thank you for those comments, and particularly thank you for that last comment.

Power plants are a serious issue, and you certainly have to properly look into the potential environment impacts of this project.

Our main goal here is to find out what your concerns are, and if you have those concerns tonight with regard to jobs.

More importantly, I am particularly glad

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to hear about the problems that you have had in the past with government mitigation, that there are concerns regarding truck traffic, and a number of other issues.

Would anyone else like to speak?

MR. ASH: Roger Ash, Grassy Meadows. Mr. Brown's statements did not repair my statements. The Constitution is still being broken.

One government agency cannot loan money to another, to produce a products. And these are loans, they are not given.

You say that somewhere in the waive of the future, they may -- catch the word "may" let us own the brick.

But what are they going to do, survey it off? I don't believe so.

DOE, I ask you before this goes forward, to require them to show you where it would be privatized. Make them come to our terms. We have the power to do so.

I am not against this project. I want it to go ahead, but it must, in some way, be privatized, and plan for it, not "may".

It is possible.

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MR. PATTERSON: I just wanted to second Roger on everything that he said. I just want to add something; West Nile Virus.

With the West Nile Virus, we are going to get eaten alive.

MR. McKOY: I think that probably concludes the formal comment period.

Again, keep in mind the closing date for your comments.

If you want to submit a written comment, give me a call. That will be July 3, 2003.

Let the record show that the comment period has ended at 9:14.

Thank you very much.

(Public hearing concluded.)

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STATE OF WEST VIRGINIA, To-Wit:

I, Michele G. Hankins, a Notary Public and Court Reporter within and for the State aforesaid, do hereby certify that the Public Scoping Meeting was taken by me and before me at the time and place specified in the caption hereof.

I do further certify that said testimony was correctly taken by me in stenotype notes, that the same was accurately transcribed out in full and

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reduced to typewriting, and that said transcript is a true record of the testimony.

I further certify that I am neither attorney or counsel for, nor related to or employed by, any of the parties to the action in which these proceedings were had, and further I am not a relative or employee of any attorney or counsel employed by the parties hereto or financially interested in the action.

My commission expires the 29th day of December 2003.

Given under my hand and seal this 29th day of July 2003.

Michele G. Hankins
Notary Public
Court Reporter

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PUBLIC PARTICIPATION - COMMENTS & COMMUNICATIONS

WESTERN GREENBRIER CO-GEN POWER PROJECT

#	RESPONDENT	DATE; TIME / SOURCE	COMMENTS/CONCERNS
1	Margaret Janes Appalachian Center for the Economy and the Environment	5/7/03 (am) e-mail	FOIA request for any and all info re the WGC project.
2	Fred Patterson Monte Meade Farms	6/11/03 (am) e-mail	Wanted names and ph numbers of DOE people in charge of monitoring the WGC project.
3	Rodger Ash	6/12/03 (am) ph. call	Why put project on wetlands? Why not put project on dry land? Lots of dry land areas are available. Concerned that loss of wetlands will require mitigation, which might occur in Grassy Meadows area where the land owners do not want more wetlands. Concerned that created wetlands would spread the wetlands designation and associated land use restrictions onto lands adjoining the wetlands mitigation project, thereby adversely affecting the owner's enjoyment and use of their own land – A regulatory taking.
4	Halsley Carr	6/24/03 (am) ph. call	Wanted basic info – logistics – re the project.
5	John Deets	6/24/03 (am) ph. call	John wanted to put us in contact w/ Aerofab, re an invention to dehumidify air at the intake port for the combustor. John believes that this would reduce the formation of acid rain.
6	George Schults RUS	6/24/03 (am) got ph. message	George is with the Rural Utilities Service, which has been approached by WGC regarding a bridge loan. George wanted to know the status of the WGC project and whether environmental issues would possible hold-up the project. George wants DOE to contact Larry Wolf, chief of the RUS environmental division, regarding the use of the NEPA process to satisfy the RUS NEPA requirements.
7	Mary Nutter	6/21/03 (am) e-mail	Had question re (1) Will public get to see the results? (2) Is the plant in CO still operational? (3) Can we ask the community questions re their plant? If the plant that is proposed here doesn't work out, will we have a white elephant? (5) Who will pay property taxes on the proposed plant? (6) Is our plant one of the eight already chosen (for funding)…?
8	John Harris	6/25/03 ph. call	Seeking business opportunities. Owns and operates a small construction firm.
9	Kerry Moss NPD-GRD	6/27/03 email	Wants copy of draft EIS for National Park Service review.
10	Louis Zeller Blue Ridge Environmental Defense League	7/02/03 ph. call	BREDL requested more technical information.
11	Barbra Douglas US Fish & Wildlife Service Elkins, WV	7/02/03 ph. message 7/03/03 ph call 304-636-6586	Barbra informed DOE that an endangered or threatened plant, *Virginia Spirea*, inhabits the stream banks along the Meadow River to the North of Rainelle. There is no indication that the plant inhabits the Sewell Creek area, but it is possible. Barbra suggested that DOE do a search along the stream banks for these plants before disturbing the area.

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#	RESPONDENT	DATE; TIME / SOURCE	COMMENTS/CONCERNS
12	Margret Janes Appalachian Center for Southern West Virginia	7/03/03 ph call	Wanted to know whether the Anjean Site predated the surface mining and reclamation act.
13	Dale Morlock National Park Service	7/03/03 email	Dale wants to be included on all mailing for this project.
14	Marcia & Jim Leitch Coordinator WV Interfaith Global Climate Change Campaign	7/02/03 7/29/03 7/30/03 Email	Marcia emailed some questions re project.
15	Lyle Bennet WVDEP Div. Water & Waste Mgmt	7/30/03 ph. message	Lyle asked to be listed as the contact person for his division re the project (at WVDEP).
16	Christy Stoll	8/13/03 email	Christy requested a copy of the draft EIS and the scoping documents, when they become available.
17	Ray E. Ratliff, Jr.	Letter received 9/2/03	Expressed opposition to this proposed project and to all coal-fired power plants because such plant cause increased air pollution, a lack of need for more electricity generation capactity, increased coal truck traffic, mis-allocation of Federal funds (which should be used for project with much lower impacts), insufficient waste coal supplies, and cumulative impacts from other similar power plants that are proposed for the SW West Virginia region. Requested that the EIS be produced by WVDEP.
18	Ken Ward Charleston Gazette	Ph. call 10/1/03	Ken had a few questions to ask as an info gathering process for a news paper article. He requested a copy of the technical proposal.
19	Paul Knighten Charleston Gazette	Ph call message on 10/24/03.	I returned the ph. message on 10/27/03. Needed some general info from the NETL website.
20	Joe Myers Beckley Register (newspaper)	Ph. call message on 11/13/03	Joe called to ask about the status and timeline for the EIS. Joe also asked about adverse comments from Margret Janes, the Sierra Club and others. Joe wanted to know how much negative feedback we had gotten and who had given it. Joe also asked whether we would investigate and report on the usage of tax dollars to clean-up the Anjean (and other) gob piles, as opposed to using industry-paid special reclamation funds for this purpose. He was also interested in why DOE selected this project for funding, given that this project was not like the others which are projects to reduce emissions of air pollutants.
21	Janet E. Lyons	email	The Document Retrieval Center of the Environmental Assessment Division wants to be put on the mailing list for the EIS (and the Draft?).
22	Halsley Carr	2/2/04 (pm) ph. call	Halsley wanted an update on the project, for reporting in the Engineering News Record. He asked about the projections for the start of construction.

Appendix A2

August 27, 2003

Mr. Mark L. McKoy
US Dept. of Energy
National Energy Technology Lab
P.O. Box 880
Morgantown, WV 26507-0880

Re: Proposed Western Grbr. Co-Production
Demonstration Project
NOTICE OF OPPOSITION

Dear Sir:

We have recently learned of the proposed Western Greenbrier Co-Production Demonstration Project to be sited somewhere near Rainelle in western Greenbrier County, WV. We have a farm/residence near Frankford, WV, in the northeastern part of the county. Our mailing address for your purposes is :

P.O. Box 278
Frankford, WV 24938

We would like more information, and request you to send us a copy. From all appearances, however, we would oppose any so-called "clean coal" project for the following fundamental reasons:

(1) A coal fired power plant is a coal fired power plant and not a "clean coal project, regardless of the coal source, with major east/northeast air pollution consequences under the current state- of -the- art technology. Northeastern Greenbrier County, where we live, already has numerous hazy days caused by air pollution, with air quality readings that significantly violate the federal clean air guidelines. The proposed power plant will significantly add to the degradation of the air shed.

(2) All the recent news regarding the "black out" has emphasized the point, repeated here, that the USA has about 20% excess generation capacity, despite a shortage of transmission capability. Why spend federal dollars to build another coal fired power plant at this time or in the foreseeable future?

(3) This "clean coal" proposal entails the clean up of the Anjean coal waste pile by transporting the waste to an "ecopark" near Rainelle, where it is burned to produce electricity. The roads are curvy, mountainous and two lane. Does the proposal assume the use of overweight coal trucks (120,000 lbs or more)? If so, what are the specific road segments and distances to be so used? Regardless of the tonnages, is scenic Rte. 60, with the designation as a scenic by-way for tourist purposes, to be used?

(4) Why do not these federal dollars under the DEP's demonstration project have alternative fuel sources, with low impact fuels, as a priority ?

(5) The Anjean gob pile would seem to be a temporary source for a big power plant like this. What happens in your projection of the plant's future sources of coal?

(6) We reserve the right to raise other points based upon the information you provide.

In addition to these specific objections to this specific project, we now understand that this project is the first of five proposed coal burning plants in southern WVa, including other areas of Summers and Mercer Counties. The northeastern part of Greenbrier County is basically the catchment area formed by the big mountains to the east (Peters/Greenbrier Mtn complex, etc) and north (Cold Knob/Droop, etc.) for air pollutants from the southwest, including the close by areas of Summers and Mercer Counties, that funnel north by northeast. Therefore we oppose this project for the additional reason that:

(7) Considering the cumulative effect of this and other such projects, the air shed in eastern /northeastern Greenbrier County will be significantly degraded.

Preliminarily, we request a full Environmental Impact Statement and complete analysis done by DEP (not the applicant), and specifically oppose anything short of that.

Please lodge this notice of opposition in the file of the matter, and keep us informed.

Sincerely,

Ray E. Ratliff, Jr.

Mary P. Ratliff

RER
cc: Senator Robert C. Byrd
Senator John D. Rockefeller
Representative Nick J. Rahall

Appendix A2

SIERRA CLUB
WEST VIRGINIA CHAPTER
P.O. Box 4142
Morgantown, WV 26504

July 3, 2003

NEPA Document Manager
Mr. Mark L. McKoy
National Energy Technology Laboratory
U.S. Department of Energy
P.O. Box 880
Morgantown, WV 26507-0880

RE: Notice of Intent in the Federal Register for the Western Greenbrier Co-Production Demonstration Project, 68 FR 33111, June 3, 2003.

Dear Mr. McKoy:

Please accept these scoping comments on behalf of the 1600 members of the West Virginia Chapter of Sierra Club. We appreciate the opportunity to cooperate in determining the scope of the proposed EIS.

The West Virginia Chapter Executive Committee adopted a position in January 2001 "to oppose the siting of new fossil-fuel fired power plants that do not provide for emission offsets." We believe that it is critical to work to reduce net emissions of air pollutants in West Virginia, and that Clean Coal technologies should only be used where they offset emissions of older dirtier power plants. New power plants, no matter how clean, will only increase the total emissions in the state unless they lead to the clean-up or shut-down of older dirtier technologies. Therefore, it is critical that this objective be incorporated into the alternatives addressed by this EIS. While we recognize that the proposal by project proponents must be considered as one alternative, any alternative that does not lead to a net emissions reduction for West Virginia should be considered a "non-starter" by DOE and need not be considered in detail in the EIS.

Alternatives to be Considered.

We urge that you consider a broader range of alternatives than appears to be indicated in DOE's "Background Information and Potential Environmental Issues" for preparation of the EIS where DOE states:

> "... when dealing with applicants for financial assistance awards under the Clean Coal Power Initiative program, the scope of alternatives is necessarily more restricted because DOE must focus on alternative ways to accomplish its purpose that reflect both the applications before it and the functions that DOE plays in the decision process. As a grantor of financial assistance awards under a competitive open solicitation, DOE must give substantial deference to each applicant's needs in establishing a project's reasonable alternatives."

If, in fact, DOE plans to consider only the action and no-action alternatives, the EIS will be clearly deficient in analyzing project outcomes or in reaching a good decision. The concept of considering only the project proponents' alternative and "no action" means that DOE is essentially removing itself from the kind of rational review and good environmental decision-making envisioned in NEPA. This limited approach allows private entities to undergo less stringent review than similar projects initiated by the federal government thus driving the agenda of DOE and minimizing the potential to reduce or eliminate environmental impacts.

We further recommend that two "No Action" alternatives be assessed. In addition to a "No Build" alternative, a No Action alternative be designed to compare the environmental outcomes of a Clean Coal project with a project that uses renewable energy sources such as wind or solar without the use of Clean Coal technologies.

Issues to Be Analyzed

The Western Greenbrier proposal is identified as a "demonstration project". As such, it sets precedents for fuel use and technology applications that will impact the region and the nation well into the future. In fact, the project sponsors state in their Clean Coal Power Initiative application that "the project is expected to catalyze the demonstration of an entire eco-park complex distributed network" of at least four additional 150 MW co-production facilities planned for southern West Virginia. Thus, any environmental impacts or policy decisions relating to this plant are disproportionately great because it will serve as a model and stimulus for the other plants in the network and additional projects across the country. Therefore, it is critical that the EIS assess the potential impacts from the Western Greenbrier plant in terms of the impacts of the additional plants as the technologies demonstrated by the project are duplicated throughout the network. If, on the other hand, future power generation projects are not built (an outcome that we view as quite likely), the EIS should clearly conclude that the "Demonstration" goal for the project is not met. Funding should be contingent on meeting this "Demonstration" goal so that the Clean Coal Power Initiative remains credible as something other than tax-payer financed welfare for the coal industry.

This assessment must include an analysis of impacts to global climate change from the continued use of coal versus efforts to encourage power conservation or the use of other fuels. Much of the analysis for this issue will be determined in the design of alternatives. If all alternatives considered include either carbon sequestration or offsets of carbon dioxide emissions (as proposed above), much of the complexity and uncertainty of global climate change modeling can be avoided, thereby greatly simplifying the analysis required by the EIS. If, contrary to our recommendations, alternatives are analyzed that do not implicitly remove the issue of carbon emissions, those alternatives must consider in detail the direct contribution of this plant, the indirect contributions of subsequent plants, and the cumulative impact that Clean Coal technologies would have on global climate change if sequestration or offsets are not considered. We note that climate change is frequently not considered in the EIS of many federal projects because it is judged to be "beyond the scope" of the project analysis. Yet this is clearly not appropriate for the Western Greenbrier project as future restrictions on carbon emissions will certainly affect the economic and environmental viability of this project, and as such, are critical to making good decisions on this project.

As required under the Clean Air Act, Clean Coal demonstration projects such as Western [illegible] add-on technologies such as flue gas desulfurization and low-sulfur fuels as BACT. We note that some older fluidized bed boilers do not include scrubbers and other pollution control

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devices. While we recognize that fluidized bed boilers have lower emissions than conventional boilers, the best available controls consistently occur when fluidized bed boilers are coupled with scrubbers and other pollution control devices. The reliance of the proposed project on waste coal co-fired with significant amounts of high grade new coal also promotes continued mountaintop removal coal mining and the subsequent environmental devastation those mining practices entail. The EIS should not allow the environmental outcomes to be pre-determined by the applicant's proposed fuel source. While there are environmental benefits from clean-up of coal gob piles, these should be balanced in the BACT analysis by the excess emissions associated with use of low-grade fuels, compared to emissions scenarios where high-BTU, low-sulfur coal is used.

We further recommend that the volume and quality of coal gob reserves be assessed in comparing alternatives. We are aware of other projects (e.g., the Grant Town fluidized bed power plant in Marion County, WV) where the plant was originally developed to burn coal gob piles. At the time, project proponents assured the public that there was a 30-year supply of burnable coal gob. Less than 10 years later, the plant operators found that they had run out of suitable coal gob, and have been searching for suitable fuels ever since. They are now accepting materials from SuperFund sites, have experimented with tires as fuel (with significant increases in pollution) and are now burning freshly-mined coal instead of the waste coal gob originally proposed. Based on this history, a thorough analysis of the quantity and quality of coal gob reserves must be documented and the default assumption should be based on the actual experiences at places like Grant Town, rather than overly optimistic wishful thinking of project proponents.

The Western Greenbrier project is proposed as the "center of a synergistic eco-park." DOE admits the project is a "high-risk" activity that utilizes unproven technologies that may not be commercially viable. To assure good decision-making, the EIS must evaluate the build alternatives considering the plant on its own without taking credit for secondary environmental and economic projects that may never come to fruition. This experience again should benefit from the past history of plants such as Grant Town which proposed numerous industries that would benefit from co-generated steam heat for subsequent industrial park development. In fact, the Grant Town power plant still sits alone with no other industries using the waste heat almost 15 years after the plant became operational. Since there are no contractual agreements that assure any additional industrial activities will be carried out over the life of the Western Greenbrier plant or proof that they will meet environmental claims – this alternative is far more likely than the assumption of subsequent industrial development.

Other issues that should be analyzed within the scope of this EIS include:

- Emissions of nitrogen oxides, and impact on ozone levels.
- Emissions of sulfur dioxides and impacts to acid deposition, especially in the vulnerable, poorly buffered, Appalachian headwater streams.
- Emissions of toxic heavy metals, both direct and cumulative impacts of 30 to 50 years of emissions.
- Emissions of radionuclides.
- Emissions of particulates, and health effects to humans and wildlife. This should especially address health impacts to sensitive populations, including senior citizens, children with asthma and other respiratory disease, and miners with Black Lung and related respiratory disease. In particular, health impacts of emissions of both PM 10 and PM 2.5 should be assessed individually and cumulatively.
- Indirect emissions from truck exhaust and fugitive dust emissions associated with transport of limestone, coal and coal gob.
- Visibility impacts to Class I areas such as Dolly Sods Wilderness Area and Shenandoah National Park.
- Noise impacts to surrounding residents and to receptors along truck haul routes.
- Economic impact of reductions in property values of adjacent properties due to power plant development.
- Economic impact of future ozone non-attainment designations. We note that Greenbrier County is already near the EPA standard for ozone and additional emissions may push the area across the threshold for non-attainment, resulting in significant adverse economic impacts to Greenbrier County. We note that Greenbrier County already exceeds EPA's health standard for ozone on at least two days every year for the last four years, suggesting that it is very near this non-attainment threshold.
- Economic impact to highways and bridges, especially as a result of use of overweight trucks exceeding engineering limits of bridges and highways. The EIS should also recognize that the overwhelming majority of coal trucks in West Virginia haul loads that dramatically exceed established weight limits. Thus the actual impact is substantially greater than would be the case if legal weight limits are assumed.
- Impacts of fly ash and other waste disposal practices. The analysis should recognize that, under West Virginia's solid waste rules, so-called "beneficial uses" are allowed (and routinely employed) whereby ash may be disposed in fills without any requirements for liners, ground water monitoring, or other environmental protections.
- Impacts to area streams and ground water resources from waste heat disposal, both in terms of water removals, and temperature increases from heated water returns. This analysis, again, should be based on the assumption of no co-generation use of waste heat. Alternatively, if cooling towers are used for waste heat removal, the impact of water vapor on area microclimate (increased fog and cloud cover) should be considered.
- Potential impacts to listed Threatened and Endangered Species.
- Impacts to land and aquatic wildlife resources, both from the plant, and from anticipated mining and subsequent land disturbance.
- Impacts to historic and cultural resources.
- Impacts to recreational resources.
- Environmental justice issues. Will this facility create impacts that disproportionately affect low-income, under-educated or minority communities? We note that most of West Virginia would meet the low-income and under-educated criteria for environmental justice concerns.

Thank you for the opportunity to comment. Please send us a copy of the Draft EIS when it becomes available.

Sincerely,

James Kotcon

James Kotcon
Chapter Executive Committee

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

West Virginia Field Office
694 Beverly Pike
Elkins, West Virginia 26241

JUL 01 2003

Mr. Mark L. McKoy
NEPA Document Manager
U.S. Department of Energy
National Energy Technology Laboratory
Post Office Box 880
Morgantown, West Virginia 26507-0880

Dear Mr. McKoy:

The U.S. Fish and Wildlife Service (Service) has reviewed the Federal Register, Vol. 68, No. 106, Notice of Intent to Prepare an Environmental Impact Statement (EIS) for the Western Greenbrier Co-Production Demonstration Project, Rainelle, West Virginia, and Notice of Floodplain/Wetlands Involvement. The project would evaluate the economic feasibility of a relatively new, compact design for an atmospheric-pressure circulating fluidized bed combustor system, and it would also test the commercial feasibility of using coal combustion ash and wood wastes to make structural bricks for use in the construction industry. The following comments are provided under the authority of the National Environmental Policy Act (33 Stat. 852, as amended; 42 U.S.C. 4321 et seq), the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq) (ESA), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. 661 et seq.).

Only one federally listed species under the jurisdiction of the Service, the Indiana bat, Myotis sodalis, could occur in the vicinity of the project. This species may use the project area for foraging and roosting between April 1 and November 14. Indiana bat summer foraging habitats are generally defined as riparian, bottomland, or upland forest, and old fields or pastures with scattered trees. Roosting/maternity habitat consists primarily of live or dead hardwood tree species such as shagbark hickory, which have exfoliating bark that provides space for bats to roost between the bark and the bole of the tree. Tree cavities, crevices, splits, or hollow portions of tree boles and limbs also provide roost sites.

The Service has determined the number of acres of suitable foraging and roosting habitat on the West Virginia landscape available to each Indiana bat known to occur there. On that basis, we have determined that small projects, generally affecting 17 acres or less of suitable foraging and roosting habitat, will have little chance of resulting in direct or indirect take of the species and is therefore considered discountable. If 17 acres or less will be removed, tree removal can occur at any season of the year. If more than 17 acres will be disturbed, the Service recommends one of two options.

Option 1:
Mist net surveys can be conducted to determine if the summer foraging and roosting habitat within the area affected by the proposed project is occupied. A survey plan should be submitted to the Service and the West Virginia Division of Natural Resources (WVDNR) for concurrence prior to conducting the work. The survey should follow the standard Indiana bat mist net protocol from the Draft Indiana Bat Recovery Plan, and be conducted between May 15 and August 15 by a qualified mammalogist with experience in identifying Indiana bats. These data should be incorporated into an Environmental Impact Statement. In addition, if Indiana bats are collected, consultation pursuant to section 7 of the ESA should continue with the Service's West Virginia Field Office.

Option 2:
Assume Indiana bats are present and schedule timber removal operations during the hibernation period, between November 15 and March 31. If this option is chosen, the developer must then submit a calculation of the percentage of area of suitable habitat that would remain within a two-mile radius of the center point of the proposed disturbance to the Service's West Virginia Field Office.

Regardless of the option chosen the decision and/or survey results should be incorporated into an Environmental Impact Statement. This information should also be submitted to the Service's West Virginia Field Office pursuant to section 7 of the ESA.

As you have concluded, numerous wetlands occur in the vicinity of the proposed project. Definitive determinations of the presence of waters of the United States, including wetlands, in the project area and the need for permits, if any, are made by the U.S. Army Corps of Engineers. They may be contacted at: Huntington District, Regulatory Branch, 502 Eighth Street, Huntington, West Virginia 25701, telephone (304)529-5710.

If you have any questions regarding these comments, please have your staff contact me directly by phone at (304)-636-6586 or at the letterhead address.

Sincerely,

Thomas R. Chapman
Field Supervisor

Appendix A2

United States Department of the Interior

NATIONAL PARK SERVICE

NEW RIVER GORGE NATIONAL RIVER
GAULEY RIVER NATIONAL RECREATION AREA
BLUESTONE NATIONAL SCENIC RIVER
104 Main Street
P.O. Box 246
Glen Jean, West Virginia 25846

IN REPLY REFER TO:

N3615 (NERI)

July 1, 2003

Mark L. McKoy
National Energy Technology Laboratory
U.S. Department of Energy
P.O. Box 880
Morgantown, WV 26507-0880

RE: Preparation of Environmental Impact Statement: Western Greenbrier Co-Production Demonstration Project, Rainelle, West Virginia

Dear Mr. McKoy:

On behalf of the National Park Service units in southern West Virginia, I would like to submit this letter for the record, outlining our preliminary scoping comments on the proposal to construct a co-production power plant within ten miles of the New River Gorge National River and Gauley River National Recreation Area. Our third unit, the Bluestone National Scenic River, located in adjacent Summers County may also be affected by the proposal. Based on the close proximity of the project to the 3 park units, and the potential to impact sensitive park resources, the National Park Service (NPS) would like to be a cooperator in the preparation of the Environmental Impact Statement (EIS). The NPS would also like to have some role in the development of alternatives, to ensure that park interests are reflected in the draft EIS. The following is a tentative list of issues that have the potential to adversely impact park resources, and should be evaluated during the EIS process.

- Greenbrier County is a non-attainment area for 8-hour ozone and is a neighboring county to the New River Gorge National River (NERI), Gauley River National Recreation Area (GARI), and Bluestone National Scenic Area (BLUE). NERI & GARI are equal-distance between the non-attainment areas of the Kanawha Valley and Greenbrier Valley. EPA models predict that both parks probably exceed the national standard for ozone. What is the affect of this project on ozone levels in the two parks?

- The project proposes to utilize waste coal found in "gob" piles in southern WV, then mix it with fresh coal. The largest gob pile to be "mined" for the project is located in Anjean, WV, and is a known source of mine acid production within the Meadow River watershed. The lower 7 miles of the Meadow River are within the GARI. What measures will be taken to ensure that mine acid problems on the Meadow River will not be further exacerbated by disturbance of the "gob"?

- Does the project propose to burn coal refuse with a high sulfur content, and if so, how will this affect air quality modeling? If coal waste with a low pH is utilized at the plant, how is the waste handled and acid levels mitigated? How is coal waste (shale, slate, sandstone, and other particles) not consumed in the steam making process, stockpiled on the site? How much waste is projected to be produced at the project site and where will it be stored?

- NERI has numerous gob piles, some of which are still in private ownership. There may be some interest by these private inholders to mine their gob piles for the co-production plant. How would this activity be regulated? Surface mining is currently prohibited within the congressional boundary of the NERI & GARI (30 CFR §761.11). Would the Surface Mine Control & Reclamation Act (SMCRA) apply to mining "gob" piles?

- Viewshed protection is an issue at all three parks, especially NERI. One of the most spectacular panoramic views in West Virginia is found at Grandview overlooking the New River Gorge. Will the co-production project impair the air quality and visibility of this scenic vista? Will the plume from the smokestack or cooling towers be visible from Grandview or the National River? Modeling of the plume and air pollution variables need to be conducted and analyzed for their impacts on park resources, including the Bluestone National Scenic River (BLUE) located southeast in Summers County. NERI conducted five years of viewshed monitoring at Grandview from 1995-2000, and a private contractor in Ft. Collins, CO analyzed the data. The final report completed in 2001 is available at park headquarters for your use. NERI has also conducted passive ozone monitoring at Grandview the past ten years.

- The co-production project will be located on the Meadow River, approximately 15 miles upstream of the GARI. How will the co-production plant and "gob pile" mining effect water quality and quantity. The Meadow River contains the federally threatened Virginia spiraea, which is found in a narrow band between the river's edge and upland forest in the riparian zone. Unnatural fluctuations in water temperatures and river levels could impact this rare plant. The Meadow River is also a very important recreation area for skilled whitewater enthusiasts. Does the project have potential to adversely impact water levels during seasons of high recreational use?

I hope you find the above list of issues helpful as you determine needs for additional analysis and study during the scoping process. We look forward to working with you on the draft EIS. Should you have any questions, please contact John Perez at 304-465-6537 or john_perez@nps.gov.

Sincerely,

Calvin F. Hite

Calvin F. Hite
Superintendent

cc: Deborah Darden, Deputy Superintendent/RPM, New River Gorge National River
Holly Salazer, NER, Regional Air Resources Coordinator
David Reynolds, NER, Natural Resources Stewardship and Science
Kerry Moss, WASO, Geologic Resources Division, Denver

Appendix A2

From: Debbie Fletcher <fletchd@citynet.net>
To: <mmckoy@netl.doe.gov>
Date: 6/26/03 7:50AM
Subject: Co Generation Plant for Rainelle, WV

Mr. McKoy,
I attended the meeting you had last week with the citizens of Rainelle, WV regarding the Co Generation Plant. I am very much in favor of this plant. My husband and I moved to Rainelle in August 2002 as he accepted a Pastor position at the Highland First Church of God. I fell in love with Rainelle the first time we came down to try out for the church. I have been loving it ever since we moved here. I have been concerned for the lack of employment for our youth and seeing the town slowly close it's doors on many business. I know that this plant will be a plus to the citizens of Rainelle. Thank you for coming and explaning things to us.

Debra L. Fletcher
422 Eleventh Street
Rainelle, WV 25962

American Coal Ash Association
15200 East Girard Ave., Ste 3050
Aurora, CO 80014-3988
Phone: (720) 870-7897 Fax: (720) 870-7889
E-mail: info@ACAA-USA.org

June 17, 2003

Mr. Mark L. McKoy
NEPA Document Manager
Department of Energy
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

Dear Mr. McKoy:

Thank you for offering us the opportunity to participate in the upcoming public scoping meeting for the Rainelle plant on June 19, 2003. We would like to convey our full support and encouragement for the plant's construction.

We believe it is important to promote ecologically sound coal plant technology and the efficient use of all coal combustion products (CCPs). We fully endorse efforts to minimize wasted resources and are pleased to see that Woodbrik™ will be aiding in the utilization of the plant's coal combustion products (CCPs).

At this time, we have no comments regarding the EIS and environmental analysis, but look forward to hearing of upcoming progress. Thank you again for the opportunity to be a part of this important decision-making process. If we can be of service regarding any further information on CCP use or technology, feel free to contact me at my office (720-870-7897).

Sincerely,

David C. Goss
Executive Director

Appendix A2

From: Mark McKoy
To: Nutter, Mary
Date: 6/30/03 4:48PM
Subject: Re: RAINELLE POWER PLANT

Dear Ms. Nutter,

Here are some brief answers to your questions.

Yes, the public will get to see the results of the EIS. First, copies of the draft EIS will be made available in the public reading areas, and copies will be provided to those who request copies. When we get feedback, we will modify the draft EIS to produce a final EIS. We will then distribute the final EIS by placing copies in the public reading areas and by sending copies to those who request copies. The DOE will make its decision regarding whether to provide financial assistance by issuing a Record of Decision (ROD). The ROD will be published in the *Federal Register*, and the DOE may send copies of the ROD to those who request copies.

I am assuming that your question regarding the plant in Colorado refers to the pilot plant for making Woodbrik. A pilot plant was constructed and used to test the concept of making brick from ash, limestone and wood wastes. I am not certain whether this plant is still capable of operations. This plant produced enough brick for building at least one home. The plant proposed for Rainelle would be the first plant to continuously manufacture Woodbrik and the first to make commercial sales of Woodbrik.

The pilot plant was of very small size, so the community was probably not aware of the plant. It operated for a short time, producing only enough Woodbrik for a few homes.

Regarding the possible white elephant, here are some tentative answers. The power plant should have an agreement negotiated with the local transmission company regarding the purchase of all the electricity produced by the power plant. This agreement should be signed prior to building the power plant. The Woodbrik plant poses a greater risk of not selling its products. Simply getting people to try something new is always difficult. Getting people to build houses in a different way using these new brick will be an even greater challenge. The Woodbrik plant would produce a variety of products to facilitate sales of the material. These products would include: large structural blocks (similar to conventional concrete blocks), small bricks (as a substitute for conventional clay bricks), bagged cement mix (similar to the bagged Portland cement mix), and perhaps an additive for Portland cement. Hopefully, a market will become established for at least some of these products. I do not know if other products could be produced, but I intend to look into the possibilities and report these in the EIS.

Property taxes are usually collected by the county government. Given that the power plant will be owned by the municipalities, the property may be exempt from county property taxes. I do not know the answer to this question at this point in time.

The Western Greenbrier Co-Production Demonstration Facility is one of eight project proposals that have been selected for financial assistance from the DOE under the current Clean Coal Power Initiative program.

These answers are subject to change as I get more information. The whole project is still in the early (planning) stage. I hope these answers help.

Sincerely,

Mark L. McKoy
U.S. DOE

Mr.McKoy,
I was at the presentation at the Greenbrier High School Thursday,June 19.I enjoyed the presentation,and liked what I saw.I sincerely hope the project goes through for our community.I read the EIS,and was surprised how thorough it was.I have a few questions,though.
Will the public get to see the results of the EIS ?
Is the plant in Colorado still operational?
Can we ask the community questions concerning their plant?
If the plant that is proposed for here doesn't work out,will we be stuck with a white elephant?
Who will pay any taxes on the property where the power plant will be located?
Is our plant one of eight in the plans,or will we be chosen from one of eight sights?
Thank you for your input.I hope the project goes through.

Mary Nutter
Quinwood,W.Virginia

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July 3, 2003

NEPA Document Manager:
Mr. Mark L. McKoy
National Energy Technology Laboratory
U.S. Department of Energy
P.O. Box 880
Morgantown, WV 26507-0880
mmckoy@netl.doe.gov

RE: Notice of Intent in the Federal Register for the Western Greenbrier Co-Production Demonstration Project, 68 FR 33111, June 3, 2003.

Dear Mr. McKoy:

The Appalachian Center for the Economy and the Environment is submitting these comments on behalf of the West Virginia Highlands Conservancy. The Conservancy is a nonprofit, statewide membership organization and is one of the largest and oldest nonprofit conservation organizations in West Virginia. The Appalachian Center is a regional nonprofit organization serving central Appalachia with offices located in Greenbrier County, West Virginia, the same county as the proposed Western Greenbrier Co-Production Demonstration Project. Thus, organizational members and the environment they depend on will be directly affected by the project.

The Western Greenbrier Co-Production proposal is a "demonstration project" that sets dangerous precedents for fuel use and technology applications that will impact the region and the nation well into the future. In fact, the project sponsors state in their Clean Coal Power Initiative application that "the project is expected to catalyze the demonstration of an entire eco-park complex distributed network" of at least four additional 150 megawatt (MW) co-production facilities planned for southern West Virginia, in the area of Summers and Mercer Counties. Thus, the environmental impacts of this plant are disproportionately great because it will serve as a model and stimulus for the other plants in the network and additional projects across the country. The immediate impact of the complex will be equal to a single power plant of 685 MW. Therefore, the EIS must not only assess the potential impacts from the Western Greenbrier plant but also assess impacts of additional plants as the technologies demonstrated by the project are duplicated throughout the network. Pursuant to CEQ regulations (§§ 1508.7 and 1508.8(b)), DOE must consider indirect effects of the project and cumulative impacts that are reasonably foreseeable. Accordingly, the effects of the four additional power plants must be part of the DOE's analysis.

As a demonstration project, Western Greenbrier must use state-of-the-art pollution control technology and low impact fuels. Instead, the project reaffirms the use of coal as a primary fuel source, does not use the best pollution control technologies for all pollutants, and leads the region away from sustainable sources of power. The reliance of the project on waste coal and significant amounts of high quality coal also promotes continued mountaintop removal coal mining. Therefore, the EIS must evaluate not only the projects' cumulative impacts on global warming but

also the broad and indirect environmental impacts from the coal mined and limestone quarried to carry out the project. These impacts must be compared to those from projects using alternative energy sources and to DOE's support of conservation campaigns.

In addition, while the project is advertised as a "co-generating power plant of advanced design that will be the center of a synergistic eco-park," DOE admits the project is a "high-risk" activity that utilizes unproven technologies that may not be commercially viable. Because the construction of the eco-park is so unlikely, the EIS must judge the "build alternative" considering the plant on its own without taking credit for secondary environmental and economic projects that likely will never materialize. DOE must evaluate the environmental impacts of the project as though all or most of the secondary projects are never initiated or completed, do not fulfill claims and/or fail to be sustained throughout the life of the power plant. In other words, DOE must consider the proposal in light of the likelihood that there is no market for 1,000 tons of Woodbrix per day, the "eco park" will have few if any tenants, hot water produced from the plant's turbine exhaust will be discharged to area streams, tilapia will neither be produced nor sold, and the leftover ash/limestone is an inappropriate material to use to neutralize acid mine drainage from the source coal waste piles. Since there are no contractual agreements that assure these activities will be carried out over the life of the plant or evidence that they will meet environmental claims, this alternative is far more likely than implementation of the full project alternative.

Western Greenbrier LLC is currently struggling to finance this project. The only financing it has managed to secure is from governmental sources. Indeed, the proposed plant is a pork-barrel project that will waste taxpayers' money on technology that will harm 1) the health of the people in the region; 2) the region's environment; and 3) the economy of the region. The financial instability of the project undermines the entire proposal. Many of the proposed actions – creation of the eco-park; creation of an agricultural project that can use generated heat to create a commercially viable floral, fruit and vegetable market; marketing of Woodbrix; buffered ash adequately treating AMD from the Anjean waste pile – require significant capital expenditure for implementation. If the partnership struggles to finance the plant by relying almost entirely on public money, DOE cannot realistically expect that secondary projects will be fully implemented or implemented at all. DOE must consider whether the public money required by this project is simply an attempt to use taxpayer dollars to fund a project that is too weak to succeed in the free market.

Additionally, DOE should not be persuaded by the claim that the proposed project is necessary to clean up the Anjean gob pile or other gob piles. The coal industry is currently obligated to pay money into the State's Special Reclamation Fund sufficient to remediate in perpetuity acid mine drainage discharges like the one at Anjean. If the Special Reclamation Fund is not sufficient to remediate the site, the coal industry is legally obligated to pay more money into the fund to clean it up. Taxpayers should not be forced to clean up a mess made by the coal industry – a mess for which the coal industry is still legally responsible. Finally, it appears that the owner of the Anjean gob pile is bankrupt. This project should not be used to allow that owner, or subsequent owners, to escape environmental liabilities resulting from their ownership of the property. Indeed, it may be improper for the owner of the gob pile to sell it to an entity that lacks the financial resources to

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clean up the pollution discharged from the pile.

Alternatives

In DOE's "Background Information and Potential Environmental Issues" for preparation of the EIS, DOE states:

> The Clean Coal Power Initiative program was structured to achieve National Energy Policy goals by promoting private sector initiatives to invest in demonstrations of advanced commerce-ready technologies through the use of Federal, cost-sharing, financial assistance awards. This approach puts DOE in a much more limited role than if the Federal government were the owner and operator of the project. In the latter situation, DOE would be responsible for a comprehensive analysis of reasonable alternative locations for the project. However, when dealing with applicants for financial assistance awards under the CCPI program, the scope of alternatives is necessarily more restricted because DOE must focus on alternative ways to accomplish its purpose that reflect both the applications before it and the functions that DOE plays in the decision process. As a grantor of financial assistance awards under a competitive open solicitation, DOE must give substantial deference to each applicant's needs in establishing a project's reasonable alternatives.

Clearly, this approach will considerably narrow alternatives to the proposed action. In fact, DOE currently plans to consider only the action and no-action alternatives. This limited approach allows private entities to undergo less stringent review than similar projects initiated by the federal government, thus driving the agenda of DOE and minimizing the potential to reduce or eliminate environmental impacts. It is a transparent attempt to evade the scrutiny that rightfully should come with any federal expenditure.

Specifically the commenters believe the following alternatives must, at a minimum, be considered in the EIS:

- The project outlined by Western Greenbrier Co-Production, LLC without the benefit of secondary projects that are not likely to materialize over the life of the plant and do not have a track record of proven environmental or commercial benefit. This alternative must include cumulative impacts to global warming for the power plant network and impacts from the mining of coal and quarrying of limestone needed for project.
- A similar project using a CFB boiler with better pollution control devices for all pollutants, including additional mercury controls and carbon sequestration technologies.
- A similar project using integrated gasification combined cycle and better pollution control devices for all pollutants including additional mercury controls and carbon sequestration technologies.
- A project using alternative fuel sources.
- A stand-alone project without an associated power plant that moves the gob piles to dry

land preventing both run off and ground water contamination and fully reclaims the former refuse site.
- Providing support of conservation programs that focus on reducing the consumption of electricity at a consumer and industrial level.
- The no-action alternative.

Specific comments:

Air

All impacts from emissions of NOx, SO2, metals and radionuclides and particulates must be quantified and assessed through a dispersion model. Would, for example, the degradation of air quality drive the region, including Greenbrier County, into a non-attainment status for ozone standards? If Greenbrier County does not comply with the eight-hour ozone standard – and there is good evidence it will not, especially if these plants are built – then offsets must be required. DOE must consider the potential ozone issues, including offsets, for all five plants. In addition, because this project may set a precedent for the types of fuels and technologies used in future power plants, a predictive model should be used to assess potential cumulative impacts to air quality of all plants in the network and other new plants utilizing the same fuels and technologies. Because coal gob has a relatively low BTU content, many more tons of CO2 and other pollutants are released per unit of electricity generated than from other fuels. Thus, local and regional CO2 impacts must be critically examined both for the proposed project and for cumulative impacts of the network of proposed plants. Impacts from ozone, acid rain, mercury deposition, diesel fuel emissions from hauling coal, limestone, and fly ash, and the potential for fugitive dust escaping off-site, must also be assessed. Also, impacts to Class 1 areas must be assessed and modeled.

Other air emission impacts that must be assessed are:
- Increased smog locally and regionally
- Impact and movement of water vapor plume

Health impacts

The EIS must assess health impacts to:
- Elderly care facilities
- Low income housing
- Housing for the disabled
- Schools and nurseries
- Public at-large, especially the local communities where the negative health consequences will be the greatest
- Increase in respiratory ailments generally, but in particular, impacts on the young and elderly in the local communities in terms of increased respiratory diseases like asthma
- Impact of the significant fugitive dust that will result from the project

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Environmental Justice

The EIS must assess the impacts of siting five power plants in low-income regions of West Virginia and the health, pollution, and other life quality impacts they will cause. DOE must consider whether it is appropriate to site power plants in disproportionately poor areas of the country and whether the power plants proposed for West Virginia are located in such low income areas Pursuant to Executive Order 12898, "[t]o the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States . . ."

Economic impacts from environmental degradation

The decision to support this project will have numerous negative impacts on the economy. As emissions from the project and other plants in the project network degrade air quality and may push the region into non-attainment for ozone, it could trigger the implementation of extensive auto emissions reduction programs and stop future road construction in the area. Degradation of air quality and the environment will have a negative impact on tourism, potential growth of other industries, and life quality in the area. People want to live in the counties where the proposed plants would be located because it is perceived as having clean air and water. Further degradation of the region's air and water may, therefore, have negative economic impacts that must be considered in the EIS.

Noise

The EIS must assess all noise impacts from:

- Construction and blasting
- Steam release
- Truck traffic
- Unloading/handling of coal
- Other operations

Traffic and damage to roads

The EIS must assess the impacts from:

- Increased truck traffic – over 100 round trips per day
- Interference with other road users
- Danger to local citizens from coal trucks, especially in light of the recent increase in coal truck weight limits in West Virginia
- Damage to local roads and increase in state expenditure for road repairs from haul traffic
- Demand and cost of new traffic controls

Streams/flooding

The EIS must assess the impacts from:

- Wetland loss and impacts
- Flooding due to topography changes
- Risk to property from flooding
- Changes in stream courses

Waste streams

The EIS must assess impacts from:

- Any solid waste generated
- Any hazardous waste generated
- If and how much Woodbrix leaches AMD or metals when exposed to water or weathering
- Radiation from Woodbrix verses other building materials

Water quantity and quality issues

The EIS must assess impacts from:

- Water use and stream flow – in particular the withdrawal of 173,000 gallons/day of ground water and the use of 520,000 gallons per day of effluent water from the Rainelle STP that will not be immediately returned to the stream to support stream flow
- Water lost in vapor
- Waste water quality and impacts to water quality in receiving stream
- Conveyance of water to and from power plant
- Impacts from acid rain
- Impacts from mercury deposition

Ecology & Endangered/threatened species

The EIS must assess impacts on:

- Biodiversity and integrity of the local ecosystem including species and genetic diversity
- Federally endangered and threatened species and critical habitat (in particular Harparella)
- Species of state interest

Mining and quarry issues/sawdust issues

The EIS must assess broad environmental impacts from:

- Need to open new coal mines or expand existing mines to meet this and the other plants' future demands for coal – especially when gob is not available or does not provide sufficient BTU to be financially viable
- Environmental impacts from existing mines supplying coal to the plant
- Availability of gob, where can it be secured, and whether there is enough readily available

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gob to supply fuel during the life of the project

- Refuse recovery: AMD creation, toxic ground water and surface water contamination from disruption and exposure of the gob piles, and impacts from and treatment needed for gob left at sites and not retrievable for use in power plant
- Potential landfilling of leftover ash and the toxic metals it contains, and the inability to prevent leaching of the toxic metals and other substances in the decades after the operation ceases to exist
- Environmental impacts from operation of existing and creation of new limestone quarries supplying limestone for gob treatment
- Increased demand for sawdust and increased cutting of regional forests

Visual

The EIS must assess the impacts from:

- Aerosol haze from SO2, NOx, and particulate emissions
- Emissions to Class 1 areas
- Water vapor plumes
- Damage to local and regional viewsheds
- Additional power lines needed to feed electricity into the power grid

Regulatory Compliance

The EIS must assess whether all Clean Water Act and Clean Air Act permits can and will be obtained.

In conclusion, DOE must conduct a rigorous and objective evaluation of all impacts – direct, indirect and cumulative – of each alternative. The purpose of NEPA is "to encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation." 42 USC § 4321. Given all the issues raised in these comments, it is difficult to imagine that siting new coal-fired power plants in southern West Virginia makes environmental or economic sense.

Sincerely,

Margaret Janes
Senior Policy Analyst
Appalachian Center for the Economy and the Environment
POB 507
Lewisburg, WV 24901
mjanes@hardynet.com

I'd like to know more, (than what I read in the newspaper) about the proposed power plant for Western Greenbrier County. Unfortunately, I've been on vacation and missed the Department of Energy meeting June 19th. I live in neighboring Summers County and coordinate WV's Interfaith Global Climate Change Campaign. I'm particularly interested in the EIS. [I will put you on the list to receive a copy of the draft EIS.]

Some of my questions are:

1. Who/what company/industry is benefitting from the waste steam, in co-generating. [The project company, Western Greenbrier Co-Gen, LLC, was formed by three municipalities as part of an economic development plan. They will own the power plant and the brick-making plant. They will attempt the sell heat in the form of hot water and steam to whoever will buy it. It is expected that there will be no waste high-quality steam. This steam will either be used for the production of electricity or will be extracted from the power cycle and sold at a higher price (than the produced electricity) for other industrial applications. Currently, all the high-quality steam is projected for use in the power cycle; however, industrial consumers of steam are being sought. There is waste heat that will be available from the steam cycle condenser. This heat will be available for use in the planned "eco-park" that the local municipalities have envisioned. In the absence of the planned greenhouses and fish farms, the waste heat would be lost to the surrounding air via conventional cooling equipment.] Will that process use all the excess steam, and if not, where will the rest of the excess steam go? [See answer above. The ultimate goal is to sell or otherwise use most of the potentially-beneficial waste heat. This will require the establishment of the "eco-park" or other consumers, which may not occur before the proposed power plant begins its operations. I am not aware of any contracts for the use of steam or heat at this time; however, this project is very early in the planning stages. I expect that the brick-making plant will use some waste heat. The planned "eco-park" is not part of the DOE action, so the municipalities would need to look to other sources of help with the creation of the eco-park.] Are there other byproducts being used, such as the slash in co-generation? If so how? [I assume that the term "slash" is for slag and ash. The goal is to use slag and ash in the manufacture of brick (WoodbrikTM) and bagged pozzolonic materials and/or, possibly, as a concrete additive. Western Greenbrier is currently negotiating with the WVDEP and others for the Anjean waste coal in exchange for specified remediation activities at the Anjean site. Some of the ash, which would have un-reacted limestone within it, would be returned to the Anjean waste piles and mixed with the residual waste coal (that coal waste of inadequate BTU value) in an effort to neutralize acid leachate at the point of generation.] How firm are these co-generation agreements? [We (DOE) are very anxious to see agreements for the sale of electricity, sale of steam and/or waste heat, access to waste coal with contractual requirements for remediation as the cost (price) of the waste coal, plus the sale of WoodbrikTM and other ash by-products. We would also like to see the municipalities take progressive action toward the creation of their planned "eco-park".]

2. The newspaper articles have described the plant to have newer, more advanced technology with emphasis on being environmentally clean. What new technologies are being used? [The power plant will use state-of-the-art environmental controls such as selective non-catalytic reduction (SNCR) for NOX control, a flash dryer absorber for enhanced sulfur dioxide and mercury control (limestone is also used in the furnace for sulfur control), and a state-of-the-art fabric filter will be used for fine particulate control. Two primary attributes of the combined power and WoodbrikTM plant are (1) integration of the two plants that will result is overall improved energy efficiency and emissions control and (2) a novel power plant configuration that will allow for a more compact, lower cost power plant in sizes applicable for burning waste coal.] What are the emission projections for carbon dioxide, sulphur, nitrogen, and mercury? [See the slides attached to another e-mail that will be sent to you. Slide number 2 gives the comparison. In this slide, the bars for "Current Controlled" reflects the level of emissions for power plants such as the Beechurst Avenue power plant located in Morgantown at the edge of the WVU campus. At this time we do not have data for the other pollutants, but we intend to get this information and put it in the EIS. The proposed power plant should be among the cleanest power plants at the present time using proven technology.]

3. What is the source of limestone, how far will it have to be hauled, how many trucks/day, what size trucks etc. [It is expected that 7 trucks/day of limestone and/or dolomite from local sources would be

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used at the power plant. I do not know if more would be needed for the brick-making plant.]

4. Where will the waste be dumped that's not used in the co-generation? [Ash that is not used for brick-making would be returned to the waste coal piles and mixed with the un-useable waste coal where the unreacted limestone (or dolomite) can neutralize acid leachate.]

5. Can you provide me more details such as the size of the plant, construction schedule, etc. [The projected maximum output from the power plant is 85 MWe. I do not have the numbers for the physical dimensions, but I will get this information from the designers. The approximate schedule is presented on slide 3 in the slides that I will send to you.]

6. What's the content of the gob being used? [Western Greenbrier has contracted with an engineering consulting firm for the sampling and analysis of the coal waste piles. The tentative data is that, for example, a blend of 12% quality coal (Rader Run) and 88% Anjean waste coal would provide 5,020 Btu/lb with 1.2% sulfur.] What happens when it's "disturbed"? [I do not know any details at this time, but the waste coal piles are currently leaching acid and metals, which WVDEP says is costing the State more than $225,000.00/yr to treat. The goal is to eliminate the need for on-going treatment.] What happens to the land where the gob has been dumped after it's removed from the sight for burning in the power plant? [There should be some type of remediation — recontouring, seeding, ... There is talk of a public park, but the future of the site is still being settled in legal proceedings.] How many years of gob is available? [The engineering study will give us this information for the Anjean site. The project proposal claimed that the Anjean site and other sites near Rainelle could provide waste coal for at least 20 years of power plant operations.]

7. Did the state make the $5 million commitment? [The State has verbally committed to provide a combination of money and loan guarantees. We are waiting to see how this is worked out. They are telling us that it will require at least three more months!]

Thank you for your consideration of my questions and your time and expertise in responding!

Sincerely,
Marcia Leitch

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Appendix B
Consultation Letters and Responses*

***Note:** Comments on the Draft EIS were received from the following agencies and have been added to the end of this appendix for the Final EIS: U.S. Fish and Wildlife Service (USFWS), Greenbrier County Historical Society, West Virginia State Historic Preservation Office (WV SHPO), and National Park Service (NPS). DOE met with NPS representatives on March 19, 2007 to discuss concerns as stated in their comment letter; a letter from DOE, which summarizes the main points of the meeting discussions, was submitted to NPS and is included in this appendix.*

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April 28, 2004

Brian McDonald
The West Virginia Natural Heritage Program
P.O. Box 67
Elkins, WV 26241

RE: Environmental Impact Statement (EIS), Western Greenbrier Co-Gen, LLC, Co-Production Facility

Dear Mr. McDonald:

Potomac-Hudson Engineering, Inc. (PHE) is supporting the U.S. Department of Energy (DOE) in preparing an Environmental Impact Statement (EIS) for a Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Gen, LLC (WGC), with DOE providing financial support through a 5-year cooperative agreement with WGC under the DOE Clean Coal Power Initiative (CCPI) Program. The facility would be designed for long-term commercial operation (at least 20 years) following completion of the cooperative agreement. DOE's support would amount to 50% (approximately $107.5 million) of the development cost for the proposed facility.

This letter is being submitted to your office to solicit your input on the project. To assist us in assessing any potential environmental impacts of this project, we are requesting a list of any existing or proposed federally protected and special status species for Greenbrier County, as well any site-specific information for the areas indicated on the enclosed maps. Primary local impacts to biological resources are expected to be related to site development and other land-disturbing activities from the project (see below for project description).

Proposed Co-Production Facility and Related Actions

WGC is proposing to design, construct, and operate an 85 MW ACFB power plant that would generate electricity and steam by burning approximately 1,800 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site immediately to the south of Sewell Creek and the City limits of Rainelle. Material handling and other support facilities would be located on properties to the north of Sewell Creek adjacent to a currently undeveloped industrial park (the Eco Park). A coal-fired rotary kiln associated with the power plant would combine coal ash and limestone into a cement-like material for use with wood wastes to manufacture structural building blocks (Woodbrik™). Currently, it is anticipated that the Woodbrik™ manufacturing plant would be located on the north side of Sewell Creek adjacent to the Eco Park. The power plant would likely serve as the anchor for future tenants at the Eco Park by providing a source of steam and hot water supply for building heating and other industrial activities.

Waste coal would initially be obtained from waste coal piles located at Anjean (see attached figures). Excess combustion ash not needed for Woodbrik™ manufacture would be used to remediate acid drainage from the source waste coal piles. WGC is in the process of determining additional waste coal

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OTHER LOCATIONS IN
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NORTH CAROLINA

POTOMAC-HUDSON ENGINEERING, INC.
ENGINEERS ▪ SCIENTISTS ▪ PLANNERS

pile sites for obtaining fuel source once the Anjean piles are depleted (currently estimated at 6 to 7 years). Generally, future waste coal pile sites that would be used would be within 20 to 30 miles of the power plant site. Both rail and truck are being considered as transportation options for the waste coal fuel, raw materials (e.g., limestone), and waste removal.

Additional components of the proposed project, as indicated on the enclosed maps, include the construction of power lines, the extension of a steam line to Georgia Pacific Lumber, and construction of reclaimed water supply line from the Rainelle sewage treatment plant. A combination of groundwater and reclaimed wastewater would be used for supplying water to the plant. It is anticipated that the steam and water lines will be constructed along existing railroad right-of-ways.

In addition, due to the nature of the proposed facility and associated air emissions with the operation, we are also considering the potential for regional-level impacts. Therefore, we are requesting information on protected and special status species and habitats for counties within a 30-mile radius of the proposed project site that may be sensitive to changes in atmospheric conditions. These counties include:

- Nicholas
- Fayette
- Summers
- Raleigh
- Monroe
- Webster, and
- Pocahontas

We are very interested in receiving your comments on the proposal and instructions for any further coordination. If you have any questions, please do not hesitate to call.

Sincerely,

Fred Carey, P.E.
Project Manager

Attachments:
General Location Map
Topographic Map of Proposed Power Plant Site
Aerial Photograph of Proposed Power Plant Site
Topographic Map of Anjean
Aerial Photograph of Anjean

CORPORATE OFFICE 4833 RUGBY AVENUE, SUITE 100, BETHESDA, MD 20814 ▪ **T** 301 907 9078 ▪ **F** 301 907 3446 ▪ **WWW.PHE.COM**
OTHER LOCATIONS IN CALIFORNIA ▪ NEW JERSEY ▪ NORTH CAROLINA

Appendix B

WEST VIRGINIA DIVISION OF
CULTURE AND HISTORY

July 20, 2004

Mr. Mark L. McKoy
US DOE
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507

RE: Western Greenbrier County Production Project
FR#. 04-705-GBI

Dear Mr. McKoy:

We have reviewed the above mentioned project to determine its effects to cultural resources. As required by Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties," we submit our comments.

The West Virginia State Historic Preservation Office has reviewed the proposed project to construct a power plant on the site of the former Meadow River Lumber Company at Rainelle, Greenbrier County. Thank you for meeting with us on May 12, 2004 to discuss options to decide a plan of action in order to make the power plant construction have as little an effect on cultural resources as possible. It is our understanding that the following is already within your scope of work and that you would like the West Virginia State Historic Preservation Office to decide what other additional actions must be performed to record cultural resources that may be effected by this project.

Actions contained within existing scope of work:

- Perform research on architectural history and archaeological sites using maps, documents, and reports at the West Virginia Division of Culture and History.
- Review of materials at local libraries, historical societies, and museums
- Coordination with relevant government agencies.
- Walkover survey of the proposed 26-acre power plant site, power line corridors, rail spur corridors and access roads.
- Windshield survey and brief walkover survey of the Anjean and Nettie coal waste sites (or other designated waste site localities, assuming each locality is approximately 200 acres).
- Review of historical map data, various files and records, and field observation to assess the potential for the study areas to contain historic buildings and structures.
- Review of geomorphological data, land-use history, historic map data, and field observations to assess the potential of areas to contain subsurface artifacts.
- Review of various aspects of the project to consider the potential for the project to impact significant cultural resources.
- Suggest mitigation options for any significant impacts that might arise from the proposed project.

Additional Work the West Virginia State Historic Preservation Office will require:

We would like to have the following additional work added to the current scope of work for the draft Environmental Impact Statement (EIS):

- A map showing district boundaries and potentially historic properties (excluding individual company houses but including more significant structures) would be created. Photos and information could be keyed to the electronic version of the map. **We are of the opinion that the company houses are as significant as any of the other structures and would require them to be mapped as well.**

- Renderings made of the affected views (visualizations) from selected properties.
- Detailed design plans for the proposed project showing building placement, elevations, access roads, etc....
- A Phase I archaeological survey be conducted within high-probability areas along the selected corridor for the steam and water-supply pipelines as well as the excavation of one or more backhoe trenches in high probability areas that have been identified where there would be ground disturbance by the project. Phase I archaeological testing of the benches (designated a relatively undisturbed during walkover survey) located south of fence line in the Sewell Creek area. Phase I archaeological survey at the location where the footers for the stack and building are being placed.
- A screening archaeological survey be conducted to identify high-probability areas within any new park land acquired by the city as part of a land exchange with Western Greenbrier Co-Gen., LLC.
- Results of the walkover survey of the Anjean and Nettie coal waste sites were presented at the May 12, 2004 meeting held at our office. Information submitted for review indicates that snow cover restricted access to some portions of the project area. Have these areas subsequently been survey?
- Submission of copies of reports, maps, and special computer files created as part of the project's cultural resources impact assessment.
- Submission of a map illustrating areas of disturbance within the proposed project area.

We look forward to receiving the draft Environmental Impact Statement. We will complete our review upon receipt of the materials requested.

We appreciate the opportunity to be of service. *If you have questions regarding our comments or the Section 106 process, please contact Ryan Burns, Historian or Carolyn Kender, Archaeologist, in the Historic Preservation Office at (304) 558-0240.*

Sincerely,

Jennifer W. Murdock
Program Coordinator for Review and Compliance

JWM:cmk/rb

U.S. Department of Energy

National Energy Technology Laboratory

May 20, 2005

Ms. Jennifer W. Murdock
Program Coordinator for Review and Compliance
West Virginia Division of Culture and History
The Cultural Center
1900 Kanawha Blvd., E.
Charleston, WV 25305-0300

Dear Ms. Murdock:

Thank you for your letter of July 20, 2004 to Mr. Mark McKoy, in which you indicate additional work the West Virginia State Historic Preservation Office will require for the Western Greenbrier Co-Gen Project in Greenbrier County. Enclosed please find the following reports which were developed to address your comments: (1) *Historic Resources Determination of Eligibility and Assessment of Effect;* and (2) *Phase I Archeological and Geomorphological Investigations*. Specific items you indicated should be addressed in the draft Environmental Impact Statement and their current status are listed below.

Items included in the *Historic Resources Determination of Eligibility and Assessment of Effect report:*

- A map showing distinct boundaries and potentially historic properties
- Renderings made of the affected views from selected properties

Items included in the *Phase I Archeological and Geomorphological Investigations report:*

- Phase I archaeological surveys within high-probability areas
- Screening archaeological surveys
- Results of the walkover survey of the Anjean and Nettie coal waste sites – Nettie is no longer under consideration for the project. Walkover surveys of Anjean were conducted in April 2004.
- Submission of a map illustrating areas of disturbance within the proposed project area

Additional Items

- Detailed design plans for the proposed project - Design iterations for the facility are on-going and the latest version of the site layout will be presented in the DEIS; however, the enclosed reports indicate the boundary limits within which land-disturbing activities would be expected to take place.
- Submission of copies of reports, maps, and computer files - Reports and maps are enclosed with this letter. GIS data sets have been developed that contain aerial mapping and historic district boundaries. This information can be made available to your office upon request of a specific data format, and after completion of the DEIS.

We look forward to your review comments of the materials presented. Should questions or additional comments arise, please contact Mr. Mark McKoy at 304-285-4426, Mark.McKoy@ netl.doe.gov, or me at the Morgantown Office numbers or address listed below.

Sincerely,

Roy G. Spears
Environment, Safety, and Health Division

Enclosures
Historic Resources Determination of Eligibility and Assessment of Effects
Phase I Archeological and Geomorphological Investigations

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507-0880 □ 626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236-0940
REPLY TO: Morgantown Office • roy.spears@netl.doe.gov • Voice (304) 285-5460 • Fax (304) 285-4403 • www.netl.doe.gov

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WEST VIRGINIA
DIVISION OF
CULTURE & HISTORY
1900 Kanawha Blvd., E.
Charleston, WV
25305-0300
Phone 304.558.0220
Fax 304.558.2779
TDD 304.558.3562
www.wvculture.org
EEO/AA Employer

July 5, 2005

Mr. Roy G. Spears
US Department of Energy
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507

RE: Western Greenbrier County Production Project
FR#: 04-705-GB-2

Dear Mr. Spears:

We have reviewed the additional information submitted for the above referenced project to determine its effects to cultural resources. As required by Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties," we submit our comments.

Architectural Resources:
The West Virginia State Historic Preservation Office has reviewed *Historic Resources Determination of Eligibility and Assessment of Effects West Greenbrier Co-Production Demonstration Project Greenbrier County West Virginia* for impacts to architectural resources. Unfortunately, we cannot complete our review with the materials submitted. The information submitted is very useful for the completion of the Section 106 review process. Although your report concludes that the proposed stack will have no adverse effect on the historic districts; it does not indicate if the public have commented upon this obvious visual intrusion. Consideration of public comment is also a part of the review process; therefore, we request that public comment be sought through a public meeting to be held in Rainelle regarding the proposed changes to the view shed. We also ask that the Greenbrier County Historical Society be contacted and given both the architectural and archaeological reports for their comment on the proposed plant. Their address is as follows:

Greenbrier County Historical Society
301 West Washington Street
Lewisburg, WV 24901

We ask that our office be notified when the public meeting will be held at least two weeks in advance in order to give a representative from this office the opportunity to attend. Finally, please submit comments from the Greenbrier County Historical Society to this office for our review. We will complete our review upon receipt of the materials requested.

Archaeological Resources:
We have reviewed the report, "Phase I Archaeological and Geomorphological Investigations of the Proposed Western Greenbrier Co-Production Plant, Rainelle, Greenbrier County, West Virginia." The report satisfactorily addresses our concerns regarding the presence of archaeological sites within the project area. It is our understanding that, by the time Stage 2 of the Phase I survey was conducted in November 2004, several changes had occurred to the project designs and that the following areas were included in the survey: high probability areas within the potential plant site (terraces and benches located between Sewell Creek and a ridge to the east); benches in the Plum Creek tract south of the property fence line; the steam/water pipeline corridor; and the 17-acre exchange property. Field methodology included pedestrian survey, excavation of systematic and judgmental shovel probes, and deep testing. The survey did not result in the identification of previously unknown archaeological resources. With the exception of the steam/water pipeline corridor between shovel probes 4 and 6, it is recommended that the proposed project will have no effect to archaeological sites that are eligible for or included in the National Register of Historic Places. We concur with that recommendation.

A portion of the steam/water pipeline corridor crosses an area with a high potential to contain archaeological resources. At the time of the survey, the pipeline corridor had not been finalized. Therefore it is recommended that the section of the proposed pipeline corridor between shovel probes 4 and 6 be further investigated with an intensive Phase I survey once the corridor has been determined. We concur with that recommendation. We ask to be notified should the project plans change further so that we can assess the potential for those changes to affect cultural resources.

We appreciate the opportunity to be of service. If you have questions regarding our comments or the Section 106 process, please contact Lora A Lamarre, Senior Archaeologist, or Ryan Burns, Historian, at (304) 558-0240.

Sincerely,

Susan M. Pierce
Deputy State Historic Preservation Officer

SMP/LAL/RCB

CC: Greenbrier County Historical Society

Appendix B

POTOMAC-HUDSON ENGINEERING, INC.
ENGINEERS ▪ SCIENTISTS ▪ PLANNERS

August 01, 2005

Greenbrier County Historical Society
301 West Washington Street
Lewisburg, WV 24901

RE: Environmental Impact Statement (EIS), Western Greenbrier Co-Gen, LLC, Co-Production Facility

To Whom It May Concern:

Potomac-Hudson Engineering, Inc. (PHE) is supporting the U.S. Department of Energy (DOE) in preparing an Environmental Impact Statement (EIS) for a Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Gen, LLC (WGC), with DOE providing financial support through a 5-year cooperative agreement with WGC under the DOE Clean Coal Power Initiative (CCPI) Program.

In compliance with Section 106 of the National Historic Preservation Act, and to support the preparation of the EIS, the following reports have been prepared:

(1) *Historic Resources Determination of Eligibility and Assessment of Effects West Greenbrier Co-Production Demonstration Project Greenbrier County West Virginia*
(2) *Phase I Archaeological and Geomorphological Investigations of the Proposed Western Greenbrier Co-Production Plant, Rainelle, Greenbrier County, West Virginia,*

The West Virginia State Historic Preservation Office (SHPO) has reviewed and commented on these reports and has requested that we directly solicit your comments. Therefore, we have enclosed a copy of each report for your review. It is anticipated that a Draft EIS will be distributed to the public sometime later this year, at which point a Public Meeting will be held in the Rainelle area. The Greenbrier County Historical Society will be included on the EIS mailing list and notified of any public meetings related to the EIS.

If you have any questions, please do not hesitate to call. We look forward to your input.

Sincerely,

Fred Carey, P.E.
Project Manager

Attachments:
-Historic assessment report: *Historic Resources Determination of Eligibility and Assessment of Effects West Greenbrier Co-Production Demonstration Project Greenbrier County West Virginia*
-Archeological assessment report: *Phase I Archaeological and Geomorphological Investigations of the Proposed Western Greenbrier Co-Production Plant, Rainelle, Greenbrier County, West Virginia*

CORPORATE OFFICE
7830 OLD GEORGETOWN ROAD, SUITE 220
BETHESDA, MD 20814

WWW.PHE.COM
TELEPHONE 301 907 9078
FAX 301 907 3446

Appendix B

April 27, 2004

U.S. Fish and Wildlife Service
Route 250 South, Elkins Shopping Plaza
694 Beverly Pike
Elkins, WV 26241

RE: Environmental Impact Statement (EIS), Western Greenbrier Co-Gen, LLC, Co-Production Facility

Dear Sir or Madam:

Potomac-Hudson Engineering, Inc. (PHE) is supporting the U.S. Department of Energy (DOE) in preparing an Environmental Impact Statement (EIS) for a Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Gen, LLC (WGC), with DOE providing financial support through a 5-year cooperative agreement with WGC under the DOE Clean Coal Power Initiative (CCPI) Program. The facility would be designed for long-term commercial operation (at least 20 years) following completion of the cooperative agreement. DOE's support would amount to 50% (approximately $107.5 million) of the development cost for the proposed facility.

This letter is being submitted to your office to initiate the consultation process under Section 7 of the Endangered Species Act and to solicit your input on the project. To assist us in assessing any potential environmental impacts of this project, we are requesting a list of any existing or proposed federally protected and special status species for Greenbrier County, as well any site-specific information for the areas indicated on the enclosed maps. Primary local impacts to biological resources are expected to be related to site development and other land-disturbing activities from the project (see below for project description).

Proposed Co-Production Facility and Related Actions

WGC is proposing to design, construct, and operate an 85 MW ACFB power plant that would generate electricity and steam by burning approximately 1,800 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site immediately to the south of Sewell Creek and the City limits of Rainelle. Material handling and other support facilities would be located on properties to the north of Sewell Creek adjacent to a currently undeveloped industrial park (the Eco Park). A coal-fired rotary kiln associated with the power plant would combine coal ash and limestone into a cement-like material for use with wood wastes to manufacture structural building blocks (Woodbrik™). Currently, it is anticipated that the Woodbrik™ manufacturing plant would be located on the north side of Sewell Creek adjacent to the Eco Park. The power plant would likely serve as the anchor for future tenants at the Eco Park by providing a source of steam and hot water supply for building heating and other industrial activities.

Waste coal would initially be obtained from waste coal piles located at Anjean (see attached figures). Excess combustion ash not needed for Woodbrik™ manufacture would be used to remediate acid drainage from the source waste coal piles. WGC is in the process of determining additional waste coal

CORPORATE OFFICE
4833 RUGBY AVENUE, SUITE 100
BETHESDA, MD 20814
T 301 907 9078
F 301 907 3446

WWW.PHE.COM
OTHER LOCATIONS IN
CALIFORNIA
NEW JERSEY
NORTH CAROLINA

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POTOMAC-HUDSON ENGINEERING, INC.
ENGINEERS ■ SCIENTISTS ■ PLANNERS

pile sites for obtaining fuel source once the Anjean piles are depleted (currently estimated at 6 to 7 years). Generally, future waste coal pile sites that would be used would be within 20 to 30 miles of the power plant site. Both rail and truck are being considered as transportation options for the waste coal fuel, raw materials (e.g., limestone), and waste removal.

Additional components of the proposed project, as indicated on the enclosed maps, include the construction of power lines, the extension of a steam line to Georgia Pacific Lumber, and construction of reclaimed water supply line from the Rainelle sewage treatment plant. A combination of groundwater and reclaimed wastewater would be used for supplying water to the plant. It is anticipated that the steam and water lines will be constructed along existing railroad right-of-ways.

In addition, due to the nature of the proposed facility and associated air emissions with the operation, we are also considering the potential for regional-level impacts. Therefore, we are requesting information on protected and special status species and habitats for counties within a 30-mile radius of the proposed project site that may be sensitive to changes in atmospheric conditions. These counties include:

- Nicholas
- Fayette
- Summers
- Raleigh
- Monroe
- Webster, and
- Pocahontas

We are very interested in receiving your comments on the proposal and instructions for any further coordination. If you have any questions, please do not hesitate to call.

Sincerely,

Fred Carey, P.E.
Project Manager

Attachments:
General Location Map
Topographic Map of Proposed Power Plant Site
Aerial Photograph of Proposed Power Plant Site
Topographic Map of Anjean
Aerial Photograph of Anjean

Appendix B

United States Department of the Interior

FISH AND WILDLIFE SERVICE

West Virginia Field Office
694 Beverley Pike
Elkins, West Virginia 26241

July 8, 2004

Mr. Fred Carey, P.E.
Project Manager
Potomac-Hudson Engineering, Inc.
4833 Rugby Avenue, Suite 100
Bethesda, Maryland 20814

Re: Environmental Impact Statement, Western Greenbrier Co-Gen, LLC, Co-Production Facility, Greenbrier County, West Virginia

Dear Mr. Carey:

This responds to your information request of 27 April 2004 regarding the potential impacts of a proposed project on federally listed endangered and threatened species and species of concern. Western Greenbrier Co-Gen, LLC, proposes to design, construct and operate an 85 MW ACFB power plant, which will burn 1,800 tons per day of waste coal for the generation of electricity and steam. The selected area is a 26-acre site near the town of Rainelle, in Greenbrier County, West Virginia. The initial site for acquiring waste coal is near Anjean, West Virginia.

Potomac-Hudson Engineering has requested impacts from this project on any endangered or threatened species within a 30-mile radius from the site for the preparation of an Environmental Impact Statement (EIS). This distance is requested due to the possible changes in atmospheric conditions that may occur from this power plant. These comments are provided pursuant to the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e).

Fish and Wildlife Surveys and Investigations

For the purposes of this report, impacts to federally listed endangered and threatened species have been separated into two different categories: *(1) Site Specific Impacts*, and *(2) 30-Mile Radius Impacts*. In addition, other impacts to fish and wildlife have been provided and are listed under the category: *(3) Other Impacts*.

(1) Site Specific Impacts:
Certain impacts can be attributed to the actual construction of the power plant and the associated features (rail-way, transmission lines, etc.). A check of our records indicate that only one federally listed species could occur in the project area, the endangered Indiana bat, Myotis sodalis.

The federally listed endangered Indiana bat may occur in the project area and could conceivably be adversely affected by the project proposal. The Indiana bat may use the project area for foraging and roosting between April 1 and November 15. Indiana bat summer foraging habitats are generally defined as riparian, bottomland, or upland forest, and old fields or pastures with scattered trees. Roosting/maternity habitat consists primarily of live or dead hardwood tree species, which have exfoliating bark that provides space for bats to roost between the bark and the bole of the tree. Tree cavities, crevices, splits, or hollow portions of tree boles and limbs also provide roost sites.

The U.S. Fish and Wildlife Service (Service) has determined the number of acres of suitable foraging and roosting habitat on the West Virginia landscape available to each Indiana bat, versus the total acreage of forest. On that basis, we have determined that small projects, outside of a five-mile radius of a hibernaculum and a two-mile radius of a capture site, affecting 17 acres or less of suitable forested habitat, will have a very small chance of resulting in direct or indirect take of the species, and therefore these effects are considered discountable.

If less than 17 acres of potential habitat for that species will be impacted, then no further consultation under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) is required regarding the Indiana bat on a site-specific impact. Should project plans change, or if additional information on the Indiana bat becomes available, this determination may be reconsidered. If more than 17 acres of forested habitat will be impacted, further coordination with this office will be required for this site-specific concern.

(2) 30-mile radius impacts:
Several endangered and threatened species occur within the 30-mile radius from the proposed project site. They include the Indiana bat (Myotis sodalis), the Virginia big-eared bat (Corynorhinus townsendii virginianus), Virginia spiraea (Spiraea virginiana), the West Virginia Northern flying squirrel (Glaucomys sabrinus fuscus), small whorled pogonia (Isotria medeoloides), running buffalo clover (Trifolium stoloniferum), the northern riffleshell mussel (Epioblasma torulosa rangiana), the pink mucket pearly mussel (Lampsilis abrupta), and the fanshell mussel (Cyprogenia stegaria).

While the Service commends the energy community for providing lower emission power plants, federally protected species (as listed above) could be sensitive to even slight changes in atmospheric conditions. For example, the endangered West Virginia Northern flying squirrel is dependant upon a specific habitat type. Potential habitat for the West Virginia northern flying squirrel is defined as high elevation northern hardwood forest with a conifer component, usually of red spruce or hemlock. Other parameters indicative of potential habitat include abundant

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large woody debris on the forest floor, cooler temperatures and higher humidity that promotes lichen growth and presence of moss, fern, liverwort or clubmoss groundcover. The cumulative effects from acid deposition may have a detrimental impact upon this type of habitat (especially those found in higher elevations and colder temperature regimes).

In addition, the three protected mussels species found within the 30-mile radius may show detrimental effects to changes in stream water pH and metal accumulation (aluminum, mercury, etc.) through contaminated rain and snowfall. Federally listed plants could also become indirectly impacted through acid deposition on soils, which may change the nutrient composition of the soils (calcium depletion, increasing sulfur and nitrogen, etc.).

Projected emissions were not included within your letter. Accurate emission figures, coupled with anticipated deposition rates, historical wind currents and rainfall amounts are necessary to determine environmental (and species specific) changes through atmospheric deposition (via modeling). Until this is complete, we cannot determine the long-range impact to listed species.

(3) *Other Impacts:*
Of particular concern are impacts to other fish and wildlife resources that stem from the storage and disposal of waste materials generated at coal burning plants. This waste material is generally composed of noncombustible materials (minerals) and can be either collected within the flue stacks (fly ash) or as heavier bottom ash. Your letter states that the Woodbrik manufacturing plant will use a portion of this ash (along with other materials) in the construction of bricks. Your letter goes on to state that excess ash will also be used to remediate acid mine drainage (AMD) from the source waste coal piles. The Service not only recognizes the problems in water quality associated with AMD, but also the potential for ash to release high levels toxic metals within the stream environment. The Service cannot recommend trading one environmental problem for another, potentially more serious one. Therefore the Service recommends a proper study of the composition of the ash to be used, as well as the expected dissolution of toxic metals within the downstream environment and all associated cumulative health risks to fish and wildlife. Alternate disposal areas should also be considered in order to minimize any potential risks to water quality.

Typically, power plants discharge water at permitted sites covered under the National Pollutant Discharge Elimination System (NPDES) permitting procedures. While your letter states that the power plant will provide hot water and steam for nearby businesses, it is not clear if all waste water will be processed in this manner or if some portion will be discharged into the environment. Discharged water may contain biocides and other additives used to control algae and bacteria within the power plant lines. This, as well as the extreme temperatures may be harmful to surface and groundwater quality. Possible discharge sites should be explored in order to provide for the least damaging alternative.

Conclusion

Overall, the purpose of this project remains unclear. There was no indication within your letter that the construction of this power plant would alleviate a power deficiency within West

Virginia. In fact, your letter does not mention any type of alternatives that have been considered prior to the preparation of an EIS or the implementation of the National Environmental Policy Act (NEPA) process. The NEPA process should assist with the procedures of choosing the appropriate alternative, instead of supporting the choice made prior to the NEPA implementation. With this in mind, alternate locations should be considered so that those who benefit from the electricity generated from this plant would also be responsible for the proper disposal and control of the inherent pollution.

If you have any questions regarding this letter, please contact Mr. Monte Matthews of my staff at (304) 636-6586, or at the letterhead address.

Sincerely,

Thomas R. Chapman
Field Supervisor

DIVISION OF NATURAL RESOURCES
Wildlife Resources Section
Operations Center
P.O. Box 67
Elkins, West Virginia 26241-3235
Telephone (304) 637-0245
Fax (304) 637-0250

Bob Wise
Governor

Ed Hamrick
Director

May 25, 2004

Mr. Fred Carey
Potomac-Hudson Engineering, Inc.
4833 Rugby Avenue, Suite 100
Bethesda, MD 20814

Dear Mr. Carey:

We have reviewed our files for information on rare, threatened, and endangered (RTE) species in the area the proposed Western Greenbrier Co-Gen, LLC Co-Production Facility in Rainelle, Greenbrier County, West Virginia. There are no known occurrences of RTE species at the Rainelle site, nor do we have any known occurrences at the Anjean waste coal piles.

Enclosed is a compact disc containing a list of RTE species currently known from Greenbrier County (GreenbrierCounty.doc), RTE species within a 30-mile radius of Rainelle (RainelleData.xls), and an explanation of our ranking system denoting species rarity (Rankexpl.doc). The table below lists federally protected species within the boundaries of your project description:

Name	Status*	Comments
Greenbrier County		
Shale barren rockcress (*Arabis serotina*)	LE	Restricted to shale barrens of Greenbrier, Hardy, and Pendleton counties.
Northern flying squirrel (*Glaucomys sabrinus fuscus*)	LE	Restricted to the higher elevations of the mountain counties (Greenbrier, Pendleton, Pocahontas, Randolph, Tucker, Webster); in areas with red spruce or a conifer component.
Small-whorled pogonia (*Pogonia medeoloides*)	LT	Currently known from only Greenbrier County; does not appear restricted to a specific habitat.
Indiana bat (*Myotis sodalis*)	LE	Hibernates in caves in Greenbrier, Hardy, Mercer, Monroe, Pendleton, Pocahontas, Preston, Randolph, and Tucker counties; documented as utilizing mine portals in Fayette and Raleigh counties as summer roosts; also utilizes trees as roosts; suspected maternity site in Boone County in 2003.
Virginia spiraea (*Spiraea virginiana*)	LT	A riparian shrub known to occur along the Bluestone, Greenbrier, Gauley, and Meadow rivers; additional non-riparian sites in Raleigh County.
30-MILE RADIUS OF RAINELLE		
Shale barren rockcress (*Arabis serotina*)	LE	See comments above.
Virginia big-eared bat (*Corynorhinus townsendii virginianus*)	LE	Utilizes caves as hibernacula and maternity colonies in Grant, Hardy, Pendleton, Preston, Randolph, and Tucker counties; utilizes mine portals as summer and fall roosts
Fanshell mussel (*Cyprogenia stegaria*)	LE	Known from the Kanawha River in Fayette County and the Ohio River in Wood and Jackson counties.
Northern riffleshell (*Epioblasma torulosa rangiana*)	LE	Known from the only the Kanawha River in Fayette and Kanawha counties.
Northern flying squirrel (*Glaucomys sabrinus fuscus*)	LE	See comments above.
Small-whorled pogonia (*Pogonia medeoloides*)	LT	See comments above.
Pink mucket pearly mussel	LE	Known from the Kanawha River in Fayette and Kanawha counties, and the Ohio River in Cabell, Mason, and Wood counties.
Indiana bat (*Myotis sodalis*)	LE	See comments above.
Virginia spiraea (*Spiraea virginiana*)	LE	See comments above.
Running buffalo clover (*Trifolium stoloniferum*)	LE	Found in disturbed areas in old jeep trails, logging roads, skid rows, etc. in Barbour, Brooke, Fayette, Pendleton, Pocahontas, and Randolph counties; historically known from Preston and Webster counties.

*LE = endangered; LT = threatened

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This response is based on information currently available and should not be considered a comprehensive survey of the areas under review. We hope you find this information helpful in your planning process.

Enclosed please find an invoice.

Thank you for contacting us and please call if you should have any questions.

Sincerely,

Barbara Sargent
Environmental Resources Specialist
Wildlife Diversity Program

enclosures

Appendix B

WEST VIRGINIA
Tribal Points of Contact
Huntington District

1) Absentee-Shawnee Tribe of Indians of Oklahoma
2025 S. Gordon Cooper Drive
Shawnee, Oklahoma 74801-9381
Governor: Mr. Kenneth Blanchard
NAGPRA contact: Ms. Jennifer Makaseah, Director, Cultural/Historic Preservation
405-275-4030

2) Cherokee Nation
P.O. Box 948
Tahlequah, Oklahoma 74465
Principal Chief: Mr. Chad Smith
NAGPRA contact: Dr. Richard Allen
918-456-0671

3) Delaware Nation HAS RESPONDED
P.O. Box 825
Anadarko, Oklahoma 73005
President: Mr. Bruce Gonzales
NAGPRPA contact: Ms. Phyllis Wahahrockah-Tasi
405-247-2448

4) Delaware Tribe of Indians HAS RESPONDED
220 NW Virginia Ave.
Bartlesville, Oklahoma 74003
Chief: Mr. Larry Joe Brooks
NAGPRA contact: Mr. Brice Obermeyer
918-336-5272

5) Eastern Band of Cherokee Indians of North Carolina
P.O. Box 455
Cherokee, North Carolina 28719
Principal Chief: Ms. Michelle Hicks
NAGPRA contact: Ms. Clara Holt, NAGPRA Officer
THPO/Section 106 contact: Mr. Russell Townsend
828-497-2771

6) Eastern Shawnee Tribe of Oklahoma HAS RESPONDED
P.O. Box 350
Seneca, Missouri 64865
Chief: Mr. Charles Enyart
918-666-2435

7) Shawnee Tribe
P.O. Box 189
Miami, Oklahoma 74355
Chairman: Mr. Ron Sparkman
NAGPRA contact: Ms. Rebecca Hawkins, Tribal Administrator
918-542-2441

8) United Keetoowah Band of Cherokee Indians in Oklahoma
P.O. Box 746
Tahlequah, Oklahoma 74465
Chief: Dallas Proctor
NAGPRA contact: Mr. Stephen Mouse, Assistant Chief, 2450 S. Muskcoggee Ave., Tahlequah, OK 74465
918-431-1818

9) Tuscarora Nation
Chief: Mr. Leo R. Henry
2006 Mt. Hope Rd
via Lewiston, NY 14092
716-622-7061

10) NAGPRA/106 contact: Mr. Richard Hill (Chairperson on Standing Committee on Burial Rules and Regulations)
2235 Mt. Hope Rd
via Sanborn, NY 14123

U.S. Department of Energy

National Energy Technology Laboratory

SAMPLE LETTER

July 28, 2004

Jennifer Makaseah, Director, Cultural/Historic Preservation
Absentee-Shawnee Tribe of Indians of Oklahoma
2025 S. Gordon Cooper Drive
Shawnee, Oklahoma 74801-9381

Re: Executive Memo (4/29/1994): "Gov't to Gov't Relations", and
Executive Order 13084: Consultation and Coordination with Indian Tribal Gov't,
Section 106 and NAGPRA Consultation for the
Environmental Impact Statement (EIS), Western Greenbrier Co-Gen, LLC, Co-Production Facility,
Rainelle, West Virginia

Dear Ms. Makaseah,

The U.S. Department of Energy (DOE) is preparing an Environmental Impact Statement (EIS) for a Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Gen, LLC (WGC), with DOE providing financial support through a 5-year cooperative agreement with WGC under the DOE Clean Coal Power Initiative (CCPI) Program. The facility would be designed for long-term commercial operation (at least 20 years) following completion of the cooperative agreement. DOE's support would amount to 50% of the development cost for the proposed facility.

In accordance with the referenced Executive Orders and Acts, the DOE would like to solicit your input on the project in order to determine if your tribe has any concerns or issues about the project. In particular, we are interested in learning whether or not this project has the potential to impact any archeological, religious or cultural sites in the area that are considered significant to your tribe. The DOE is requesting that you (or your designated representative) identify and/or notify my office of any concerns or issues you may have, or if you are aware of any significant archeological, religious, or cultural sites within the areas of potential impact.

To assist in your review, I have enclosed maps that illustrate the areas where construction impacts are likely to occur. Impacts to archeological resources (if present) are expected to be related to site development and other land-disturbing activities from the project. In addition, the potential for impacts related to visual or atmospheric resources associated with potential air emissions are being considered. The following discussion provides a more detailed description of the project.

Proposed Co-Production Facility and Related Actions

WGC is proposing to design, construct, and operate an 85 MW atmospheric circulating fluidized bed power plant that would generate electricity and steam by burning approximately 1,800 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site immediately to the south of Sewell Creek and the City limits of Rainelle. Material handling and other support facilities would be located on properties to the north of Sewell Creek adjacent to a currently undeveloped industrial park (the Eco Park). A coal-fired rotary kiln associated with the

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507-0880 ☐ 626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236-0940
REPLY TO: Morgantown Office • @netl.doe.gov • Voice (304) 285-4426 • Fax (304) 285-4403 • www.netl.doe.gov

power plant would combine coal ash and limestone into a cement-like material for use with wood wastes to manufacture structural building blocks (Woodbrik™). Currently, it is anticipated that the Woodbrik™ manufacturing plant would be located on the north side of Sewell Creek adjacent to the Eco Park. The power plant would likely serve as the anchor for future tenants at the Eco Park by providing a source of steam and hot water supply for building heating and other industrial activities.

Waste coal would initially be obtained from waste coal piles located at Anjean (see attached figures). Excess combustion ash not needed for Woodbrik™ manufacture would be used to remediate acid drainage from the source waste coal piles. WGC is in the process of determining additional waste coal pile sites for obtaining fuel source once the Anjean piles are depleted (currently estimated at 6 to 7 years). Generally, future waste coal pile sites that would be used would be within 20 to 30 miles of the power plant site. Both rail and truck are being considered as transportation options for the waste coal fuel, raw materials (e.g., limestone), and waste removal.

Additional components of the proposed project, as indicated on the enclosed maps, include the construction of power lines, the extension of a steam line to Georgia Pacific Lumber, and construction of reclaimed water supply line from the Rainelle sewage treatment plant. A combination of groundwater and reclaimed wastewater would be used for supplying water to the plant. It is anticipated that the steam and water lines will be constructed along the banks of Sewell Creek.

We are very interested in receiving your comments or other input you have concerning possible effects of the project on archeological, religious, or cultural sites that are considered significant to your tribe. If you have any questions, please do not hesitate to call.

In addition, please sign the signature line below and return a signed copy to my attention if you (or your designated representative) want to continue to receive information about the project, or if you wish to provide review comments on the Section 106 or NEPA documents.

Sincerely,

Mark L. McKoy
NEPA Document Manager
U.S. DOE

Attachments: General Location Map
Topographic Map of Proposed Power Plant Site
Aerial Photograph of Proposed Power Plant Site
Topographic Map of Anjean
Aerial Photograph of Anjean

RESPONSE REQUESTED:

__ Yes, we wish to continue to receive information and participate in the consultation process.

__ No we do not wish to continue to receive information or participate in the consultation process.

By: _____

Title: _____

Date: _____

Appendix B

EASTERN SHAWNEE TRIBE
OF OKLAHOMA

P.O. Box 350 · Seneca, MO 64865 · (918) 666-2435 · FAX (918) 666-2186

August 13, 2004

NETL
ATTN: Mark L. McCoy
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

Re: Western Greenbrier Co-Gen, LLC,
Co-Production Facility
Rainelle, West Virginia

To Whom It May Concern:

Thank you for notice of the referenced project(s). The Eastern Shawnee Tribe of Oklahoma is currently unaware of any documentation directly linking Indian Religious Sites to the proposed construction. In the event any items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during construction, the Eastern Shawnee Tribe request notification and further consultation.

The Eastern Shawnee Tribe has no objection to the proposed construction. However, if any human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction, the construction should stop immediately, and the appropriate persons, including state and tribal NAGPRA representatives contacted.

Sincerely,

Jo Ann Beckham
Administrative Assistant

Charles Enyart, Chief
Eastern Shawnee Tribe of Oklahoma

Appendix B

DELAWARE TRIBE OF INDIANS

220 N.W. VIRGINIA • BARTLESVILLE, OKLAHOMA 74003
TELEPHONE: (918) 336-5272 • FAX: (918) 336-5513

August 05, 2004

U.S. Department of Energy
ATTN: Mark McKoy
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

Re: Executive Memo (4/29/1994): "Gov't to Gov't Relations", and Executive Order 13084: Consultation and Coordination with Indian Tribal Gov't, Section 106 and NAGPRA Consultation for the Environmental Impact Statement (EIS), Western Greenbrier Co-Gen, LLC, Co-Production Facility, Rainelle, West Virginia

Dear, Mr. McKoy:

Our review indicates that this project is located in an area that was not inhabited by the Delaware Tribe. As such, there is little potential for impacting unknown archaeological sites culturally affiliated with the Delaware Tribe and we have no particular objection to the proposal.

If you have any questions, feel free to contact this office by phone at (918) 336-5272.

Sincerely,

Brice Obermeyer Ph.D.
NAGPRA Director
Delaware Tribe of Indians

Appendix B

Delaware Nation NAGPRA Office

P.O. Box 825, Anadarko, OK 73005
Phone: (405) 247-2448
Fax: (405) 247-9898

30 August 2004

ATTN: Mark L. McKoy
NEPA Document Manager
U.S. Department of Energy
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

RE: Environmental Impact Statement (EIS), Western Greenbrier Co-Gen, LLC, Co-Production Facility, Rainelle, West Virginia

Dear Mr. McKoy:

Thank you for contacting the Delaware Nation regarding the above referenced project. The Delaware Nation is committed to protecting archaeological sites that are important to tribal heritage, culture, and religion. Furthermore, the tribe is particularly concerned with archaeological sites that may contain human burial remains and associated funerary objects.

As described in your correspondence, the proposed ground disturbing activity of this project does not appear to endanger archaeological sites of interest to the Delaware Nation. Therefore, the Delaware Nation will defer to your State Archaeologist and your state's Office of Historical Preservation regarding the need for archaeological surveys or further investigation. Should either of these agencies recommend an archaeological survey of the proposed construction site, we ask that the Delaware Nation be informed of the results of the survey, including copies of site forms and reports. Also, any changes to the above referenced project should be resubmitted to the NAGPRA Director of the Delaware Nation for review.

Should this project inadvertently uncover an archaeological site, even after an archaeological survey, we request that you immediately contact he appropriate state agencies, as well as the Delaware nation. Also, we ask that you halt all construction and ground disturbing activities until the tribe and these state agencies are consulted.

We appreciate your cooperation in contacting the Delaware Nation. Should you have any questions, feel free to contact me.

Sincerely,

Tamara Francis
NAGPRA/Cultural Preservation Director

Appendix B

WEST VIRGINIA
DIVISION OF
CULTURE & HISTORY
The Cultural Center
1900 Kanawha Blvd., E.
Charleston, WV
25305-0300
Phone 304.558.0220
Fax 304.558.2779
TDD 304.558.3562
www.wvculture.org
EEO/AA Employer

December 18, 2006

Mr. Roy Spears
NEPA Document Manager
Department of Energy
National Energy Technology Laboratory
PO Box 880
MS NO3
Morgantown, WV 26507

RE: Western Greenbrier County Production Project
FR#: 04-705-GB-4

Dear Mr. Spears:

We have reviewed the *Western Greenbrier Co-Production Demonstration Project Draft Environmental Impact Statement: November 2006* (DEIS) submitted for the above referenced project to determine its effects to cultural resources. As required by Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties," we submit our comments.

Architectural Resources:
In our letter dated December 23, 2005, we stated that the transmission line will have no effect to cultural resources. We are still of that opinion. There are no National Register of Historic Places listed resources in the project area and, according to your report, any resources potentially eligible are far enough away to not be impacted by the project.

The DEIS says that the town of Rainelle would be eligible for the National Register of Historic Places. We concur with that determination. Regarding the Western Greenbrier County Production Plant, in our previous letter we emphasized the importance of securing comment from the public including the Greenbrier County Historical Society. It is our understanding that these comments will be solicited in conjunction with the Draft EIS publication and associated public meetings. In addition, we requested that we be given at least 2-weeks prior notice to these meetings. We will complete our review regarding effects once we have received public comments, including comments from the Greenbrier County Historical Society. We look forward to working further with your office on this project.

Archaeological Resources:
In general, the DEIS accurately summarizes archaeological survey work

conducted to date for the proposed co-production demonstration project. However, the discussion of archaeological survey methodology for co-production plant site failed to mention that, because the steam/pipeline corridor plans had not been finalized, a portion of that corridor was not subjected to archaeological survey. As indicated in our July 5, 2005 letter, this portion of the corridor crosses an area with a high potential to contain archaeological deposits. We await the survey results for this portion of the proposed project area. With respect to the transmission line corridor, we look forward to reviewing the results of archaeological survey conducted on the areas identified as PR 1-2, PR 12-13. PR 83-84, PR 92-95, PR 98-99, PR 112-114, and PR 132-134.

We appreciate the opportunity to be of service. *If you have questions regarding our comments or the Section 106 process, please contact Shirley Stewart Burns, Historian, or Carolyn Kender, Archaeologist, at (304) 558-0240.*

Sincerely,

Randall Reid-Smith
RRS/SSB/CMK

CC: Greenbrier County Historical Society
301 West Washington Street
Lewisburg, WV 24901

Appendix B

United States Department of the Interior

FISH AND WILDLIFE SERVICE

West Virginia Field Office
694 Beverly Pike
Elkins, West Virginia 26241

January 10, 2007

Mr. Roy G. Spears
U.S. Department of Energy
National Energy Technology Laboratory
Post Office Box 880
MS NO3
Morgantown, West Virginia 26507

Re: Draft Environmental Impact Statement for the Western Greenbrier Co-Production Demonstration Project (DOE/EIS-0361), Greenbrier County, West Virginia

Dear Mr. Spears:

The U.S. Fish and Wildlife Service (Service) has reviewed the draft Environmental Impact Statement (DEIS), dated November 2006, regarding the proposed cost-shared funding to Western Greenbrier Co-Generation, LLC, through a cooperative agreement under the Clean Coal Power Initiative to design, construct, and operate a new plant to demonstrate the first commercial application of a new design in the United States that incorporates a novel approach to converting waste ash into cement and integrating power generation with remediation of coal refuse piles. The demonstration project is located in Greenbrier County, West Virginia.

The Service has no comment on the proposed cost-shared funding or the demonstration plant design. The Service appreciates the opportunity to review the DEIS.

If you have any questions regarding this letter, please contact Ms. Christy Johnson-Hughes of my staff, at (304) 636-6586 ex 17, or at the letterhead address.

Sincerely,

Thomas R. Chapman
Field Supervisor

Appendix B

NORTH HOUSE MUSEUM

February 5, 2007

Western Greenbrier Co-Generation Plant
Attn: Brian Neely
P.O. Box 766
Rainelle, West Virginia 25962

Dear Mr. Neely:

On behalf of the Greenbrier Historical Society I would like to inform you that we have no comment concerning the Western Greenbrier Co-Generation Plant. If you have any other questions or concerns please feel free to contact me.

Sincerely,

Tammy

Tammy Shifflett
Executive Director
North House Museum and
Greenbrier Historical Society

Greenbrier Historical Society 301 W. Washington St. Lewisburg, WV 24901
Telephone: (304) 645-3398 Fax: (304) 645-5201

Appendix B



WEST VIRGINIA
DIVISION OF
CULTURE & HISTORY
The Cultural Center
1900 Kanawha Blvd., E.
Charleston, WV
25305-0300
Phone 304.558.0220
Fax 304.558.2779
TDD 304.558.3562
www.wvculture.org
EEO/AA Employer

February 6, 2007

Mr. Roy Spears
U.S. Department of Energy
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507

Re: Phase I Archaeological Survey of the Proposed Transmission Line Corridor for the Western Greenbrier's Co-Production Plant Demo Project (DOE/EIS-0361)
FR#: 04-705-GB 6

Dear Mr. Spears:

We have reviewed the technical report titled, *Phase I Archeological Survey of the Proposed Transmission Line Corridor Wester Greenbriar Co-Production Project Greenbrier & Nicholas Counties, West Virginia*, that was submitted for the above referenced project. As required by Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic and Cultural Properties," we submit our comments.

Architectural Resources:
It is our understanding that there is one bridge within the project area. This bridge, a Steel and Stringer bridge, is not eligible for inclusion in the National Register of Historic Places. This determination is based upon evaluation of the structure according to the Criteria of Significance and current state inventory information. However, we cannot complete our review until we receive further information regarding public comments. Please keep in mind if the project is re-routed due to archaeological site, we will need to again review for architectural resources. We will complete our review upon receipt of public comment information.

Archaeological Resources:
The report satisfactorily addresses our concerns regarding the presence of cultural resources within the proposed transmission line corridor for the Western Greenbrier Co-Production Project. Systematic archaeological survey within the project area located one previously unrecorded archaeological site, 46Ni655 (Hominy Mill), an early twentieth century logging community, In addition, one isolated prehistoric find was found on the ground surface in a disturbed context, and a modern electrical feature was identified. The consultant recommends that neither the isolated prehistoric find nor the electrical feature are eligible for inclusion in the National Register of Historic Places. We concur with these recommendations. No further archaeological investigation is necessary for the transmission line corridor except for the section in which site 46Ni655 is located.

According to project mapping, the proposed transmission line corridor bisects the eastern end of the former Hominy Mill community (46Ni655). Investigation of 46Ni655 identified a number of features within the transmission line corridor including, a stone-lined well shaft, four stone piers, an abandoned narrow gauge railroad bed, and a possible root-cellar or small foundation. Historic artifacts recovered from the site include ceramics, window glass, bottle and container glass, table glass, wire nails, shoe parts, a double-bladed hand-forged axe head, brick, a shotgun shell, and miscellaneous metal fragments.

The presence of cultural features and a diverse array of artifacts indicates the site is likely to provide significant information about the history of Hominy Mill and add to our understanding of the logging industry in West Virginia. As a result, the consultant recommends that 46Ni655 be considered eligible for inclusion in the National Register of Historic Places under Criterion D. We concur with this recommendation. Because the project's proposed ground disturbing activities will have an adverse impact on this resource, the consultant recommends that 46Ni655 be avoided by the proposed construction activities. We concur with this recommendation. If site 46Ni655 will be avoided by rerouting the proposed transmission line, we request that the new alignment undergo a Phase I archaeological survey and that the results of the survey be submitted to this office for review. If avoidance of the site is not possible, then the adverse effect will need to be mitigated via data recovery excavations. If this is the case, please notify the Advisory Council on Historic Preservation about the adverse effect and draft a Memorandum of Agreement and data recovery plan for 46Ni655 for our review.

We appreciate the opportunity to be of service. *If you have questions regarding our comments or the Section 106 process, please contact Shirley Stewart Burns, Historian, or Lora A. Lamarre, Senior Archeologist, at (304) 558-0240.*

Sincerely,

Susan M. Pierce

Susan M. Pierce
Deputy State Historic Preservation Officer

SMP/SSB/LAL/CMK

CC: Mr. J. Sanderson Stevens - John Milner Associates, Inc.

Appendix B

United States Department of the Interior

FISH AND WILDLIFE SERVICE

West Virginia Field Office
694 Beverly Pike
Elkins, West Virginia 26241

June 19, 2007

FILE COPY

Mr. Brian Neely
Western Greenbrier Co-Generation, LLC
Post Office Box 766
Rainelle, West Virginia 25962

Re: Survey for Federally-listed Species within the Vicinity of the Proposed Western Greenbrier Co-Generation Facility, Greenbrier County, West Virginia

Dear Mr. Neely:

The U.S. Fish and Wildlife Service (Service) has reviewed the report titled, "Habitat Assessments and Surveys for Endangered Mammals at Proposed Development Areas for Western Greenbrier Co-Gen, Greenbrier County, West Virginia", dated March 7, 2005, by Environmental Solutions & Innovations, Inc. The report included surveys and habitat assessments for the federally-listed endangered Indiana bat (*Myotis sodalis*), Virginia big-eared bat (*Corynorhinus townsendii virginianus*), and West Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*). These comments are provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U. S. C. 1531 *et seq.*) (ESA).

We reviewed the report on the bat and squirrel surveys conducted in the proposed project area. The bat survey followed the protocol outlined in the Draft Indiana Bat Recovery Plan. The survey covered 28 acres of bat habitat and was conducted at 2 net sites from July 13 to July 16, 2004. No federally-listed bats were captured. Mist net surveys are considered current for 5 years: the summer they are completed and the following two summer seasons. In this case they will expire **May 15, 2008**. If timber will be removed after **May 15, 2008**, new surveys may be necessary and the Service should be contacted.

A habitat assessment was also performed to determine whether potential habitat for the West Virginia northern flying squirrel (WVNFS) was present in the project area. The project area is located below elevations typically used by the WVNFS and consisted of hardwoods which are not preferred habitat. The only potential habitat for the WVNFS was found along portions of the transmission line corridor. Again, the habitat occurred at elevations below those typically used by the WVNFS. Based on the poor to moderate quality of the habitat in the project area, and location of the transmission lines and co-generation facility below elevations typically used by the WVNFS, it is not likely that the WVNFS will be affected by the proposed project.

No Federally-listed threatened and endangered species were found during the survey. Therefore, no further consultation under section 7 of the ESA is required. Should project plans change, or if additional information on listed and proposed species becomes available, this determination may be reconsidered.

If you have any questions regarding this letter, please contact Ms. Christy Johnson-Hughes of my staff, at (304) 636-6586 ex 17, or at the letterhead address.

Sincerely,

Thomas R. Chapman
Field Supervisor

Appendix B

Mr. Brian Neely
June 19, 2007

cc:
USACE – Mullins
EPA – Rider
WVDNR - Taylor
Project File
Reader File
ES:WVFO:CJohnson-Hughes:skd:6/19/2007
Filename: U:\Finalized Correspondence\NEPA\Western Greenbrier Co-Gen Bat Survey - Final.doc

Appendix B

United States Department of the Interior

REPLY REFER TO:

NATIONAL PARK SERVICE
New River Gorge National River
Gauley National Recreation Area
Bluestone National Scenic River
104 Main Street
P.O. Box 246
Glen Jean, West Virginia 25846

January 17, 2007

L7619

Roy Spears, Document Manager
U.S. Department of Energy
National Energy Technology Laboratory
3610 Collins Ferry Road
P. O. Box 880
Morgantown, WV 26507-0880

Dear Mr. Spears,

The National Park Service appreciates the opportunity to review and comment on the Western Greenbrier Co-Production Demonstration Project, Draft Environmental Impact Statement (DOE/EIS-0361). We have several major concerns about the Draft EIS. These include the presentation of alternatives, the inclusion of potential project derivatives that are not analyzed, and the relatively shallow depth of analysis for several key areas of concern as they affect resources and values of concern to the National Park Service. Examples of these concerns are presented below.

Section 2.6 presents alternatives for both Department of Energy (DOE) and the Western Greenbrier Co-Generation LLC (WGC). The alternatives for DOE are to either fund or not fund the project. The alternatives for WGC are not set forth as a set of discrete alternatives, but a list of options for several components of the overall project. Each of these components has an option that is identified as the preferred option (except fuel supply, which notes that all four potential coal refuse piles are acceptable), but there is no summary of the overall proposed action that includes all of the preferred options for each component. Thus there is no real presentation of a single preferred alternative.

The Draft EIS notes a potential third party ash byproduct facility. The potential impacts of such a facility are not analyzed in section 4.16 (Potential Secondary and Cumulative Impacts). Since such a facility would be directly related to the proposed project, it is imperative that it be analyzed.

Water draining from the proposed project area eventually drains into the Meadow River, the lower reaches of which are in Gauley River National Recreation Area (GRNRA). The National Park Service is especially concerned about the paucity of data on water and aquatic biological resources for the proposed project area, the minimal analysis of these data, and the lack of analysis regarding the potential impacts of the proposed project to these resources in GRNRA.

For example, water quality and aquatic biological information presented in the Draft EIS is based on only one sample from each of three or four sites. Such sampling is inadequate to describe the extent and range of water quality and aquatic ecological conditions and dynamics for these streams.

The Draft EIS also notes that the preferred option for primary water supply is treated effluent from the Rainelle Sewage Treatment Plant (RTSP). There is no evaluation of the performance of the RTSP in terms of the number, frequency and magnitude of bypasses during high runoff events, the density of fecal coliform bacteria in effluent, and how such events might affect operation of the proposed project, and whether operation of the proposed project will affect the later discharge of this water into the Meadow River.

The Draft EIS further notes that the preferred option for secondary water supply is the Meadow River. The Draft EIS presents flow data from the Meadow River based only on the three years of record (1979-1982) for a U. S. Geological Survey (USGS) stream gage that is no longer in service (Meadow River at McRoss, 03189890). This information is not substantial enough on which to base water supply availability for the proposed project. Comparison of the McRoss gage data with that of the still active USGS Meadow River near Mount Lookout gage (03190400, period of record September 1966 – September 1983, October 1985 to present) indicates that 1979 was a very high water year. Further, during 24 months since 1985 the average monthly flow at the Mount Lookout gage has been lower than the lowest flow ever recorded at the McRoss gage. The National Park Service is extremely concerned that removal of a significant portion of the flow from the Meadow River during the critical low-flow months may have significant impacts to water quality, aquatic biological resources, and recreational opportunities downstream in Gauley River National Recreation Area.

The Draft EIS seems to indicate that water discharged from the proposed project will be discharged into Sewell Creek, although this is ambiguous. Increased discharge of Sewell Creek has the potential to increase bank and channel erosion and increase silt delivery and sedimentation in the Meadow and Gauley Rivers. Increased sedimentation is well known to have significant negative impacts on stream ecosystems, and the National Park Service is concerned about the potential adverse impacts of such sedimentation on the Meadow and Gauley Rivers within our jurisdiction. Such potential impacts are not analyzed in the Draft EIS.

Another issue of concern to the National Park Service is inadequate citation of information from outside sources. For example, the Draft EIS uses the computer program HEC-RAS for floodplain evaluation, but while the citation for this (Haestad Methods 2003) is provided, it is not provided in a location that associates it with use of the method. These oversights make it difficult for the reader to understand, evaluate, and adequately comment on the Draft EIS.

Appendix B

In summary, it is our opinion that the Draft EIS is inadequate. We request that DOE address the concerns noted above in a revised Draft EIS. Only upon review of a Revised Draft EIS can we accurately evaluate the proposed action, and the potential impacts that it might have on resources and values of concern to the National Park Service. If you have any questions concerning our comments, please contact Jesse Purvis of my staff at (304) 465-6513 or jesse_purvis@nps.gov.

Sincerely,

Calvin F. Hite

Calvin F. Hite
Superintendent

Appendix B

U.S. Department of Energy

National Energy Technology Laboratory

April 5, 2007

Dr. Jesse Purvis
National Park Service
104 Main Street
P.O. Box 246
Glen Jean, West Virginia 25846

Dear Dr. Purvis:

Thank you for the meeting on March 19, 2007, at your Glen Jean office to discuss your concerns regarding the proposed Western Greenbrier Co-Production Demonstration Project Draft Environmental Impact Statement (EIS). The National Park Service (NPS) was represented by Deborah Darden, Ken Stephens, Mike Hunter, and Jesse Purvis, while the Department of Energy was represented by Wolfe Huber and Roy Spears, with Fred Carey and Cynthia Ong of Potomac Hudson Engineers participating via conference call. Primary areas of concern and points of discussion for the meeting included potential impacts to water flow in the Meadow River, water quality and aquatic ecological conditions, air quality, sedimentation loading in the Meadow River due to runoff from the proposed plant site, use of all proposed water sources for the power plant, coal prep plant information, and ash byproduct usage.

It is my understanding that according to Mr. Stephens and you, all areas of concern were satisfactorily addressed during the meeting discussions. The request for a revised Draft EIS is withdrawn and you have no objection to our preparation of the revised Final EIS. Additionally, the NPS's initial request to participate as a cooperating agency for preparation of the EIS is withdrawn. If this letter accurately represents your understanding of our meeting conclusions, please respond in writing so we may include your letter in the administrative record.

Should questions or comments arise, please contact me at the numbers listed below.

Sincerely,

Roy G. Spears
NEPA Document Manager

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507
roy.spears@netl.doe.gov@netl.doe.go • Voice (304) 285-5460 • Fax (304) 285-4403 • www.netl.doe.gov
v

Appendix C
Wetlands Survey Report

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WETLAND DELINEATION REPORT

FOR

PROPOSED COGENERATION PLANT

AT

RAINELLE

GREENBRIER COUNTY, WEST VIRGINIA

Prepared for:

Western Greenbrier Cogeneration, LLC
One John Rainelle Drive
P.O. Box 766
Rainelle, WV 25962

Prepared by:

POTOMAC-HUDSON ENGINEERING, INC.

June 2005

PHE Project No. 14.0001

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APPENDICES

Appendix A Wetland Photographs
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1.0 INTRODUCTION

Potomac-Hudson Engineering, Inc. (PHE) has completed a wetland delineation for a 35-acre site located in and near the City of Rainelle, Greenbrier County, West Virginia (Figure 1) currently under investigation for the siting of a proposed coal co-production facility. The purpose of the wetland delineation was to identify all jurisdictional waters of the United States, including wetlands, located within the site's boundaries and obtain a jurisdictional determination from the U.S. Army Corps of Engineers (USACE) to verify the extent of wetlands in accordance with Section 404 of the Clean Water Act. The studies were conducted on behalf of the U.S. Department of Energy, the project sponsor, and Western Greenbrier Co-Gen, LLC (WGC), the entity which would construct and operate the facility. The information obtained during the wetland delineation and verification of the wetland boundaries will also be utilized by PHE in the Environmental Impact Statement being prepared for the overall project.

Within the overall 35-acre site, the co-production facility, kiln and coal storage area will be located within the 28 acres on the south side of Sewell Creek. This part of the site extends to the east and southeast across a partially leveled ridgeline that is part of Sims Mountain. This 28-acre area is positioned just outside the southwestern boundary of the city limits of Rainelle on the southern side of Sewell Creek (Figure 2). The remaining 7 acres are located on the north side of Sewell Creek, within the city limits of Rainelle, and within the boundaries of a planned industrial park known as the EcoPark. (Development proposed in any other parts of the EcoPark are not part of the proposed project evaluated in this report.) Within the 7 acres on the north side of Sewell Creek, a wood brick facility is proposed. A road crossing over Sewell Creek is proposed to provide access between the facilities on both sides of Sewell Creek.

The part of the site on the north side of Sewell Creek was the former location of the Meadow River Lumber Company that operated from 1906 through 1970 (John Milner Associates, 2005). The entire mill and lumber yards, including two former log ponds, were razed by 1975 and vegetation currently covers the site. Most of the site located on the north side of Sewell Creek is an open field with small areas of trees. The part of the site on the south side of Sewell Creek consists of a disturbed area associated with previous earth moving activities and approximately 15-acres of wooded area, part of which is wetlands and part of which is located on a hillside. An aerial photograph of the site and immediate vicinity is provided in Figure 3. Photographs of the site and the wetland areas are provided in Appendix A of this report.

The limits of the proposed site have expanded from the time of the initial site planning efforts, therefore, the wetland delineation was conducted in stages on April 19-23, September 13-16 and October 18-20, 2004. Other properties, not located in Rainelle, are also part of this overall project, such as the waste coal piles at Anjean, but these properties are not included in the scope of this report since no wetland delineation efforts have occurred at the other locations.

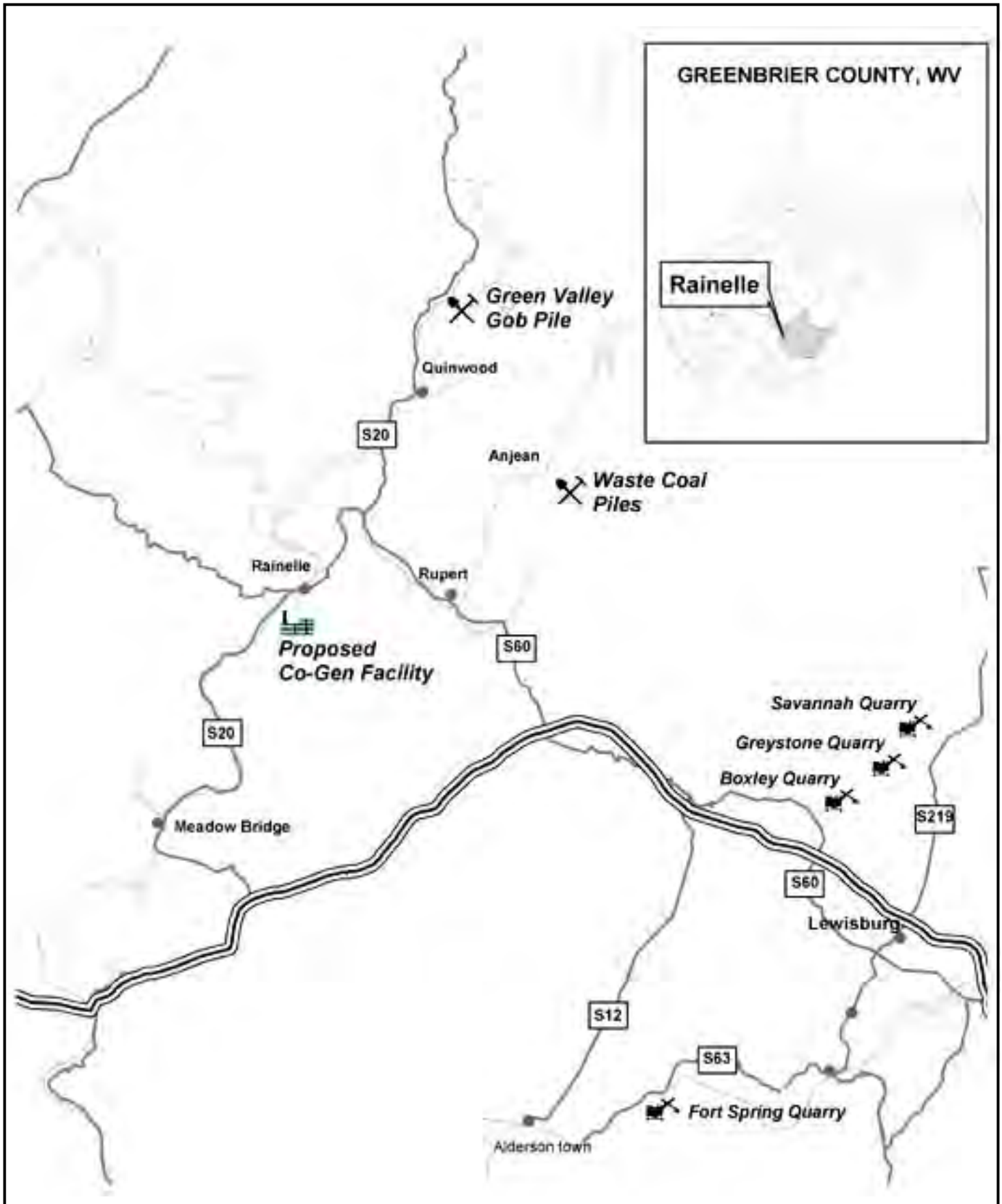


Figure 1.
Project Vicinity

Source: WVDOT, 2004

U.S. Department of Energy

National Energy Technology Lab

APPROXIMATE SCALE

1" = 4 miles

Date: June 6, 2005

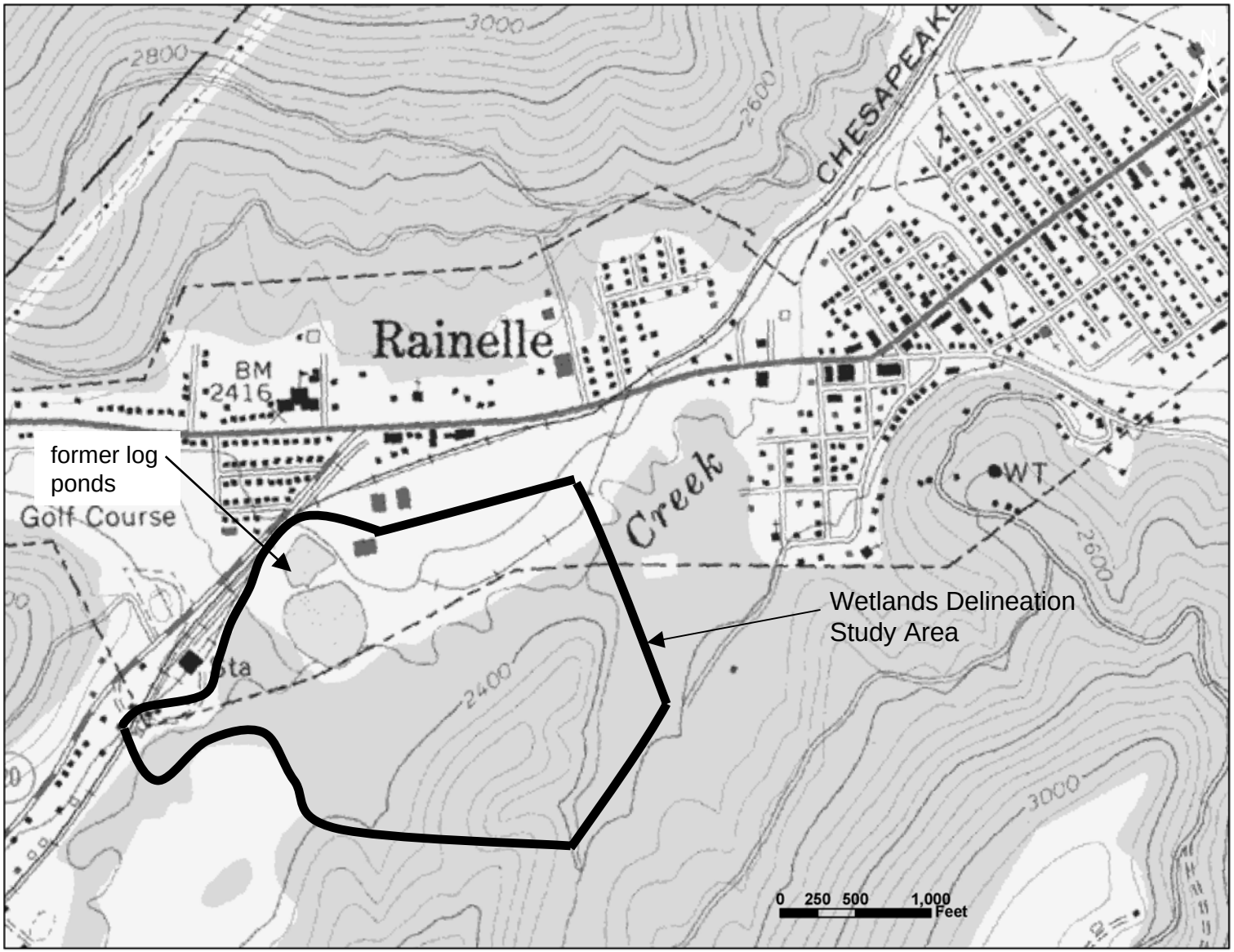


Figure 2.
Wetlands Delineation Study Area Map
Map Source: NE/4 Meadow Creek 15' Quadrangle, USGS, 1976

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APPROXIMATE SCALE
1" = 1,000'

Date: June 6, 2005



Figure 3.
Aerial Photo of Wetlands Delineation Study Area
Map Source: USGS, 1996

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APPROXIMATE SCALE
1" = 1,000'

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2.0 METHODOLOGY

2.1 Regulatory Background

The following is a definition of the term "wetlands" as provided in the *Corps of Engineers Wetlands Delineation Manual* (1987). Wetlands are:

> "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." (EPA, 40 CFR 230.03 and CE, 33 CFR 328.3).

Wetland determinations, using the *Corps of Engineers Wetlands Delineation Manual* (1987), are based on a three parameter approach. Under this methodology, an area must exhibit these three characteristics to be classified as a wetland:

(1) hydrophytic vegetation;
(2) hydric soils; and,
(3) wetland hydrology.

As defined in the *Manual*, hydrophytic vegetation is defined as macrophytic plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content. A list of wetland plants has been prepared to describe a species' affinity for wetland conditions. The appropriate list for West Virginia is the *National List of Plant Species that Occur in Wetlands: Northeast Region* (1988). Hydric soils are soils that are saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions within the major portion of the root zone. The National Technical Committee for Hydric Soils has developed criteria for hydric soil determination in addition to a list of hydric soil types. Wetlands hydrology is the permanent or periodic inundation or soil saturation for a significant period (7 days or more) during the growing season. Many factors influence the hydrology of an area including precipitation, topography, soil permeability and plant cover. The frequency and duration of inundation or soil saturation are the important factors in the determination of the existence of wetland hydrology.

2.2 Field Methodology

The wetland delineation occurred on April 19-23, September 13-16 and October 18-20, 2004. The purpose of the field delineation was to identify and delineate the limits of jurisdictional freshwater wetlands and waters of the U.S. within the limits of the site. The delineation was based upon the accepted methodology as outlined in the *Corps of Engineers Wetlands Delineation Manual (*1987), which uses the three parameter approach, i.e., vegetation, soils and hydrology, as discussed in the previous paragraphs.

The limits of on-site wetlands were determined and physically defined in the field by a series of consecutively numbered flag points. The flags established during the April 2004 investigation are blue, the flags established during the September and October 2004 investigation are pink/black striped flags. All flags marking the limits of the wetlands are single flags, while the flags marking the location of a recorded soil sample are double flags of the same color as those nearby wetland flags. A typical wetland flag was labeled with two letters and consecutive numbers, i.e., WA23 indicates "W" indicating wetland flag; "A" indicating the overall wetland line designation; and "23" to indicate the actual flag number. Soil points were labeled as SP1 through SP14 and their proximity to an individual wetland flag was noted on the Wetland Determination Data Sheets in Appendix B. A survey of those flag points, providing an accurate representation of the wetland limits with respect to the property boundaries, is provided on three maps in the back of this report along with a list of all of the wetland flags and soil points that were established.

2.2.1 Vegetation

Since vegetation serves as an indicator of existing environmental conditions, the methodology of the *Manual* directs the researcher to analyze the existing vegetation. This involves estimation of existing plant species composition by direct observation. Wetlands are usually characterized by the predominance of hydrophytic plant species. Conversely, upland areas would be dominated by more xerophytic species, or plants better adapted to drier soil conditions. A mesic zone, or the transition zone between wetland and upland habitat, is often comprised of a mixture of facultative wetland species, facultative, and facultative upland species.

With respect to vegetation, the *Manual* places great emphasis on the presence of hydrophytic species as indicators of wetland areas should these species be dominant within a plant community; the determination of whether or not a species is dominant is based upon its percentage of cover. Dominance, as defined herein, refers to the spatial extent of a species; commonly the most abundant species in each vegetation stratum that, when ranked in descending order of abundance and cumulatively totaled, exceeds 50 percent of the total dominance measure (i.e., aerial cover or basal area).

The USFWS has assigned a wetland indicator classification to plant species as follows:

Classification	Plant Affinity for Wetland Conditions Percent Occurrence In Wetlands
Obligate Wetland (OBL)	> 99
Facultative Wet (FACW)	67 - 99
Facultative (FAC)	33 - 66
Facultative Upland (FACU)	1 - 33
Obligate Upland (UPL)	< 1

A positive (+) or negative (-) symbol used in conjunction with one of the facultative indicator classes relates to a species preference to either the drier or the wetter end of its indicator class. The positive sign indicates preference to the wetter end of the category and a negative sign is a preference to the drier end. These wetlands indicator classifications were determined for species

found at the site and used in conjunction with their percentage of cover to determine whether a prevalence of wetland species were dominant in any of the vegetation communities occurring on-site.

2.2.2 Soils

During the field survey of the property, a hand auger was used by PHE personnel to bore soil samples to accurately document the extent of hydric soil conditions. The number of samples examined took into consideration the size and variability of the site, including the changes in the overall topography of the site. Soil samples were taken to a depth of approximately 24 inches and were examined for color, texture, and moisture content. Soils were then field checked to determine the Munsell Soil Color Chart designations. Hydric soils were identified by color in relation to the Munsell Chart and/or other field indicators. The Munsell designation indicates the soil color as removed from an auger or shovel hole. In general, soils are considered hydric if the chroma of the soil sample, at the top of the "B" horizon, is less than or equal to one, or less than or equal to two when mottling is present.

Although numerous soil samples were examined by PHE personnel during the delineation efforts, only some of these samples were recorded. The information regarding the soils, vegetation and hydrology at that particular sampling point is presented on the Wetland Determination Data Sheets provided in Appendix B of this report.

2.2.3 Hydrology

Wetland hydrology is often the least exact and most difficult parameter to establish in the field, due largely to the normal fluctuations in the relative abundance of water. Numerous factors influence the wetness of an area including: precipitation, topography, plant cover, and soil characteristics. Documenting the existence of wetlands hydrology on a site involves the detection of field indicators which provide direct or indirect evidence of inundation or soil saturation for seven days or longer during the growing season. Although these indicators are quickly assessed in the field, professional judgment must be used to decide whether these indicators demonstrate that the wetland hydrology criterion has been satisfied. Drift lines, water marks, sediment deposits, root staining, scour areas, buttressed trees and drainage patterns are some of the indicators which commonly identify wetland hydrology.

3.0 EXISTING CONDITIONS

3.1 Vegetation

The site consists of the following vegetative communities:

- Open field areas, with areas of trees and shrubs, located on the north side of Sewell Creek;

- Forested areas, both upland and wetland, present as small patches of woods along the north side of Sewell Creek and as larger, contiguous wooded areas on the south side of Sewell Creek; and
- Disturbed areas with only small amounts of vegetation located on the south side of Sewell Creek.

The open fields on the north side of Sewell Creek were the site of the former lumber mill and yard as identified during the archeological investigation (John Milner Associates, 2005) conducted for this project. Subsequent to the demolition of the lumber company's facilities in 1975, the field became vegetated. Also, as shown on the topographic map provided in Figure 2, two ponds were present in this area when the map was photorevised in 1976. These ponds are no longer present, but an isolated wetland identified by Flags WD1 through WD17 (Photo 11) was delineated within part of the former southern pond. This wetland is located in a topographically low area and is dominated by cattails. Another wetland dominated by cattails on the northern side of Sewell Creek is present near the western edge of the site (see Flags WA322 – WA333) on the enclosed maps.

Currently, the upland areas within the open fields on the north side of Sewell Creek consist of areas dominated by herbaceous species, including various grasses, wingstem, goldenrod, Indian hemp and milkweed. Some parts of these fields are mowed occasionally, while other areas are not and shrubs and young trees have become established. The species observed in the upland shrubby areas include sumac, black cherry, multiflora rose, and blackberry in addition to the herbaceous species listed above. In other parts of the field, such as near the eastern edge of the area delineated along Sewell Creek (Flags WA16-WA56, Photo 1) and in the western part of the site near the CSX Railroad yard (Flags WA253-WA295), there are small, wooded areas. Part of each of these wooded areas is upland and the remainder is wetland. The dominant species observed in the upland section of the eastern wooded area included American beech, ironwood, hawthorne, black cherry, jack-in-the-pulpit, mayapple and blackberry. The wetland area in this location was vegetated with swamp dogwood, willows, sedges, sensitive fern and some skunk cabbage. The wooded area near the CSX Railroad yard is vegetated with black cherry, flowering dogwood, black willow, mayapple, sensitive fern and skunk cabbage. Along the banks of Wolfpen Creek (WA227-WA240, Photo 7) near this wooded area, young specimens of these trees as well as poison ivy, goldenrod, blackberry and evening primrose were observed.

In addition to the above described features, three ditches are also present in the fields on the north side of Sewell Creek (Flags WA72-WA89, Photo 3, WA112-WA128 and Flags WB1-WB41). Another ditch is present on the north side of Sewell Creek, but it is located adjacent to the railroad tracks and flows to Wolfpen Creek (Flags WA197-WA225, Photos 8 & 9). These ditches are primarily vegetated with cattails, sedges, and soft rush. Some dogwood, arrowwood and multiflora rose shrubs are present along the banks in some areas of these ditches.

On the south side of Sewell Creek, wooded areas are present on most of the hillside shown as Sims Mountain on Figure 2 and in parts of the adjacent lower elevation areas. Most of the wooded area adjacent to the north side of the hillside is a wetland with several old channels leading to Sewell Creek (Photos 22, 23 & 24). The dominant species observed in the wooded wetland were red maple, pin oak, spice bush, swamp dogwood, cinnamon fern, jewelweed,

sensitive fern, and skunk cabbage. The wooded upland areas were dominated by red maple, American beech, red oak, hawthorne, ironwood, Christmas fern, witch hazel and Virginia creeper. Heading east along the base of the hillside, the site changes to a disturbed area associated with previous earth moving activities. Additionally, part of the hillside has been removed. The disturbed areas are dominated by barren areas as well as areas vegetated with wingstem, grasses, sedges, soft rush, goldenrod and areas dominated by shrubs and young trees including sumac, black cherry and black locust. On the eastern side of the hill, there is an unnamed tributary (Photos 14, 15, 18-20) that flows to Sewell Creek. This tributary runs through part of the disturbed area, but also through wooded areas of similar vegetation types as mentioned above. Within the disturbed area, the tributary's banks are vegetated with sedges and soft rush and some shrubs including elderberry and arrowwood. These two shrubs are also common in parts of the wetland boundary along the edge of Sewell Creek within the site.

A detailed list of vegetation observed on the site is provided in Table 1. The data sheets for the soil points recorded on the site also provide information on the vegetation present at those particular locations (Appendix B). Photographs of the site are provided in Appendix A.

Table 1: Vegetation Observed During the Field Investigations of the Wetland Delineation Site

TREES	
Red maple	*Acer rubrum*
Striped maple	*Acer pennsylvanicum*
Norway maple	*Acer platanoides*
Sweet birch	*Betula lenta*
Paper Birch	*Betula papyrifera*
Ironwood	*Carpinus caroliniana*
Shagbark hickory	*Carya ovata*
Mockernut hickory	*Carya tomentosa*
Flowering dogwood	*Cornus florida*
Hawthorn	*Crataegus sp.*
American beech	*Fagus grandifolia*
Green ash	*Fraxinus pennsylvanica*
Red cedar	*Juniperus virginiana*
Tulip tree	*Liriodendron tulipifera*
Apple	*Malus sp.*
Hop-hornbeam	*Ostrya virginiana*
Quaking aspen	*Populus tremuloides*
Black cherry	*Prunus serotina*
Pin cherry	*Prunus pensylvanicum*
Pear	*Pyrus sp.*
White oak	*Quercus alba*
Red oak	*Quercus rubra*
Pin oak	*Quercus palustris*
Swamp white oak	*Quercus bicolor*
Scarlet oak	*Quercus coccinea*
Black locust	*Robinia pseudoacacia*
Black willow	*Salix nigra*
Sassafras	*Sassafras albidum*
American linden	*Tilia americana*
SHRUBS	
Smooth Alder	*Alnus cf. serrulata*
Common barberry	*Berberis cf. vulgaris*
Swamp Dogwood	*Cornus amomum*
Autumn Elaeagnus	*Elaeagnus umbellata*
Witch hazel	*Hamamelis virginiana*
Spicebush	*Lindera benzoin*
Bush Honeysuckle	*Lonicera sp.*
Staghorn sumac	*Rhus typhina*
Raspberry	*Rubus spp.*
Multiflora rose	*Rosa multiflora*
Pussy Willow	*Salix discolor*

Table 1: Vegetation Observed During the Field Investigations (continued)

Elderberry	*Sambucus canadensis*
Maple-leaf viburnum	*Viburnum acerifolium*
Withe-rod	*Viburnum cassinoides*
Arrowwood	*Viburnum dentatum*
Grape	*Vitis sp.*
HERBACEOUS SPECIES	
Yarrow	*Achillea millefolium*
Wingstem	*Actinomeris alterniflora*
Ragweed	*Ambrosia artemisiifolia*
Wood anemone	*Anemone quinquefolia*
Jack in the pulpit	*Arisaema atrorubens*
Common mugwort	*Artemisia vulgaris*
Asters	*Aster spp.*
Beggar ticks	*Bidens cf. frondosa*
False nettle	*Boehmeria cylindrica*
Sedge	*Carex crinita*
Sedge	*Carex intumescens*
Blue-cohosh	*Caulophyllum thalictroides*
Oxeye Daisy	*Chrysanthemum leucanthemum*
Spring beauty	*Claytonia cf. caroliniana*
Virgin's bower	*Clematis virginiana*
Umbrella sedge	*Cyperus strigosus*
Orchard grass	*Dactylis glomerata*
Jimson Weed	*Datura stramonium*
Queen Anne's Lace	*Daucus carota*
Deertongue Grass	*Dichanthelium clandestinum*
Field Horsetail	*Equisetum arvense*
Trout Lily	*Erythronium umbilicatum*
Gill-over-the-Ground	*Glechoma hederacea*
Bluets	*Hedyotis caerulea*
Jewelweed	*Impatiens capensis*
False Rue Anemone	*Isopyrum biternatum*
Soft Rush	*Juncus effusus*
Everlasting pea	*Lathyrus latifolius*
Lily	*Lilium sp.*
Japanese honeysuckle	*Lonicera japonica*
Evening primrose	*Oenothera biennis*
Sensitive Fern	*Onoclea sensibilis*
Cinnamon Fern	*Osmunda cinnamomea*
Fall panicum	*Panicum dichotomiflorum*
Virginia creeper	*Partenocissus quinquefolia*
Pokeweed	*Phytolacca americana*
English plantain	*Plantago lanceolata*

Table 1: Vegetation Observed During the Field Investigations (continued)

May Apple	*Podophyllum peltatum*
Japanese knotweed	*Polygonum cuspidatum*
Pennsylvania smartweed	*Polygonum pensylvanicum*
Christmas Fern	*Polystichum acrostichoides*
Curly dock	*Rumex crispus*
Woolgrass sedge	*Scirpus cyperinus*
Golden Ragwort	*Senecio aureus*
Star Flowered Solomon's Seal	*Smilacena stellata*
Bristly Greenbrier	*Smilax hispida*
Roundleaf Greenbrier	*Smilax rotundifolia*
Goldenrod	*Solidago spp.*
Skunk Cabbage	*Symplocarpus foetidus*
Dandelion	*Taraxacum officinale*
Poison ivy	*Toxicodendron radicans*
Red clover	*Trifolium pratense*
Nodding Trillium	*Trillium cernum*
Purple trillium	*Trillium erectum*
Common Cattail	*Typha latifolia*
Common mullein	*Verbascum thapsus*
Violet	*Viola sp.*
Common Blue Violet	*Viola papilonacea*
Wooly Blue Violet	*Viola sororia*
Cocklebur	*Xanthium chinense*

Source: Potomac-Hudson Engineering, Inc., January 2005.

3.2 Soils

Soils within Greenbrier County, as is typical in most areas, in part reflect the lithology of the underlying rock formations and the respective physiographic provinces. Western Greenbrier County, which includes the project site, is part of the Appalachian Plateau and contains generally deep, easily eroded soils that formed in material weathered from shale. As described in the Phase I Archeological Report (John Milner Associates, 2005) produced for this project, there are three major soil associations are found within the vicinity of the site. These are:

- Atkins-Teas-Monogahela association along Sewell Creek and other lowlands in the area;
- Teas-Calvin-Gilpin-Litz association in the upland ridges east of Sewell Creek and south of U.S. Route 60; and
- Dekalb-Gilpin-Laidig-Cookport association in the upland areas west of State Route 20 and south of U.S. Route 60.

These general soil associations are further broken-down into more specific individual soil map units, as depicted in the *Soil Survey of Greenbrier County, West Virginia* (1972). According to the *Soil Survey*, there are four soil map units present on the site as indicated in Figure 4. The soil map units in order of abundance on the site are:

- Atkins silt loam (At);
- Calvin and Gilpin very stony soils, 25 to 40 percent slopes (CgE);
- Monongahela silt loam, 2 to 8 percent slopes (MgB); and
- Pope fine sandy loam (Po).

The Atkins silt loam soil type is classified as a hydric soil (i.e., that soil typically found in wetlands) based on information obtained from the U.S. Department of Agriculture, Natural Resources Conservation Service (12/27/04). The following paragraphs are descriptions of the soil types found on site as excerpted from the *Soil Survey of Greenbrier County* (1972).

Atkins silt loam (At) – The Atkins series consists of deep, poorly drained, nearly level soils. These soils are on bottom lands, generally near the base of the hills, but in certain places they occupy the entire bottom. They are commonly along streams that drain the upland areas. These soils formed in alluvium derived from upland soils that are underlain by acid sandstone and shale. They are subject to flooding, as slopes typically range from 0 to 3 percent. Included in mapping with this soil type were small areas of very poorly drained soils and small areas of soils that have a surface layer of fine sandy loam. Also included were small, slightly more sloping areas on hillsides.

In a typical profile, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil extends to a depth of about 36 inches. The upper part is gray heavy silt loam, and the lower part is gray light silty clay loam. Strong-brown mottling begins at a depth of about 8 inches. Below the subsoil is gray silty clay loam that contains thin lenses of sandy and silty material. This layer extends to a depth of 50 inches or more.

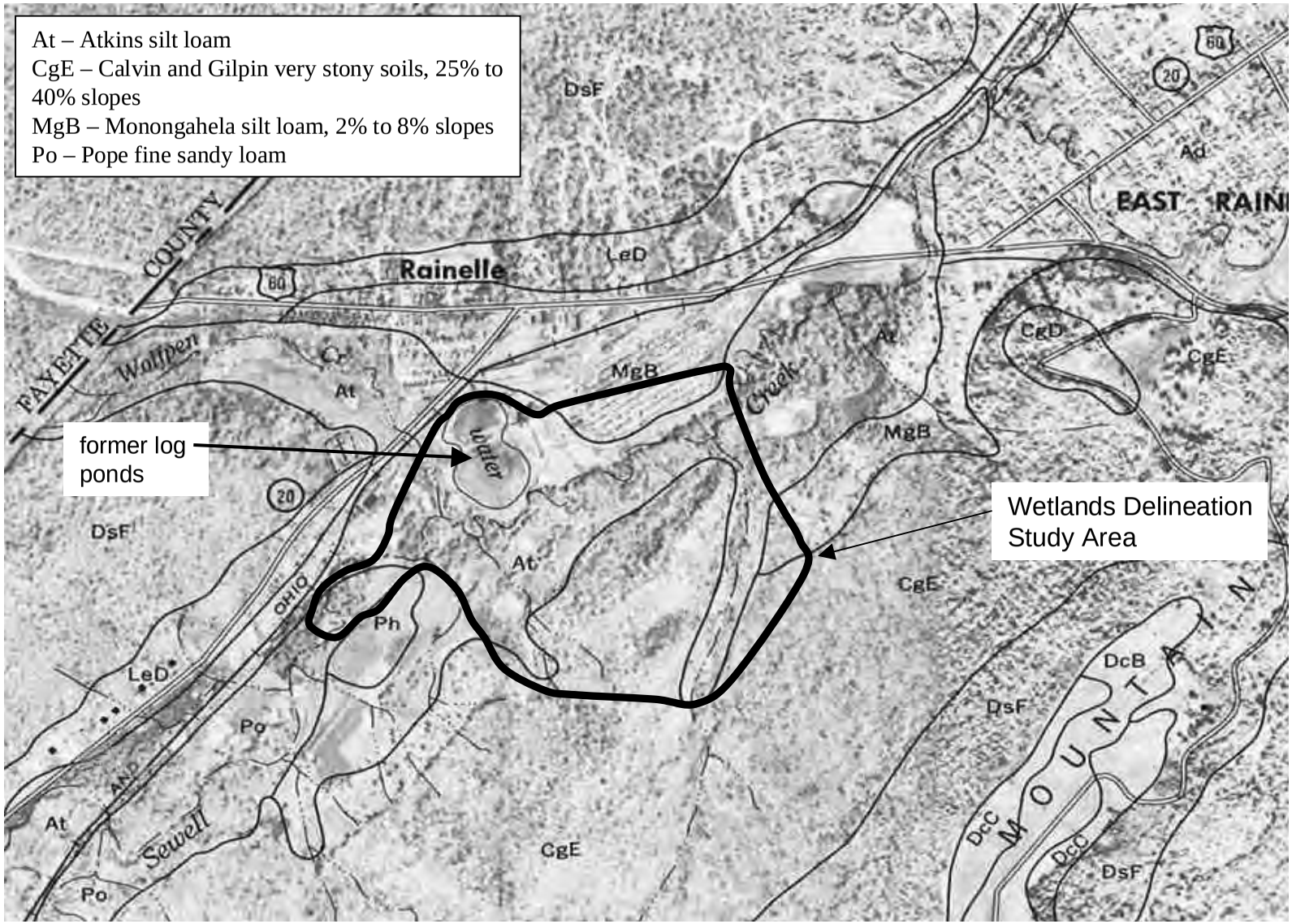


Figure 4.
Soil Survey of Greenbrier County, West Virginia
Source: USDA SCS, 1972

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SCALE
(Not to Scale)

Date: June 6, 2005

Permeability is moderately slow to slow, the available moisture capacity is moderate, and fertility is low to moderate. The water table is high.

The use of these soils for most purposes is severely to very severely limited by the high water table and the hazard of flooding. Surface drainage is generally poor. The subsoil drains moderately well into tile and into open ditches if the permanent water table is not too high. If adequately drained, this soil is suitable for crops, such as hay or pasture crops mixed with water-tolerant grasses or legumes.

Calvin and Gilpin very stony soils, 25 to 40 percent slopes – Any given area of this undifferentiated group may consist of one or the other of these soils, or, more commonly, of both. Also included in the mapping areas of this soil type are small areas of Dekalb and Litz soils and small, severely eroded areas.

The Calvin series consists of moderately deep, well-drained, reddish-brown stony soils. These soils are on dissected uplands common in the west-central part of the county. They formed in material weathered from reddish, acidic siltstone and shale.

The Gilpin series, which is commonly found with the Calvin series, consists of moderately deep, well-drained, strongly sloping to very steep soils. These soils are also on dissected uplands in the western portion of the county and formed in residuum weathered from gray acid siltstone and shale and some interbedded sandstone.

In a typical profile of the Calvin series in a wooded area, a thin mat of dark-colored organic matter covers the surface. The surface layer, below this mat, is dark-reddish brown silt loam in the uppermost 2 inches and reddish-brown silt loam in the next 5 inches. The subsoil extends to a depth of about 23 inches. The upper part is dark reddish-brown heavy silt loam, and the lower part is dark reddish-brown very channery silt loam. Siltstone fragments make up 60 to 70 percent of the lower part. Red siltstone bedrock begins at a depth of 23 inches.

In a typical profile of the Gilpin series in a wooded area, a thin mat of organic matter covers the surface. The surface layer, below this mat, is very dark grayish-brown silt loam in the uppermost 2 inches and brown silt loam in the next 6 inches. The subsoil extends to a depth of 22 inches. The upper part is yellowish-brown, friable, shaly silty clay loam, and the lower part is yellowish-brown, shaly heavy silt loam. Shale fragments are common in the subsoil and increase in volume with increasing depth. Below the subsoil is yellowish-brown very shaly silt loam that is about 75 percent shale fragments. Gray shale bedrock begins at a depth of 28 inches.

Both the Calvin and Gilpin series have moderate permeability. The available moisture capacity and fertility of both series are low to moderate. Generally, these soils are better suited to trees than to other uses. They are difficult to manage because of the large stones.

Monongahela silt loam, 2 to 8 percent slopes (MgB) – The Monongahela series consists of deep, moderately well drained, gently sloping to strongly sloping, silty soils. These soils formed in old alluvium washed from uplands that are underlain principally by acid sandstone and shale.

In a typical profile, the surface layer is dark grayish-brown and pale-brown silt loam about 10 inches thick. The subsoil extends to a depth of 57 inches. The upper part is light olive-brown, firm silty clay loam. The middle part is yellowish-brown, firm heavy silt loam. The lower part if yellowish brown, very firm and compact silt loam that is mottled with light gray and yellowish red. The very firm layer begins at a depth of about 27 inches. Below the subsoil is light yellowish-brown, yellowish-red, and gray, firm light silty clay loam that contains some sandstone fragments. This layer extends to a depth of 65 inches or more.

Permeability is moderate above the fragipan, but slow within it. The available moisture capacity is moderate. The water table is high in winter and spring and seepy spots are common. The use of these soils is limited mainly be the seasonal high water table and the slowly permeable fragipan. The usefulness of these soils for building sites is also limited by the high water table.

Pope fine sandy loam (Po) – The Pope series consist of deep, well-drained, moderately coarse textured soils. These soils are on bottom lands, generally near streambanks. They formed in recent alluvium washed from upland areas underlain by gray, acid sandstone and shale. These soils are flooded at intervals ranging from once a year to once in 3 or 4 years; the length varies by location.

In a typical profile of the series, the surface layer is dark grayish-brown fine sandy loam about 10 inches thick. The subsoil extends to a depth of 40 inches. The upper part is dark yellowish-brown, friable fine sandy loam, and the lower part is dark yellowish-brown, very friable sandy loam. Below the subsoil is loose, stratified silty, sandy, and gravelly material to a depth of 60 inches or more.

Permeability is moderately rapid and the available moisture capacity is moderate to moderately low. The use of these soils is limited by flooding and by their tendency to be droughty. It has been identified that the streambanks may need stabilization in some areas of the Po map unit.

During the wetland delineation, soil information was recorded at 14 different locations within the 35-acre site. These soil points are marked on site by double flags of the same color of the wetland flagging used in that area. The information recorded at each of these locations is provided on the Wetland Determination Data Sheets in Appendix B. Observations of the soils encountered at these data points include that the soils recorded within wetlands consisted primarily of gray to black soils, some with mottling. All of the wetland soils recorded were primarily clay, although the amount of clay varied with location, i.e., some of the samples were entirely clay, others were clay loam or silty clay loam soils. Although many of the upland data points that were recorded consisted of clay soils, many of the upland soils observed throughout the site were primarily sandy loam soils of varying colors. Gravel and pebbles were also observed in some of the upland areas.

3.3 Hydrology

Sewell Creek is the primary waterway within the site. Sewell Creek runs roughly in a southwest to northeast direction through the limits of the site and continues a meandering course until its

confluence with the Meadow River, located approximately one mile to the northeast of the site. The Meadow River flows to the Gauley River which then flows to the New River. At the confluence of the Gauley River and New River, the Gauley River watershed drains into the head of the Great Kanawha River, and consequently, is captured by the Kanawha-New River Basin. The Kanawha-New River Basin comprises most of the southern half of West Virginia and parts of Virginia and North Carolina. Within the vicinity of the site, Wolfpen Creek and Little Sewell Creek are the primary tributaries to Sewell Creek. Wolfpen Creek has its confluence with Sewell Creek in the northwestern part of the site and the confluence of Little Sewell Creek with Sewell Creek is located about one half mile northeast of the site.

The jurisdictional waters and wetlands delineated for this project were Sewell Creek, Wolfpen Creek, unnamed tributaries to Sewell Creek, and low lying areas located adjacent to both the north and south side of Sewell Creek. Indicators of wetland hydrology in the areas delineated included: defined channels, standing water, saturated soils, and/or mottling as observed in the soil profiles (see Data Sheets in Appendix B).

4.0 RESULTS

Most of the wetland flags established by PHE within the site are associated with delineating the boundaries of Sewell Creek (Photos 4, 5, 6, 10, 12 & 21). Other areas delineated on the north side of Sewell Creek include, beginning on the western edge of the site and heading east:

(1) a small, emergent wetland area vegetated primarily with cattails located adjacent to Sewell Creek (Flags WA322-WA333; 0.052 acres);
(2) a short ditch adjacent to the dirt roadway within the CSX Railroad property (Flags WA308-WA318, Photo 13; 0.016 acres);
(3) a section of wooded wetland near the CSX Railroad property and west of Wolfpen Creek (Flags WA253-WA295; 0.479 acres);
(4) Wolfpen Creek from the railroad crossing south to its confluence with Sewell Creek (Flags WA184-WA197 & WA 225-WA240, Photo 7; 0.440 acres);
(5) a ditch that runs parallel to the railroad tracks and enters Wolfpen Creek near the railroad crossing (Flags WA197-WA225, Photos 8 & 9; 0.109 acres);
(6) a two part ditch, connected via a culvert, within the open field part of the site (Flags WB1-WB41; 0.204 acres);
(7) an isolated, emergent wetland vegetated with cattails and sedges located within the open field part of the site (Flags WD1-WD17, Photo 11; 0.232 acres);
(8) topographically low areas adjacent to a ditch within the open field and adjacent to Sewell Creek (Flags WA112-WA143; 2.362 acres);
(9) a ditch beginning within the open field that widens into a back channel area as it approaches Sewell Creek (Flags WA69-WA100, Photos 2 & 3; 0.389 acres); and
(10) a narrow wetland that exists within a portion of the wooded area and the adjacent open field (Flags WA16-WA56, Photo 1; 0.709 acres).

The areas delineated on the south side of Sewell Creek, include many back channels that are separated from Sewell Creek by small upland areas (Photos 22, 23, & 24). Some of these back channels are also separated from a larger wetland system that is located adjacent to the bottom of

the hillside on the southern edge of the site. This larger, wetland system is a wooded area where standing water was observed in some locations and a small, unnamed tributary (Flags WE33-WE49 & WF1-WF24) provides runoff from the adjacent hillside. Most of these features occur in the western half of the site on the south side of Sewell Creek.

Most of the eastern half of the site on the south side of Sewell Creek has been disturbed from previous earth moving activities. In the eastern half of this part of the site, Sewell Creek was the primary feature delineated. However, an unnamed tributary is located near the eastern edge of the site that has several smaller tributaries of its own. Photos 14 through 20 provide different views of this tributary and its smaller tributaries. As shown in the photos, some of the areas along this feature are primarily open water, while other areas are wooded wetlands or narrow drainage features without defined channels through wooded wetlands.

The wetland boundaries presented on the maps provided in the back of this report (Figures 5 through 8) represent only those wetlands observed within the limits of the site. Many of the features delineated by PHE continue beyond the limits of the site, such as Sewell Creek, Wolfpen Creek, the unnamed tributary on the southern side of Sewell Creek and several of the wetland boundaries delineated on the south side of Sewell Creek. The following table provides a list of all wetland boundaries established within the site during the April, September and October 2004 site visits.

The information provided in Table 2 corresponds to the accompanying Wetlands Delineation Maps, Figures 5 through 8, prepared by Potomac-Hudson Engineering, Inc. The wetland flags/stakes established by PHE were located by Marathon Technical Services Inc. using a GPS (Global Positioning System) unit to obtain sub-meter accuracy. The GPS data was then incorporated into an AutoCAD drawing provided by Potesta Associates, Inc. depicting the topographic features, roadways, buildings, etc. to produce Figures 5 through 8.
See Appendix A of this report for the Wetlands Delineation Maps. Due to the size of the site and the need to see the individual wetlands points clearly, the maps have been divided into three figures (Figures 6 through 8), while an overall view of the wetlands delineation is provided in Figure 5, located in the back of this report:

- Figure 5. Wetlands Delineation – Overview: depicts an overall view of the project site and the wetlands delineation at a scale of 1” = 120’ (Sheet 1 of 4).
- Figure 6. Wetlands Delineation – West Area: depicts the western section of the wetlands survey area at a scale of 1” = 60’.
- Figure 7: Wetlands Delineation – Middle Area: depicts the middle section of the wetlands survey area at a scale of 1” = 60’.
- Figure 8: Wetlands Delineation – East Area: depicts the eastern section of the wetlands survey area at a scale of 1” = 60’.

Table 2: Wetland Flag Information

Flag/Stake Numbers	Water/Wetland Type & Location	Notes
WA1 - WA337	Delineates northern edge of Sewell Creek, a tributary in a wooded area, three ditches & eastern edge of Wolfpen Creek	WA1-WA308 (blue) WA309-WA337 (pink/black) Photos 1-9 & 12, 13, 21
WB1 – WB41- WB1	Delineates a ditch in field on northern side of Sewell Creek. Connected to WA line via a culvert.	all blue flags
WC1 – WC69, WC69a – WC69e, WC70-WC118	Begins at edge of disturbed area on south side of Sewell Creek, delineates tributary, southern edge of Sewell Creek & western edge of a tributary on the eastern edge of the site.	all blue flags Photos 10 & 18
WD1 – WD17 - WD1	Isolated, emergent wetland located within field on north side of Sewell Creek	Isolated wetland; all blue flags Photo 11
WE1 - WE49	Southern edge of wooded wetland at base of hill on south side of Sewell Creek & a tributary	all pink/black flags
WF1 – WF69 WF69a-WF87 WF87a, WF87b WF88 – WF130	Begins at top of tributary within site boundaries across from WE49, continues through wooded area, delineates a tributary, then part of southern edge of Sewell Creek, then back into the woods. Ends at tree line on western edge of site.	all pink/black flags Photo 24
WG1 - WG48 –WG1	Delineates a tributary and part of the southern edge of Sewell Creek, delineating an upland pocket	all pink/black flags
WH1 – WH46 - WH1	Delineates two tributaries in wooded area & part of southern edge of Sewell Creek to create an upland pocket	all pink/black flags
WJ1 – WJ31	Begins on edge of tree line on western edge of site on south side of Sewell Creek.	all pink/black flags Photo 23
WK1 – WK8	Begins & ends on edge of tree line on western edge of site on south side of Sewell Creek	all pink/black flags Photos 22 & 23
WL1 – WL14	Begins & ends along western edge of site on south side of Sewell Creek	all pink/black flags Photo 22
WO1 – WO35 – WO1	Delineates tributaries and part of southern side of Sewell Creek near western edge of site. Isolates an upland pocket	all pink/black flags

Table 2: Wetland Flag Information (continued)

WP1 – WP12, WP12a, WP13 – WP45 – WP1	Delineates south side of Sewell Creek and tributaries in wooded area; delineates isolated upland pocket	all pink/black flags
WR1 – WR42 – WR1	Delineates oxbow of Sewell Creek in center of site	all pink/black flags
WV1 – WV38 – WV1	Delineates an isolated, upland pocket within wooded area at base of hill on south side of Sewell Creek	all pink/black flags
WX1 – WX32	Delineates tributary on eastern edge of site on south side of Sewell Creek	all pink/black flags Photos 18 & 19
WY1 – WY92	Delineates western side of tributary located on eastern edge of site on south side of Sewell Creek	all pink/black flags Photos 14-17 & 20
WZ1 – WZ55	Delineates eastern side of tributary located on eastern edge of site on south side of Sewell Creek	all pink/black flags Photos 14, 15 & 20

NOTES:

- The following flags are missing from the map and may or may not have been marked in the field: WA270, WA274, WY26. Their absence from the map does not have a significant impact on the wetland boundaries represented.
- The flags established to mark the wetland boundaries were typically tied to vegetation. However, in instances where no sturdy vegetation was present, the wetland flags were tied to wooden stakes instead.

Source: Potomac-Hudson Engineering, Inc., January 2005.

During the field investigation in April 2004, PHE requested that a representative from the USACE visit the site to conduct a preliminary review of the wetlands delineated by PHE that week. Ms. Sarah Workman from the USACE viewed some of the wetland boundaries and agreed with the delineation of the areas observed. Ms. Workman also identified one wetland delineated by PHE (Flags WD1- WD17) as an isolated wetland feature. Isolated features are those not connected to a surface water tributary system and based on a Supreme Court decision in 2001, are no longer subject to Section 404 (see Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers [SWANCC]). The boundaries of this feature remain on the maps accompanying this report so that the USACE office may review the site in its entirety and make a determination as to whether the wetland delineated by Flags WD1-WD17 will be considered a jurisdictional feature or not due to its proximity to other wetlands. Also, the location of this isolated wetland may be pertinent if the guidelines for regulating wetlands change in the future prior to the completion of the proposed project.

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APPENDIX A

WETLAND PHOTOGRAPHS



Photo 2: From near Flag WA-70, looking north.



Photo 1: From near Flag WA-34, looking east.



Photo 3: From near Flag WA-72, looking north at ditch.



Photo 4: Looking downstream (east) at Sewell Creek from near Flag WA-164.



Photo 5: Looking downstream (southwest) at Sewell Creek at Flag WA-179.

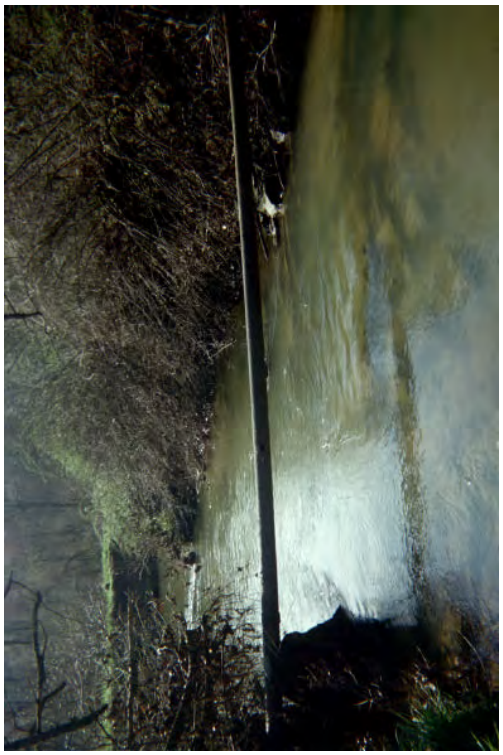


Photo 6: Looking downstream (southeast) at Sewell Creek from near Flag WA-182.



Photo 7: Looking upstream (northwest) at Wolfpen Creek from its confluence with Sewell Creek, near Flag WA-184.



Photo 8: Looking downstream (southwest) at ditch parallel to railroad tracks, from near Flag WA-211.



Photo 9: Looking upstream (northeast) at Flags WA-210, 211 & 212 in ditch parallel to railroad tracks.



Photo 10: Looking upstream (northwest) at Flags WC-69 & WC-70 along Sewell Creek.



Photo 11: Looking west from near Flag WD17 toward Flag WD14.



Photo 12: Looking upstream (southeast) from near Flag A307.



Photo 13: Looking downstream (southwest) at ditch delineated by Flags A308 through A318.



Photo 14: Looking north along tributary near Flag WZ18.



Photo 15: Looking south along tributary near Flag WZ18.



Photo 16: Looking east at channel in wetland near Flag WY52.



Photo 18: Looking south at tributary from near Flag WX31.



Photo 17: Looking south from near Flag WY91 toward Flag WY92.



Photo 19: Looking downstream (north) at unnamed tributary at Flags WC117 (blue on left side) and WX1 (pink & black on right side.)



Photo 20: Looking upstream (south) at unnamed tributary from near Flag WZ2.





Photo 23: Looking northeast at Flags WJ31 and WK1 at edge of field on south side of Sewell Creek.

Photo 21: Looking north at Sewell Creek near Flag WA 322.



Photo 22: Looking northeast at Flag WK8, near edge of field on south side of Sewell Creek.



Photo 25: View of overall site on north side of Sewell Creek, looking southeast.



Photo 24: Typical view of wetland delineated by WF Flags.



Photo 26: View of site, looking northwest from hillside on south side of Sewell Creek.

APPENDIX B

WETLAND DETERMINATION DATA SHEETS

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA/CROSSAN Date: 4/20/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP1 near
Municipality: RAINELLE Block: Lots: Flag A142

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

	Species	Indicator Status		Species	Indicator Status
Trees			Herbs		
1.	Salix nigra	FACW+	11.	Typha latifolia	OBL
2.			12.	Panicum clandestinum	FAC+
3.			13.	Scirpus cyperinus	FACW+
4.			14.	Viola sororia	FAC
5.			15.		
Saplings/Shrubs			Woody Vines		
6.	Rosa multiflora	FACU	16.		
7.	Cornus amomum	FACW	17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 85%
Is the hydrophytic vegetation criterion met? Yes X No
Comments: Greater than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Pope fine sandy loam
Subgroup On hydric soils list NO

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-13"	10YR 2/1			clay loam
13-14"	10YR 5/3	10YR 5/6	10%	sandy clay loam
14-15"	2.5Y 3/1			loam
15-24"	10YR 4/2	7.5YR 4/6	10%	clay loam

Other hydric soil indicators:
Is the hydric soil criterion met? Yes X No
Comments: Soil is of low chroma values with mottling

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes No X Depth to saturated soil:
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes X No
Comments:

Wetland X Non Wetland

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA/CROSSAN Date: 4/21/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP2 near
Municipality: RAINELLE Block: Lots: Flag WC60

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

	Species	Indicator Status		Species	Indicator Status
Trees			Herbs		
1.	Prunus serotina	FACU	11.	Podophyllum peltatum	FACU
2.			12.	Senecio aureus	FACW
3.			13.	Erythronium umbilicatum	FAC
4.			14.		
5.			15.		
Saplings/Shrubs			Woody Vines		
6.	Lindera benzoin	FACW-	16.	Vitis sp	ID
7.	Cornus amomum	FACW	17.		
8.	Rosa multiflora	FACU	18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 50%
Is the hydrophytic vegetation criterion met? Yes No X
Comments: At least 50% of dominant species are FAC or wetter

Series/phase as mapped by SCS Atkins silt loam
Subgroup On hydric soils list YES

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-7"	10YR 3/1			clay loam
7-24"	10YR 3/4			clay loam

Other hydric soil indicators:
Is the hydric soil criterion met? Yes No X
Comments: Soil is of high chroma values

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes No X Depth to saturated soil:
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes No X
Comments:

Wetland Non Wetland X

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA/CAREY Date: 4/22/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP 3 near
Municipality: RAINELLE Block: Lots: FLAG WA 257

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Carpinus caroliniana	FAC	11. Symplocarpus foetidus	OBL
2.		12. Typha latifolia	OBL
3.		13. Erythronium umbilicatum	FAC
4.		14. Senecio aureus	FACW
5.		15. Viola papilionacea	FAC
		Smilacina stellata	FACW
Saplings/Shrubs		**Woody Vines**	
6. Cornus amomum	FACW	16.	
7. Rosa multiflora	FACU	17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 90%
Is the hydrophytic vegetation criterion met? Yes X No
Comments: Greater than 50% of the dominant species are FAC or greater

Series/phase as mapped by SCS Pope fine sandy loam
Subgroup On hydric soils list NO

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-10"	2.5Y 3/1	7.5YR 4/4	5%	clay loam
10-20"	2.5 4/2	7.5 YR 4/4	15%	clay loam
20-24"	2.5Y 5/3	7.5YR 4/4 AND 2.5YR 4/1	20% 15%	clay

Other hydric soil indicators:
Is the hydric soil criterion met? Yes X No
Comments: Soil is of low chroma values with mottling

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes X No Depth to saturated soil: 3-4"
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes X No
Comments:

Wetland X Non Wetland

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA/CAREY Date: 4/22/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP 4 near
Municipality: RAINELLE Block: Lots: Flag WA 257

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Quercus rubra	FACU-	11. Erythronium umbilicatum	FAC
2.		12.	
3.		13.	
4.		14.	
5.		15.	
Saplings/Shrubs		**Woody Vines**	
6. Prunus serotina	FACU	16. Toxicodendron radicans	FAC
7. Rosa multiflora	FACU	17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 40%
Is the hydrophytic vegetation criterion met? Yes No X
Comments: Less than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Pope fine sandy loam
Subgroup On hydric soils list NO

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-4"	10YR 3/2			loam
4-12"	10YR 4/4 (mixed w 10YR 3/1)			clay loam
12-24"	10YR 5/6			clay

Other hydric soil indicators:
Is the hydric soil criterion met? Yes No X
Comments: Soil is of high chroma values

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes No X Depth to saturated soil:
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes No X
Comments:

Wetland Non Wetland X

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA Date: 4/22/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP5 near
Municipality: RAINELLE Block: Lots: WD17

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1.		11. Typha latifolia	OBL
2.		12.	
3.		13.	
4.		14.	
5.		15.	
Saplings/Shrubs		Woody Vines	
6. Salix nigra	FACW+	16.	
7.		17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 100%
Is the hydrophytic vegetation criterion met? Yes X No
Comments: Greater than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Pope fine sandy loam
Subgroup On hydric soils list NO

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-13"	2.5Y 2.5/1	10YR 5/6	10%	clay loam
13-24"	2.5Y 5/1	10YR 5/6	20%	clay loam

Other hydric soil indicators:
Is the hydric soil criterion met? Yes X No
Comments: Soil is of low Chroma values with mottling

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes X No Depth to saturated soil: 2"
Depth to free-standing water in soil probe hole: 4"
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes X No
Comments:

Wetland X Non Wetland

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA Date: 4/22/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP6 near flag
Municipality: RAINELLE Block: Lots: WD1

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1.		11. Senecio aureus	FACW
2.		12. Equisetum arvense	FAC
3.		13.	
4.		14.	
5.		15.	
Saplings/Shrubs		Woody Vines	
6. Rhus typhina	NL	16.	
7. Salix nigra	FACW+	17.	
8. Rosa multiflora	FACU	18.	
9. Prunus serotina	FACU	19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 50%
Is the hydrophytic vegetation criterion met? Yes No X
Comments: At least 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Pope fine sandy loam
Subgroup On hydric soils list NO

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-3"	2.5Y 3/1			clay loam
3-7"	2.5Y 3/1	10YR 4/4	25%	clay loam
7-24"	10YR 4/4			clay

Other hydric soil indicators:
Is the hydric soil criterion met? Yes No X
Comments: Soil is of high chroma values

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes No X Depth to saturated soil:
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes No X
Comments:

Wetland Non Wetland X

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA | RUA Date: 9/13/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP7 near
Municipality: RAINELLE Block: Lots: Flag WE8

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

	Species	Indicator Status		Species	Indicator Status
Trees			Herbs		
1.	Acer rubrum	FAC	11.	Osmunda cinnamomea	FACW
2.			12.	Carex crinita	OBL
3.			13.	Boehmeria cylindrica	FACW+
4.			14.		
5.			15.		
Saplings/Shrubs			Woody Vines		
6.	Lindera benzoin	FACW-	16.		
7.	Cornus amomum	FACW	17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 100%
Is the hydrophytic vegetation criterion met? Yes X No
Comments: Greater than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Atkins silt loam
Subgroup On hydric soils list YES

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-3"	7.5YR 4/1	10YR 5/1 + 10YR 5/6	20/10	silty clay loam
3-13"	10YR 5/1	7.5YR 4/1 + 10YR 5/8	15/10	silty clay loam
13-24+	10YR 6/1	10YR 5/8	25	clay loam

Other hydric soil indicators:
Is the hydric soil criterion met? Yes X No
Comments: Soil is of low chroma values with mottling

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes X No Depth to saturated soil: 2"
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.
matted leaves, evidence of ponding
Is the wetland hydrology criterion met? Yes No
Comments:

Wetland X Non Wetland

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA | RUA Date: 9/13/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP8 near
Municipality: RAINELLE Block: Lots: Flag WE8

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes No X

	Species	Indicator Status		Species	Indicator Status
Trees			Herbs		
1.	Acer rubrum	FAC	11.	Polystichum acrostichoides	FACU-
2.	Ostrya virginiana	FACU-	12.	Parthenocissus quinquefolia	FACU
3.			13.		
4.			14.		
5.			15.		
Saplings/Shrubs			Woody Vines		
6.	Crataegus sp.	ID	16.		
7.	Fagus grandifolia	FACU	17.		
8.	Hamamelis virginiana	FAC-	18.		
9.	Carpinus caroliniana	FAC	19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 25%
Is the hydrophytic vegetation criterion met? Yes No X
Comments: Less than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Calvin and Gilpin very stony soils, 25-40% slopes
Subgroup On hydric soils list NO

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-6"	10YR 3/3			sandy loam
6-11"	10YR 3/2			sandy loam
11-24"	10YR 4/3			sandy loam

Other hydric soil indicators:
Is the hydric soil criterion met? Yes No X
Comments: Soil is of high chroma values

Is the ground surface inundated? Yes No X Surface water depth:
Is the soil saturated? Yes No X Depth to saturated soil:
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.
Is the wetland hydrology criterion met? Yes No X
Comments:

Wetland Non Wetland X

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA | RVA Date: 9/13/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP9 near
Municipality: RAINELLE Block: Lots: Flag WY-37

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Quercus palustris	FACW	11. Carex crinita	OBL
2.		12. Impatiens capensis	FACW
3.		13. Symplocarpus foetidus	OBL
4.		14. Onoclea sensibilis	FACW
5.		15.	
Saplings/Shrubs		**Woody Vines**	
6. Viburnum dentatum	FAC	16. Toxicodendron radicans	FAC
7. Betula lenta	FACU	17.	
8. Fraxinus pennsylvanica	FACW	18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 88%
Is the hydrophytic vegetation criterion met? Yes X No
Comments: Greater than 50% of the dominant species are FAC or wetter.

Series/phase as mapped by SCS Atkins silt loam
Subgroup On hydric soils list YES

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-9"	10YR 4/1	7.5YR 4/6	10%	clay loam
9-	10YR 4/2	7.5YR 4/6	15%	clay

Auger slides straight down into hole - soil very wet
No recovery in auger

Other hydric soil indicators:
Is the hydric soil criterion met? Yes X No
Comments: Soil is of low chroma values with mottling

Is the ground surface inundated? Yes ___ No X Surface water depth: ___
Is the soil saturated? Yes X No ___ Depth to saturated soil: surface
Depth to free-standing water in soil probe hole: 2"
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes X No
Comments:

Wetland X Non Wetland ___

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA | RVA Date: 9/13/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP10 near
Municipality: RAINELLE Block: Lots: Flag W.Y-37

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Acer rubrum	FAC	11. Polystichum acrostichoides	FACU-
2. Acer platanoides	NL	12. –	
3. Fagus grandifolia	FACU	13.	
4. Quercus alba	FACU	14.	
5.		15.	
Saplings/Shrubs		**Woody Vines**	
6. Hamamelis virginiana	FAC-	16.	
7.		17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 16%
Is the hydrophytic vegetation criterion met? Yes ___ No X
Comments: Less than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Calvin + Gilpin very stony soils, 25-40% slopes
Subgroup On hydric soils list NO

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-9"	5YR 3/2			loam
9-16"	5YR 3/4			loam w/pebbles
16-"	2.5YR 5/4			gravelly loam w/pebbles

Other hydric soil indicators:
Is the hydric soil criterion met? Yes ___ No X
Comments: Soil is of high chroma values

Is the ground surface inundated? Yes ___ No X Surface water depth: ___
Is the soil saturated? Yes ___ No X Depth to saturated soil: ___
Depth to free-standing water in soil probe hole: ___
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes ___ No ___
Comments:

Wetland ___ Non Wetland X

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: MAKOFKA/RUA Date: 9/15/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP11 near
Municipality: RAINELLE Block: Lots: Flags WH9 and WF94

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Quercus palustris	FACW	11. Impatiens capensis	FACW
2. Cornus Florida	FACU-	12. Carex crinita	OBL
3.		13. Symplocarpus foetidus	OBL
4.		14. Sphagnum spp	NL
5.		15.	
Saplings/Shrubs		**Woody Vines**	
6.		16.	
7.		17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 66%
Is the hydrophytic vegetation criterion met? Yes X No
Comments: Greater than 50% of the dominant species are FAC or wetter.

Series/phase as mapped by SCS Atkins silt loam
Subgroup On hydric soils list YES

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-7"	10YR 3/2			clay loam
7-24"	10YR 3/2	10YR 4/6	50%	clay loam

Other hydric soil indicators:
Is the hydric soil criterion met? Yes ___ No ___
Comments: Soil is of low chroma values with mottling.

Is the ground surface inundated? Yes ___ No X Surface water depth: ___
Is the soil saturated? Yes ___ No X Depth to saturated soil: ___
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes X No ___
Comments:

Wetland X Non Wetland ___

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: RUA/MAKOFKA Date: 9/15/04
Project/Site: WGC State: WV County: GREENBRIER
Applicant/Owner: Sample Point #: SP12 near
Municipality: RAINELLE Block: Lots: Flag WF94

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Fagus grandifolia	FACU	11. Solidago sp	ID
2. Quercus rubra	FACU-	12.	
3. Carya ovata	FACU-	13.	
4.		14.	
5.		15.	
Saplings/Shrubs		**Woody Vines**	
6. Crataegus sp.	ID	16. Smilax rotundifolia	FAC
7. Berberis cf. vulgaris	FACU	17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 14%
Is the hydrophytic vegetation criterion met? Yes ___ No X
Comments: Less than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Atkins silt loam
Subgroup On hydric soils list YES

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-5"	10YR 3/4			loam
5-9"	10YR 3/6			loam
9-24"	7.5YR 4/6			loam

Other hydric soil indicators:
Is the hydric soil criterion met? Yes ___ No X
Comments: Soil is of high chroma values

Is the ground surface inundated? Yes ___ No X Surface water depth: ___
Is the soil saturated? Yes ___ No X Depth to saturated soil: ___
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes ___ No X
Comments:

Wetland ___ Non Wetland X

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: RUA/McMillan Date: 10/19/04
Project/Site: WGC State: WV County: Greenbrier
Applicant/Owner: Sample Point #: SP13 near
Municipality: RAINELLE Block: Lots: Flag WF126

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Crataegus sp.	ID	11. Polystichum acrostichoides	FACU-
2. Acer rubrum	FAC	12. Vibia papilenacea	FAC
3. Fagus grandifolia	FACU	13.	
4. Acer platanoides	NL	14.	
5.		15.	
Saplings/Shrubs		**Woody Vines**	
6. Viburnum dentatum	FAC	16.	
7. Viburnum acerifolium	NL	17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 37%
Is the hydrophytic vegetation criterion met? Yes ___ No X
Comments: Less than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Atkins silt loam
Subgroup On hydric soils list YES

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-6"	10YR 4/3			clay loam
6-10"	10YR 4/3	10YR 3/2	5%	clay loam
10-13"	5YR 4/4	10YR 5/6	5%	clay loam
13-15+	5YR 4/4	10YR 5/6	5%	sandy clay loam

auger refusal at 15" due to rock

Other hydric soil indicators:
Is the hydric soil criterion met? Yes ___ No X
Comments: Soil is of high chroma values

Is the ground surface inundated? Yes ___ No X Surface water depth: ___
Is the soil saturated? Yes ___ No X Depth to saturated soil: ___
Depth to free-standing water in soil probe hole:
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes ___ No X
Comments:

Wetland ___ Non Wetland X

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Field Investigators: RUA/McMillan Date: 10/19/04
Project/Site: WGC State: WV County: Greenbrier
Applicant/Owner: Sample Point #: SP14 near
Municipality: RAINELLE Block: Lots: Flags WF126

Do normal environmental conditions exist at the plant community?
Yes X No
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No X

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Carpinus caroliniana	FAC	11. Polystichum acrostichoides	FACU-
2. Quercus palustris	FACW	12. Symplocarpus foetidus	OBL
3.		13.	
4.		14.	
5.		15.	
Saplings/Shrubs		**Woody Vines**	
6. Hamamelis virginiana	FAC-	16. Smilax rotundifolia	FAC
7. Viburnum dentatum	FAC	17.	
8.		18.	
9.		19.	
10.		20.	

Percent of dominant species that are OBL, FACW, and/or FAC 71%
Is the hydrophytic vegetation criterion met? Yes X No ___
Comments: Greater than 50% of the dominant species are FAC or wetter

Series/phase as mapped by SCS Atkins silt loam
Subgroup On hydric soils list YES

DEPTH	MATRIX COLOR	MOTTLE COLOR	MOTTLING%	TEXTURE
0-3"	10YR 4/1			clay loam
3-8"	10YR 5/1	10YR 5/8 + 10YR 6/1	10/5%	cldy loam
8-24"	10YR 5/1	10YR 5/8	25%	clay

Other hydric soil indicators:
Is the hydric soil criterion met? Yes X No ___
Comments: Soil is of low chroma values with mottling

Is the ground surface inundated? Yes ___ No X Surface water depth: ___
Is the soil saturated? Yes X No ___ Depth to saturated soil: Surface
Depth to free-standing water in soil probe hole: 1"
List other field evidence of surface inundation or soil saturation.

Is the wetland hydrology criterion met? Yes X No ___
Comments:

Wetland X Non Wetland ___

LIST OF DATA SHEET LOCATIONS (Soil Points)

Soil Point Number	Location	Wetland or Upland Point
Soil Point 1	Near Wetland Flag WA142	Wetland
Soil Point 2	Near Wetland Flag WC60	Upland
Soil Point 3	Near Wetland Flag W257	Wetland
Soil Point 4	Near Wetland Flag W257	Upland
Soil Point 5	Near Wetland Flag WD17	Wetland
Soil Point 6	Near Wetland Flag W1	Upland
Soil Point 7	Near Wetland Flag WE8	Wetland
Soil Point 8	Near Wetland Flag WE8	Upland
Soil Point 9	Near Wetland Flag WY37	Wetland
Soil Point 10	Near Wetland Flag WY37	Upland
Soil Point 11	Near Wetland Flag WH9/WF94	Wetland
Soil Point 12	Near Wetland Flag WF94	Upland
Soil Point 13	Near Wetland Flag W126	Upland
Soil Point 14	Near Wetland Flag W126	Wetland

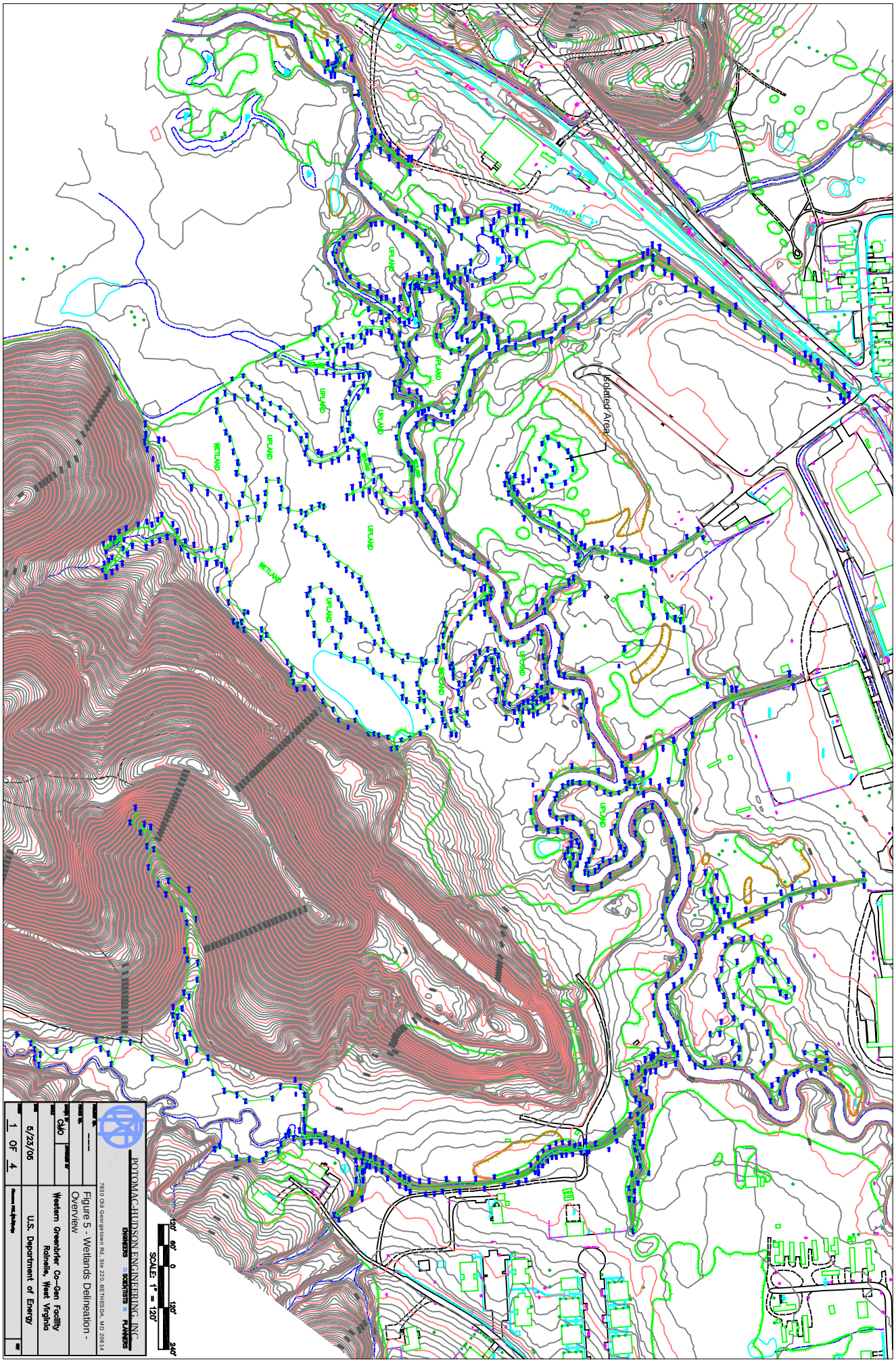
Wetland Flag Information

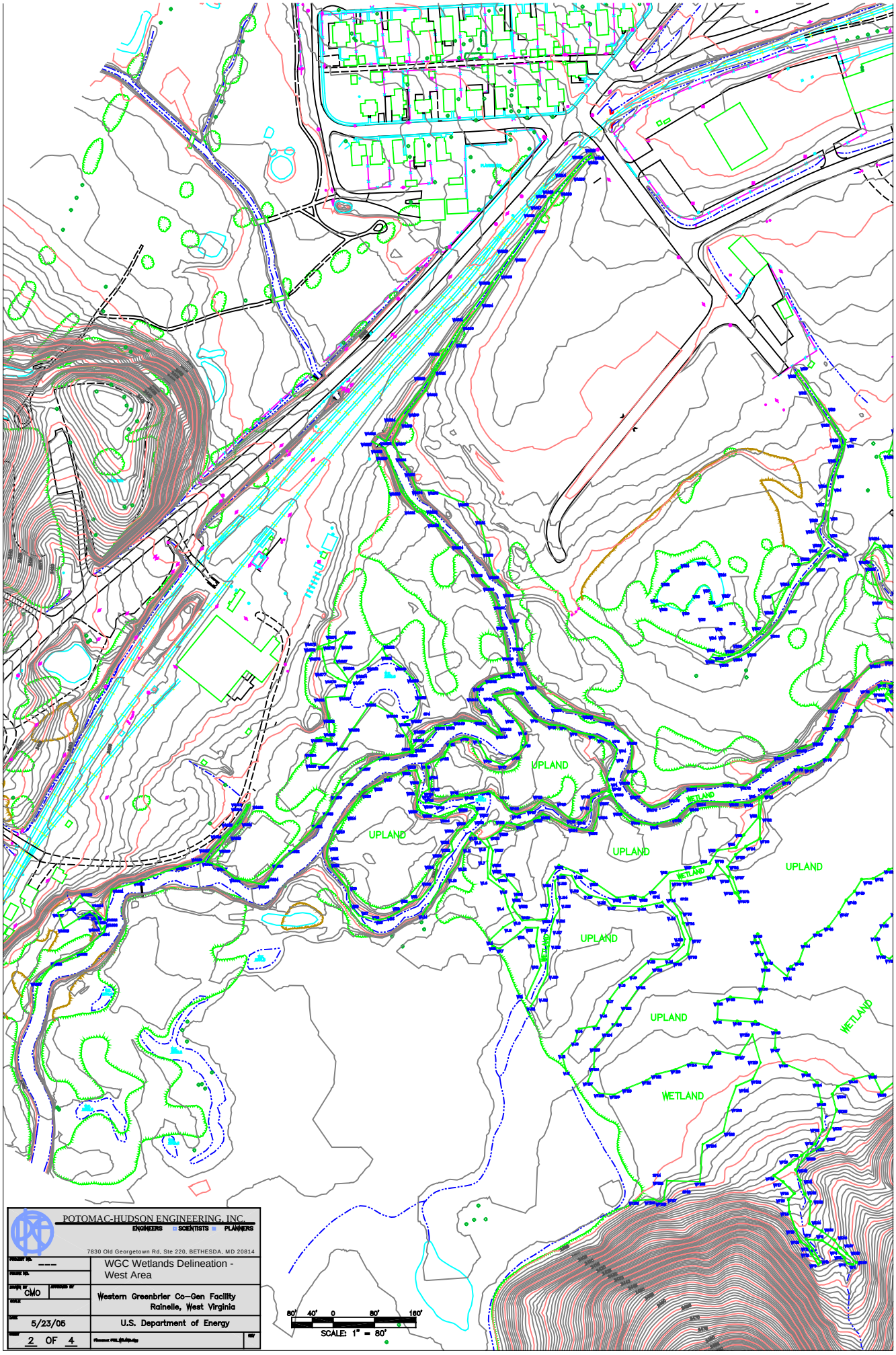
Flag/Stake Numbers	Water/Wetland Type & Location	Notes
WA1 - WA337	Delineates northern edge of Sewell Creek, a tributary in a wooded area, three ditches & eastern edge of Wolfpen Creek	WA1-WA308 (blue) WA309-WA337 (pink/black) Photos 1-9 & 12, 13, 21
WB1 – WB41- WB1	Delineates a ditch in field on northern side of Sewell Creek. Connected to WA line via a culvert.	all blue flags
WC1 – WC69, WC69a – WC69e, WC70-WC118	Begins at edge of disturbed area on south side of Sewell Creek, delineates tributary, southern edge of Sewell Creek & western edge of a tributary on the eastern edge of the site.	all blue flags Photos 10 & 18
WD1 – WD17 - WD1	Isolated, emergent wetland located within field on north side of Sewell Creek	Isolated wetland; all blue flags Photo 11
WE1 - WE49	Southern edge of wooded wetland at base of hill on south side of Sewell Creek & a tributary	all pink/black flags
WF1 – WF69 WF69a-WF87 WF87a, WF87b WF88 – WF130	Begins at top of tributary within site boundaries across from WE49, continues through wooded area, delineates a tributary, then part of southern edge of Sewell Creek, then back into the woods. Ends at tree line on western edge of site.	all pink/black flags Photo 24
WG1 - WG48 –WG1	Delineates a tributary and part of the southern edge of Sewell Creek, delineating an upland pocket	all pink/black flags
WH1 – WH46 - WH1	Delineates two tributaries in wooded area & part of southern edge of Sewell Creek to create an upland pocket	all pink/black flags
WJ1 – WJ31	Begins on edge of tree line on western edge of site on south side of Sewell Creek.	all pink/black flags Photo 23
WK1 – WK8	Begins & ends on edge of tree line on western edge of site on south side of Sewell Creek	all pink/black flags Photos 22 & 23
WL1 – WL14	Begins & ends along western edge of site on south side of Sewell Creek	all pink/black flags Photo 22
WO1 – WO35 – WO1	Delineates tributaries and part of southern side of Sewell Creek near western edge of	all pink/black flags

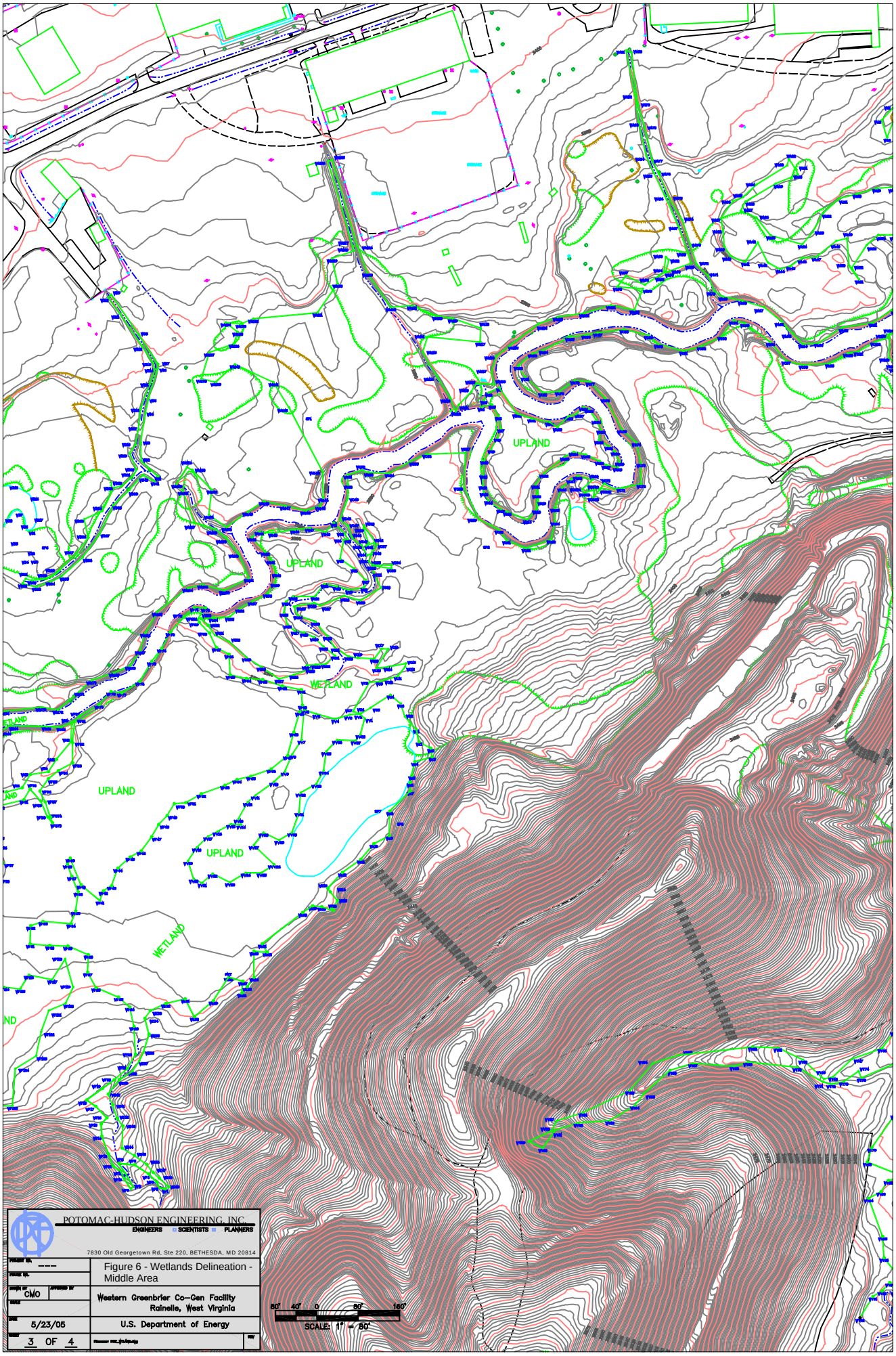
	site. Isolates an upland pocket	
WP1 – WP12, WP12a, WP13 – WP45 – WP1	Delineates south side of Sewell Creek and tributaries in wooded area; delineates isolated upland pocket	all pink/black flags
WR1 – WR42 – WR1	Delineates oxbow of Sewell Creek in center of site	all pink/black flags
WV1 – WV38 – WV1	Delineates an isolated, upland pocket within wooded area at base of hill on south side of Sewell Creek	all pink/black flags
WX1 – WX32	Delineates tributary on eastern edge of site on south side of Sewell Creek	all pink/black flags Photos 18 & 19
WY1 – WY92	Delineates western side of tributary located on eastern edge of site on south side of Sewell Creek	all pink/black flags Photos 14-17 & 20
WZ1 – WZ55	Delineates eastern side of tributary located on eastern edge of site on south side of Sewell Creek	all pink/black flags Photos 14, 15 & 20

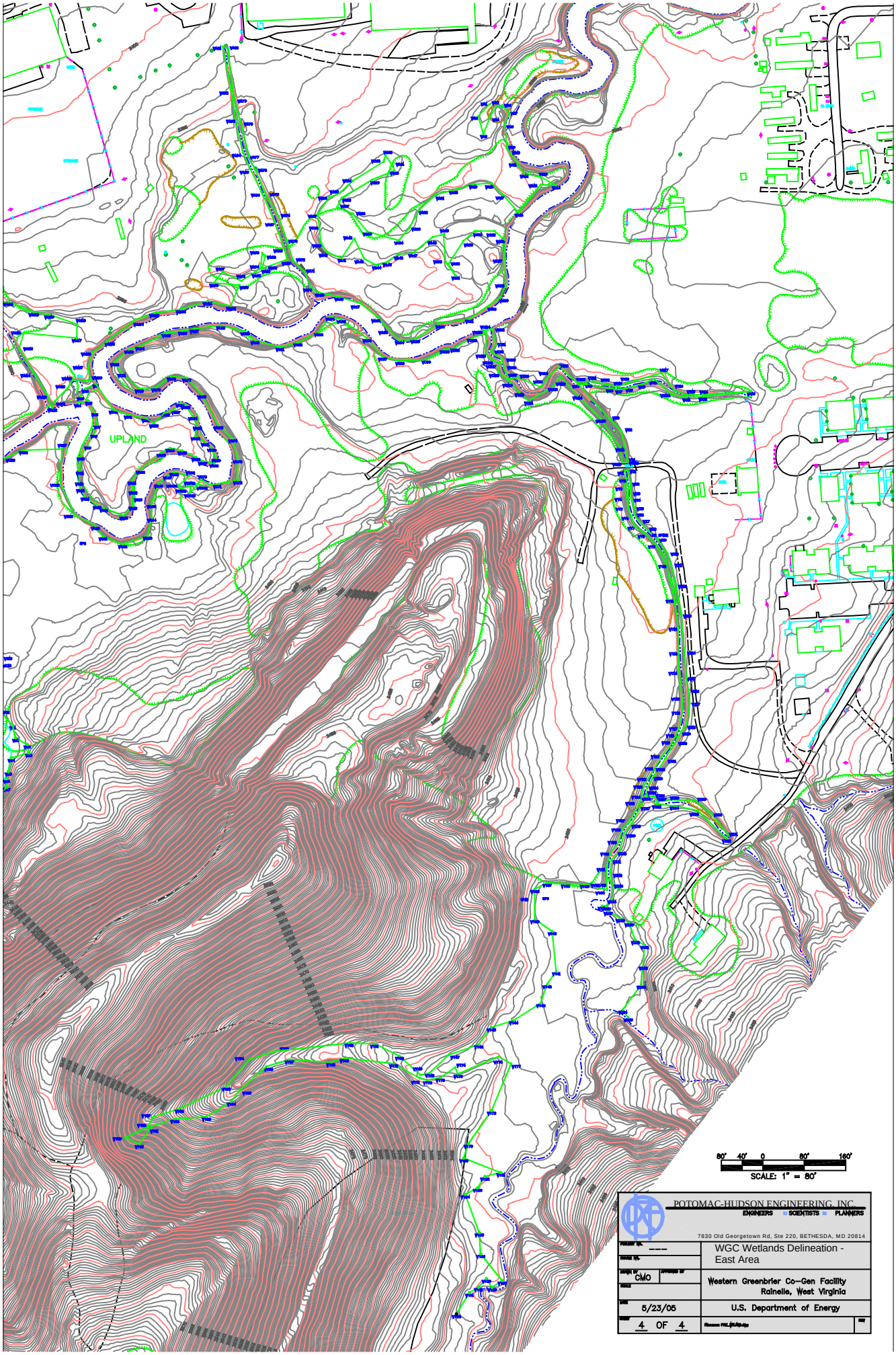
NOTES:

- The following flags are missing from the map and may or may not have been marked in the field: WA270, WA274, WY26. Their absence from the map does not have a significant impact on the wetland boundaries represented.
- The flags established to mark the wetland boundaries were typically tied to vegetation. However, in instances where no sturdy vegetation was present, the wetland flags were tied to wooden stakes instead.


WETLAND
UPLAND
Isolated Area
SCALE: 1" = 120'
120' 60' 0 120' 240'
POTOMAC-HUDSON ENGINEERING, INC.
ENGINEERS ■ SCIENTISTS ■ PLANNERS
7830 Old Georgetown Rd. Ste 720, BETHESDA, MD 20814
Figure 5 - Wetlands Delineation - Overview
Western Greenbrier Co-Gen Facility
Rainelle, West Virginia
U.S. Department of Energy
5/23/05
1 OF 4


UPLAND
WETLAND
UPLAND
UPLAND
WETLAND
UPLAND
UPLAND
UPLAND
WETLAND
WETLAND
POTOMAC-HUDSON ENGINEERING, INC.
ENGINEERS SCIENTISTS PLANNERS
7830 Old Georgetown Rd, Ste 220, BETHESDA, MD 20814
WGC Wetlands Delineation - West Area
Western Greenbrier Co-Gen Facility
Rainelle, West Virginia
U.S. Department of Energy
CMO
5/23/05
2 OF 4
80' 40' 0 80' 160'
SCALE: 1" = 80'


UPLAND
UPLAND
WETLAND
UPLAND
UPLAND
WETLAND
POTOMAC-HUDSON ENGINEERING, INC.
ENGINEERS SCIENTISTS PLANNERS
7830 Old Georgetown Rd, Ste 220, BETHESDA, MD 20814
Figure 6 - Wetlands Delineation - Middle Area
CMO
Western Greenbrier Co-Gen Facility
Rainelle, West Virginia
5/23/05
U.S. Department of Energy
3 OF 4
80' 40' 0 80' 160'
SCALE: 1" = 80'


UPLAND
80' 40' 0 80' 160'
SCALE: 1" = 80'
POTOMAC-HUDSON ENGINEERING, INC.
ENGINEERS SCIENTISTS PLANNERS
7830 Old Georgetown Rd, Ste 220, BETHESDA, MD 20814
PROJECT NO. ---
WGC Wetlands Delineation - East Area
DESIGN BY CMO
APPROVED BY
SCALE
Western Greenbrier Co-Gen Facility
Rainelle, West Virginia
DATE 5/23/05
U.S. Department of Energy
SHEET 4 OF 4
REV

Appendix D
Groundwater Pump Tests

Appendix D1 - Evaluation of Groundwater Pumping in Rainelle, West Virginia (dated: December 23, 2005)

Appendix D2 – Model Development to Evaluate Groundwater Pumping in Rainelle, West Virginia (dated: March 2007)*

Appendix D3 – Well Logs**

***Since publication of the Draft EIS, an additional pump test report (dated March 2007) has become available and has been added as Appendix D2 for the Final EIS.*

****New appendix added for Final EIS.*

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Evaluation of Groundwater Pumping in Rainelle, West Virginia

S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

December 23, 2005

7944 Wisconsin Avenue, Bethesda, Maryland 20814-3620 • (301) 718-8900

Evaluation of Groundwater Pumping in Rainelle, West Virginia

Prepared For:

Potomac-Hudson Engineering, Inc.

Prepared By:

S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

December 23, 2005

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Appendix D1

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Appendix D1

REPORT

Section 1
Introduction

S.S. Papadopulos & Associates, Inc. was retained by Potomac-Hudson Engineering, Inc. (PHE) to develop a groundwater flow model to simulate groundwater conditions in Rainelle, West Virginia. The groundwater model was used to evaluate the availability of groundwater as a water source for the proposed power facility and to evaluate potential impacts to local pumping wells from groundwater withdrawals.

Groundwater flow was simulated using MODFLOW-2000 (Harbaugh et al., 2000), the most widely used program in simulating groundwater flow. For the purposes of this analysis, a GIS application was developed to assist in data management and to generate necessary input files for the model.

Appendix D1

Section 2
Groundwater Flow Analysis

Geographic Information System (GIS) Application

The GIS coordinate system was registered to the NAD 1983 West Virginia South Zone State Plane with units in feet. The following vector and raster data were included:

- A digitized basemap of roads and hydrologic features.
- Georeferenced geologic maps of Fayette (White, 1919) and Greenbrier (Price, 1937) Counties.
- A Topographic map of the area.
- A Digital Elevation Model (DEM) with 10-foot resolution.
- Mapped locations of the pumping and observation wells.
- Mapped location of the National Oceanic and Atmospheric Administration (NOAA) East Rainelle station.
- Mapped location of the U.S. Geological Survey (USGS) streamflow station on Meadow River.

Conceptual Model

The groundwater system in the study area was conceptualized as consisting of three major units: a saturated surficial alluvial overburden, 5-15 feet thick; a layer of interbedded red to green shales, sandy shales and sandstone, 25-50 feet thick (intermediate layer); and an underlying fractured sandstone layer, at least 100 feet thick. The production and deep observation wells are open to both the intermediate and sandstone layers.

The geologic units in the vicinity of Rainelle dip to the northwest; the dip is calculated to be approximately 120 feet per mile based on the structure contour map of the base of the Sewell Coal prepared by Price (1937). As a result, the sandstone unit in which the production and observation wells are completed, which is at a nominal depth of 50 feet below ground surface at Rainelle, directly underlies the alluvium in the valleys of Sewell Creek and Little Sewell Creek to the south and east of Rainelle. For the purposes of this analysis, the elevation contours of the base of the Sewell Coal were digitized and used to calculate the average dip of the formations. Given known elevations of the sandstone formation at the observation wells, the dip of the sandstone unit was determined and then three-dimensionally superimposed on the ground surface DEM, delineating the areas of sandstone outcrop.

The intermediate layer acts as an aquitard, allowing limited vertical leakage. There is limited hydraulic connection between the surficial aquifer and the sandstone aquifer. Although there is limited data regarding hydrogeologic conditions in the area, groundwater movement appears to occur primarily through horizontal fractures in the sandstone formation. According to a study by Wyrick and Borchers (1981), groundwater movement in the valleys of the

Appalachian Plateaus Physiographic Province of West Virginia is the result of stress relief fracturing. Stress relief, the removal of compressional stresses on underlying rocks by erosion of overlying rocks, results in predictable fracture patterns in valley; fractures are generally horizontal under valley floors and are generally vertical along valley walls. The horizontal fractures beneath the valley floor typically develop along bedding plane partings. Horizontal fracturing is limited beyond the valley walls, and thus the valley walls essentially act as low permeability barriers. Recharge to the aquifers primarily occurs via the vertical fractures along the valley walls. In the study area, the valleys along Sewell Creek, Little Sewell Creek, and Meadow River, define the areal extent of the aquifer systems as described above.

Aquifer Test Data Analysis

The data from the aquifer tests performed by PHE at PW-1, PW-3, and PW-4 were reviewed and analyzed using the commercially available software AQTESOLV (Duffield, 2002). For purposes of analyzing the aquifer test, the groundwater system was conceptualized as a leaky aquifer system. The analytical solution developed by Hantush (1960) for a leaky confined aquifer with storage in the aquitard was used to analyze the drawdown data from the tests.

Analysis of the data from the deep observation wells for the 72-hour pump test at well PW-1 indicated that the effective transmissivity and storativity in the vicinity of PW-1 are approximately 700 ft^2/d and $4x10^{-6}$ respectively. The effective transmissivity and storativity in the vicinity of PW-3 range between 470 and 1070 ft^2/d, and $1x10^{-5}$ and $1x10^{-7}$, respectively. It should be noted that during the aquifer tests at wells PW-1 and PW-3, at all observation wells, high drawdown was measured very soon after commencement of the test, which is indicative of a highly fractured aquifer.

Analysis of the available drawdown data in the vicinity of well PW-4, indicated that the effective transmissivity and storativity are approximately 400 ft^2/d and $2x10^{-6}$, respectively. The aquifer transmissivity is much lower at PW-4 than at PW-1 and PW-3.

The purpose of the aquifer test analyses was to provide an indicative range of values for transmissivity and storativity, to be used as initial estimates of aquifer parameters in the calibration of the groundwater flow model.

Baseflow Analysis

Baseflow, the groundwater contribution to total streamflow, for the streams in the study area was calculated using automated hydrograph separation techniques. The Meadow River station at McRoss, West Virginia, located approximately two miles northeast of well PW-1, was the closest station to the study area. Discharge data were downloaded from the USGS National Water Information System. The available data spanned the period from 1979 to 1982. The drainage area of that station was 163 square miles. Baseflow discharge was calculated using BFI (Wahl, 2001), a software package for automated hydrograph separation. The average calculated baseflow for the period that data were available was 9.5 inches per year.

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A rough estimate of the appropriate areal extent of the model was determined based on the baseflow calculation. Assuming all necessary groundwater withdrawals for the power plant could be derived from baseflow, the minimum areal aquifer extent to guarantee such withdrawals would be equal to the pumping rate of 760 gallons per minute divided by the baseflow rate of 9.5 inches per year, or approximately 2.3 square miles. Given the hydrogeologic and topographic conditions in the study area, and to account for boundary effects, a model area of approximately 50 square miles was considered for the model.

Model Description

The groundwater model encompasses an area of approximately 50 square miles, defined by a grid of 352 rows and 152 columns of variable spacing. The vertical model discretization includes three layers, for the representation of the alluvial overburden, the intervening aquitard layer, and the sandstone layer. The model orientation is 35 degrees east of north; which means that the model columns are oriented northeast – southwest (Figure 1).

Grid spacing along model rows varies between 60.625 feet and 485 feet. Grid spacing along columns varies between 88.75 feet and 355 feet. The top layer has variable thickness to distinguish between the alluvium, where the thickness is equal to 15 feet, and the sandstone formation everywhere else, where the thickness is equal to 10 feet. The middle layer, which represents the interbedded layers of sandstone and shales, has a thickness of 50 feet, except underneath the alluvium, where the thickness is equal to 35 feet. Finally, the bottom layer, representing the sandstone formation, has a uniform thickness of 100 feet. The middle layer was assumed to be not present in areas where the sandstone layer directly underlies the alluvium; this was simulated by specifying a very large vertical hydraulic conductivity for the middle layer in these areas.

The model boundary conditions included no-flow boundaries along the model perimeter, and river nodes in the top layer along the major streams. All river nodes were assigned a constant hydraulic head.

Different hydraulic conductivity values were specified in the upland and valley areas in all layers. However, the sandstone unit underlying the alluvium along Meadow River in the vicinity of well PW-4 was assigned upland conductivities, to reflect the conclusions from the aquifer test at that well. This suggests that stress relief fracturing is not prevalent in areas where the valleys are very narrow.

Hydraulic properties of the model, including horizontal and vertical hydraulic conductivity and storage coefficient, were determined through the calibration process. Specific yield for the top layer was set equal to 0.1.

The pumping wells PW-1, PW-3, PW-4, CW-1, and CW-2 were represented by cells in the bottom layer with assigned pumping rates based on known and/or assumed pumping schedules.

Model Calibration

Model calibration was facilitated through the use of PEST (Doherty, 2005), a nonlinear parameter estimation and model calibration software. Model calibration parameters included:

- Horizontal and vertical hydraulic conductivity.
- Specific storage.

The flow model calibration targets included measured drawdown at the deep observation wells during the aquifer tests at wells PW-1 and PW-3. For simplicity, the models were calibrated to the aquifer tests results independently. Model calibration to the aquifer test data from well PW-4 was performed to estimate hydraulic parameters of the sandstone formation in the vicinity of PW-4.

Horizontal and vertical hydraulic conductivities and storage coefficients were determined through the iterative calibration procedure. The calibrated hydraulic properties of the sandstone aquifer for the two models are summarized in the following table for models calibrated to aquifer tests at PW-1 and PW-3:

Calibration Results

	Valley		Uplands	
	PW-1	**PW-3**	**PW-1**	**PW-3**
Horizontal Conductivity (ft/d)	100.6	100.6	4.7	4.7
Vertical Conductivity (ft/d)	8.6×10^{-5}	6.1×10^{-6}	2.0×10^{-3}	4.1×10^{-3}
Specific Storage (per foot)	1.2×10^{-6}	2.3×10^{-6}	1.0×10^{-8}	1.0×10^{-8}

The values of aquifer parameters calculated from the calibration process were similar for both the calibration to the aquifer test data from PW-1 and the calibration to the aquifer test data from PW-3, with the exception of vertical hydraulic conductivities in the valley, which differed by almost an order of magnitude. Plots of calculated drawdowns and observed drawdowns from the aquifer test of PW-1 are shown in Figure 2, for calibration to the aquifer test results at well PW-1. A plot of the calculated and the observed drawdowns from the aquifer test of PW-3 are shown on Figure 3.

After calibration to aquifer test data from PW-4, the calculated horizontal hydraulic conductivity of the sandstone formation underlying the alluvium along Meadow River in the vicinity of PW-4 was 3.0 ft/d.

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Model Predictions

The calibrated model was run for 25 years, with a specified production rate for PW-1 of 760 gpm, to simulate long-term drawdown in the groundwater system. The model was run using parameters obtained from calibration to aquifer test results at PW-1 and PW-3 separately, to compare aquifer response for high and low vertical conductivity conditions in the valley. In addition, combined pumping from wells PW-1 and PW-3, each at a rate of 380 gallons per minute, was simulated under both high and low valley conductivity conditions.

The results of the model runs using the parameters obtained from calibration to aquifer test results at well PW-1 are shown in Figure 4. The results of the model runs using the aquifer parameters obtained from calibration to aquifer test results at well PW-3 are shown in Figure 5. Simulated pumping from PW-1 and PW-3 at equal rates for high and low vertical conductivities resulted in drawdowns shown in Figures 6 and 7, respectively.

The calculated drawdowns after 25 years of pumping at wells CW-1 and CW-2, with hydraulic parameters from calibration to well PW-1 aquifer test, are approximately 43 and 40 feet respectively. The calculated drawdown at production well PW-1 is approximately 56 feet. For hydraulic parameters from calibration to well PW-3 aquifer test, the simulated drawdowns at CW-1 and CW-2 are approximately 35 and 32 feet respectively. The calculated drawdown at production well PW-1 is approximately 47 feet. The drawdown at PW-1 was assumed to be equal to the average drawdown in the model grid cell in which the well is located. The foundation for this assumption is the drawdown data from the aquifer tests which indicated that drawdown is relatively constant for a large radial distance around the production well, likely as the result of very high transmissivity in some fractures.

When the model was run for combined pumping from wells PW-1 and PW-3 with hydraulic parameters from calibration to PW-1 aquifer test, the simulated drawdowns at wells CW-1 and CW-2 are approximately 42 and 41 feet, respectively. The calculated drawdowns at pumping wells PW-1 and PW-3 are 45 and 44 feet, respectively. For hydraulic parameters from calibration to well PW-3 aquifer test, the simulated drawdowns at both CW-1 and CW-2 are approximately 33 feet. The calculated drawdowns at both pumping wells PW-1 and PW-3 are 36 feet.

In order to address concerns regarding short-term drought periods, available data from observation wells in Greenbrier, Fayette, and Nicholas Counties, which encompass the drainage basin of Rainelle, were downloaded from the USGS NWISWeb Database. Water level data were considered only for wells with available data spanning more than one year and with sufficient number of measurements each, regardless of the formation in which they were completed. The maximum water level fluctuation for all wells did not exceed 12 feet, which could be considered as additional drawdown to reflect short-term drought conditions.

Section 3
Summary and Conclusions

Four simulations of long-term pumping at a rate of 760 gpm were conducted with the groundwater model that was developed:

- Model using aquifer parameters estimated from PW-1 aquifer test data – PW-1 pumping at a constant rate of 760 gpm;
- Model using aquifer parameters estimated from PW-3 aquifer test data – PW-1 pumping at a constant rate of 760 gpm;
- Model using aquifer parameters estimated from PW-1 aquifer test data – PW-1 pumping at a constant rate of 380 gpm and PW-3 pumping at a constant rate of 380 gpm;
- Model using aquifer parameters estimated from PW-3 aquifer test data – PW-1 pumping at a constant rate of 380 gpm and PW-3 pumping at a constant rate of 380 gpm.

The results of these simulations indicate that long-term pumping at a rate of 760 gpm will produce significant drawdowns within the sandstone aquifer. Our analysis, though, shows that it is feasible to produce 760 gpm during a 25 year period. These analyses, though, are based on the results of relatively short term aquifer tests and a conceptual geologic model that is based on limited field data. It is possible that actual drawdown will be larger than simulated in this study if actual field conditions differ from the simulated conditions.

A major uncertainty in our understanding of the groundwater system is the characteristics of the sandstone aquifer unit beneath the upland areas. The drawdown pattern reflects the effects of low hydraulic conductivity beneath the upland areas and enhanced leakage from the water table along the valley walls. Vertical hydraulic conductivities in the upland areas appear to be more critical than those in the valley with respect to expected drawdowns. Due to the limited available data, it is not possible to draw positive conclusions as to whether the model with higher vertical conductivities or the model with lower hydraulic conductivities better describes the hydrogeologic conditions in the study area. Both models predict relatively similar drawdowns at the municipal wells. If the sandstone unit is relatively impermeable beneath the upland areas, as the result of limited horizontal fracturing, then the model may be an accurate representation of the groundwater system, though in the model we assumed significant permeability in the upland areas. If the sandstone unit beneath the upland areas is much less permeable than assumed in our analyses, then the actual drawdowns from long-term pumping will be greater than those shown on the figures.

Some of the uncertainty inherent in our evaluations could be reduced by conducting longer aquifer tests at PW-1 and/or PW-3 and by monitoring water levels during the tests in wells located in the upland areas and wells located in the valleys much further from the pumping wells than was done in previous testing. Our recommendation is that a test be conducted for at least 30 days, the minimum time required to significantly improve our current understanding of

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the system. It must be recognized that the results of additional testing may well indicate that long-term pumping at a rate of 760 gpm is not sustainable from the sandstone aquifer.

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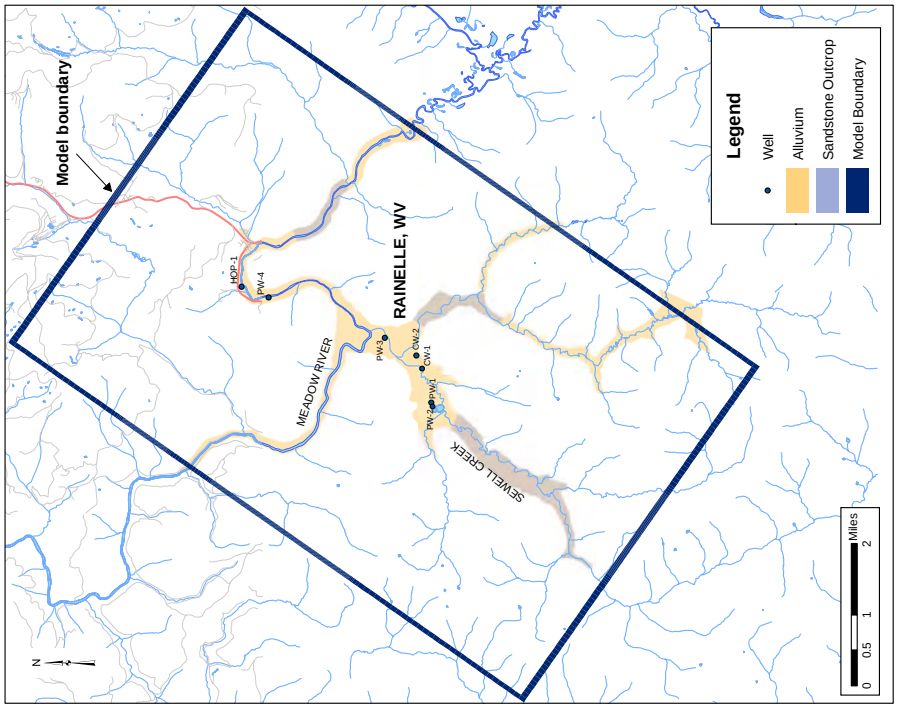
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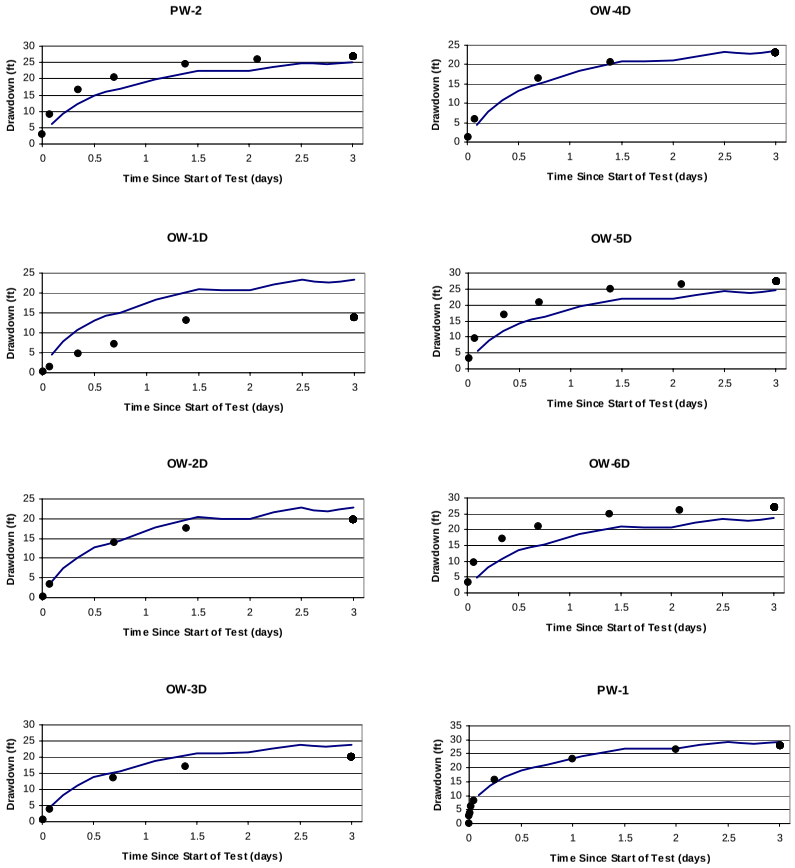
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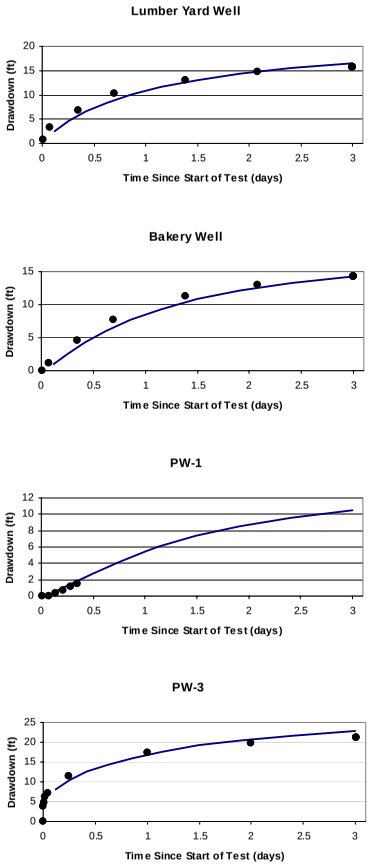


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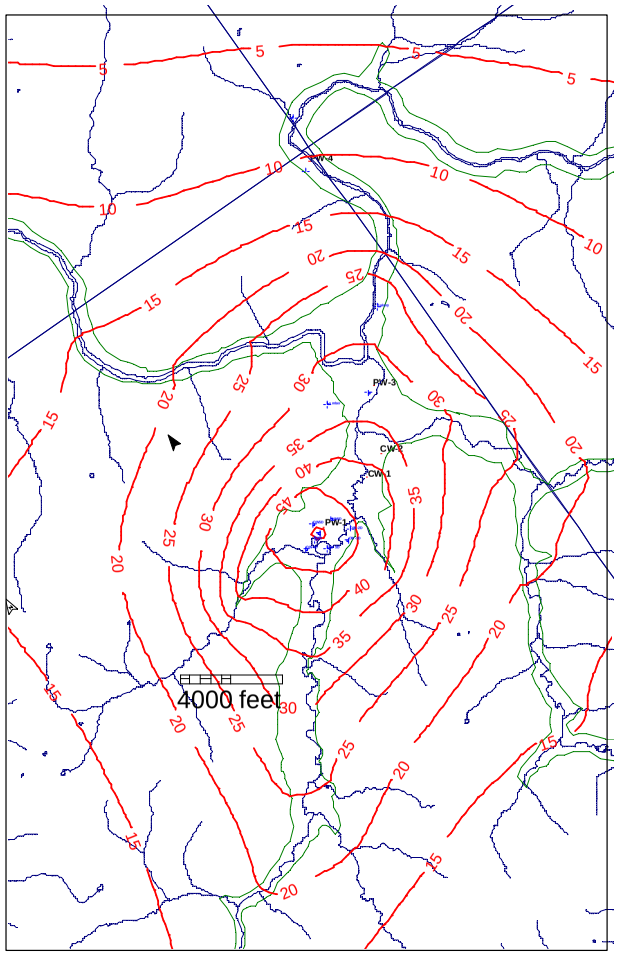
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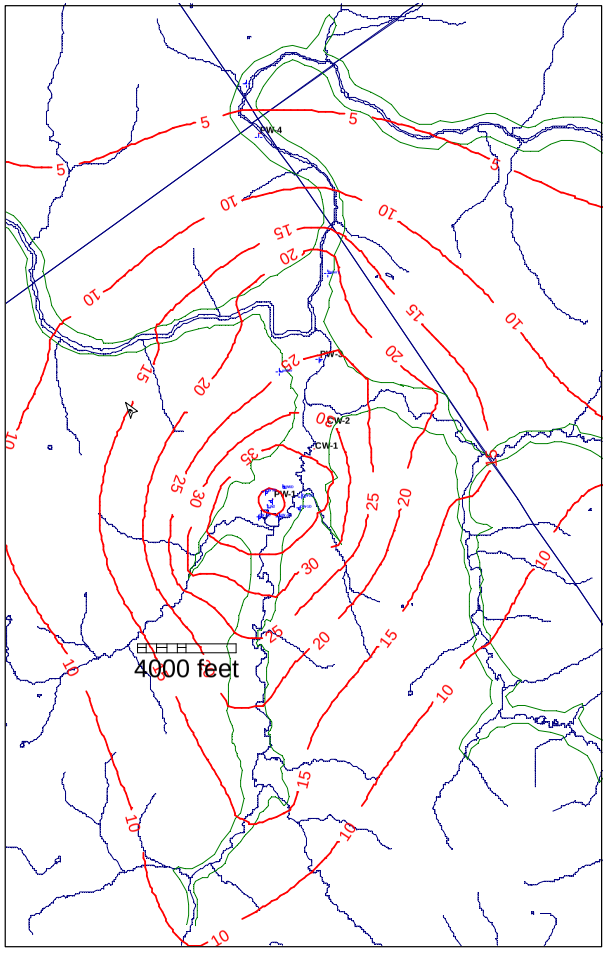
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Model alibrated to Aquifer Test Results at Well PW-1



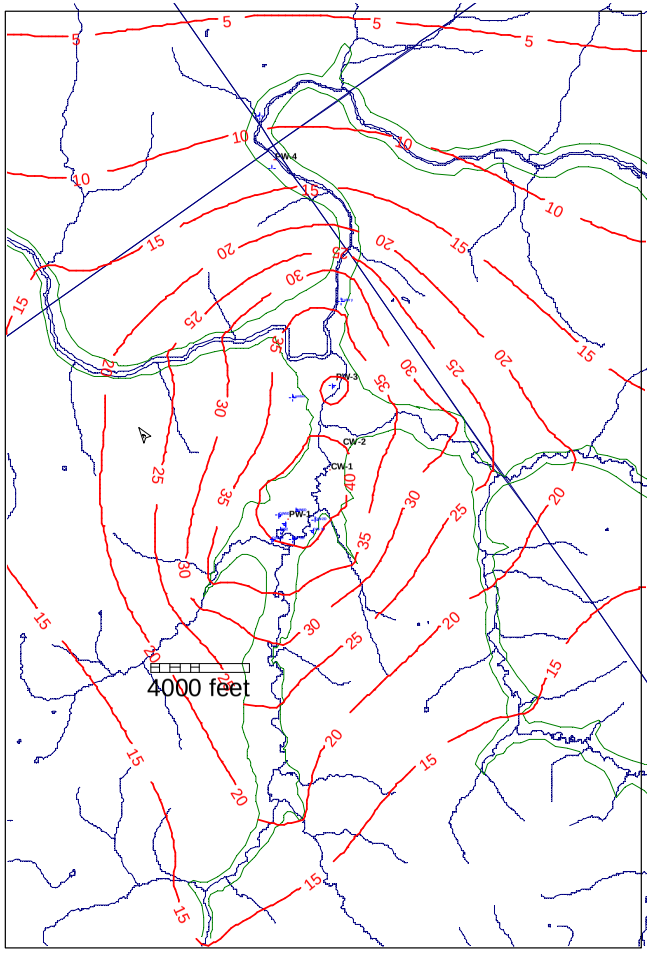
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i ure 4 Simulated Drawdown after 25 ears,
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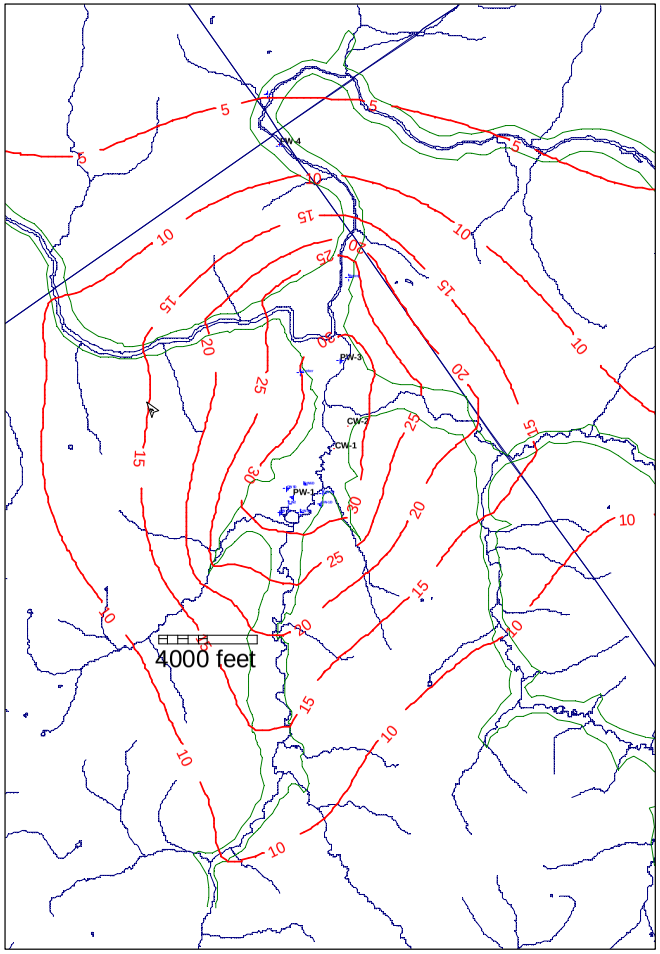


i ure 5 Simulated Drawdown after 25 ears,
Model alibrated to Aquifer Test Results at Well PW-3



i ure 6 Simulated Drawdown after 25 ears,
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Model alibrated to Aquifer Test Results at Well PW-1

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i ure 7 Simulated Drawdown after 25 ears,
Pumping from PW-1 and PW-3,
Model alibrated to Aquifer Test Results at Well PW-3

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Model Development to Evaluate Groundwater Pumping in Rainelle, West Virginia

S.S. PAPADOPULOS & ASSOCIATES, INC.
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June 5, 2007

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Model Development to Evaluate Groundwater Pumping in Rainelle, West Virginia

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REPORT

Section 1
Introduction

S.S. Papadopulos & Associates, Inc. (SSP&A) was retained by Potomac-Hudson Engineering, Inc. (PHE) to develop a groundwater flow model to simulate groundwater conditions in Rainelle, West Virginia. The purpose of the groundwater model was to evaluate the availability of groundwater as a water source for the proposed power facility, to evaluate potential impacts to local pumping wells from groundwater withdrawals, and to evaluate potential impacts to the Meadow River.

The initial groundwater model was developed and calibrated based on data and results obtained from three aquifer tests performed by PHE in the vicinity of the proposed power facility (S.S. Papadopulos and Associates, Inc., 2005). The calibrated model was used to determine drawdowns at the pumping wells within a 25-year period of constant pumping. Although it was shown that it is feasible to produce the necessary groundwater withdrawals during a 25-year period, the analysis was based on the results of relatively short term aquifer tests and a conceptual geologic model that was based on limited field data.

To confirm the conclusions of the initial groundwater model and develop a more thorough understanding of the aquifer system, SSP&A (2005) recommended a long term aquifer test with additional monitoring wells in locations that would provide information with respect to the hydrogeologic conditions over a much larger area. PHE subsequently constructed two new monitoring wells and conducted a 60-day long-term aquifer test at the proposed pumping wells during October and November 2006.

The data obtained from drilling two new monitoring wells were used to refine the structure of the groundwater flow model and the revised model was recalibrated to the data from the long-term aquifer test. After the model was recalibrated, new predictions of drawdown at the local pumping wells were made for a 25-year period of various scenarios of constant and seasonal pumping. In addition, a detailed streamflow analysis for Meadow River was conducted to estimate long term impacts on streamflow from pumping.

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Section 2
Groundwater Flow Analysis

New Monitoring Well Data

PHE conducted a long-term aquifer test at wells PW-1 and PW-3 (Figure 1) from October through November 2006. Water level data were collected during a period of approximately 35 days prior to the test, during the two month pumping period, and for a month after the pumps were shut off. For the purposes of the aquifer test, two new monitoring wells were drilled, OW-8 and OW-9 (Figure 1), in the southern part of the Sewell Creek valley and in the Little Sewell Creek valley respectively.

The lithology at monitoring well OW-8 is very similar to that at well PW-1 and the surrounding observation wells. Below the surficial alluvium, which is approximately 15 feet thick, there is a 25-foot thick unit of interbedded silts, sands and clays. Below this unit, from a depth of 40 to 60 feet, is a blue sandy shale and from a depth of 60 feet to 200 feet is the sandstone unit that is seen at PW-1. The well was cased from land surface to a depth of 40 feet and has an open hole completion to total depth of 200 feet.

Well OW-9 was completed at a depth of 160 feet below ground surface and it was cased off the first 40 feet. Blue gray and red shales and sandy shales were encountered at that well from land surface to total depth. Based on the structure contour map of the base of the Sewell Coal prepared by Price (1937) the sandstone unit observed at PW-1 was anticipated at this location. However, unlike well PW-1, no sandstone was encountered in well OW-9. In addition, visual inspection of the hillside along Little Sewell Creek confirmed sandstone outcrops at elevations above the valley floor. Based on the above, it appears that the sandstone outcrops in the valley further north and that OW-9 penetrates a unit stratigraphically below the sandstone.

Conceptual Model

The conceptual model of the groundwater system developed previously by SSP&A was modified to reflect the findings from the boring logs of the two new monitoring wells. The groundwater system is now conceptualized as consisting of four major units: 1) saturated alluvium, 5-15 feet thick; 2) a unit consisting of interbedded blue, red and green shales, sandy shales and sandstone, 25-50 feet thick (low permeability unit); 3) an underlying fractured sandstone unit, 100 feet thick; and 4) an interbedded sand and shale unit, at least 60 feet thick. The production and deep observation wells are open to both the low permeability unit and sandstone unit, except for well OW-9 which is open to the deeper sand and shale unit.

The low permeability unit acts as an aquitard, allowing limited vertical leakage. There is limited hydraulic connection between the alluvium and the sandstone unit. Groundwater movement occurs primarily through horizontal fractures in the sandstone unit, as a result of stress relief fracturing (Wyrick and Borchers, 1981).

The representation of the dip of geologic units in the vicinity of Rainelle, 120 feet per mile to the northwest, was not changed in the revised model. However, the strike of the geologic units was altered slightly to N70ºW to account for the findings at wells OW-8 and OW-9. As a result, the sandstone unit is now calculated to outcrop further north along Little Sewell Creek than previously thought to be the case (Figure 1).

Recharge to the aquifer occurs via the vertical fractures along the valley walls and in the areas where the sandstone unit outcrops. The vertical fractures extend all the way down to the deeper units and thus act as low permeability barriers.

Model Modification

The groundwater model grid remained unchanged horizontally, encompassing an area of approximately 50 square miles, defined by a grid of 352 rows and 152 columns of variable spacing. The vertical model discretization now includes four layers for the representation of the alluvium, the low permeability unit, the sandstone unit, and the interbedded sandstone and shale unit. The model orientation is 35 degrees east of north; which means that the model columns are oriented northeast - southwest (Figure 1).

Grid spacing also remained unchanged. Grid spacing along model rows varies between 60.625 feet and 485 feet. Grid spacing along columns varies between 88.75 feet and 355 feet. The top layer has variable thickness; a thickness of 15 feet is specified where saturated alluvium exists, elsewhere the thickness is specified as 10 feet. The second layer, which represents the low permeability unit, has a thickness of 50 feet, except underneath the alluvium, where the thickness is specified as 35 feet. The third model layer, representing the sandstone unit, has a uniform thickness of 100 feet. The fourth model layer, representing the deeper interbedded sandstone and shale unit, has a uniform thickness of 60 feet. The second layer, the low-permeability unit, was assumed to be not present in areas where the sandstone unit directly underlies the alluvium; this was simulated by specifying a very large vertical hydraulic conductivity for the middle layer in these areas.

The model boundary conditions included no-flow boundaries along the model perimeter, and river nodes in the top layer along the major streams. All river nodes were assigned a constant hydraulic head.

Different hydraulic conductivity values were specified in the upland and valley areas in all layers. However, the sandstone unit underlying the alluvium along Meadow River north of well BW-1 was assigned upland conductivities consistent with the results obtained previously from analysis of the aquifer test results from well PW-4. This suggests that stress relief fracturing is not prevalent in areas where the valleys are very narrow.

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Hydraulic properties of the model, including horizontal and vertical hydraulic conductivity and storage coefficient, were determined through the calibration process. Specific yield for the top layer was set equal to 0.1.

The pumping wells PW-3 and CW-1 were represented by cells in the third model layer. Well PW-1 is represented by cells in both the third and fourth model layers. The pumping rates of wells PW-1 and PW-3 during the aquifer test varied according to the values shown in Table 1. For the purposes of the groundwater flow modeling, time-averaged pumping rates were used for both wells. Well CW-1 was assigned a constant pumping rate of 150 gallons per minute (gpm), reflecting its reported pumping schedule.

Table 1 Pumping Rates for Wells PW-1 and PW-3

Date	PW-1 (gpm)		PW-3 (gpm)	
	Measured	Average over consecutive measurements	Measured	Average over consecutive measurements
10/1/2006 12:00	500		300	
10/2/2006 13:10	490	495	300	300
10/3/2006 16:40	460	475	335	317.5
10/6/2006 8:00	445	452.5	325	330
11/30/2006 12:00	409	427	308	316.5
Time Averaged Q		**430**		**315**

Model Calibration

Model calibration was facilitated through the use of PEST (Doherty, 2005), a nonlinear parameter estimation and model calibration software. Model calibration parameters included:

- Horizontal and vertical hydraulic conductivity.
- Specific storage.

The flow model calibration targets included measured drawdown at the deep observation wells during the aquifer test. Horizontal and vertical hydraulic conductivities and storage coefficients were determined through the iterative calibration procedure. The calibrated hydraulic properties are summarized in the following table:

Table 2 Calibration Results

Unit	Valley			Uplands		
	Horizontal Conductivity (ft/d)	Vertical Conductivity (ft/d)	Specific Storage (per foot)	Horizontal Conductivity (ft/d)	Vertical Conductivity (ft/d)	Specific Storage (per foot)
Alluvium	10.7	$2.9x10^{-6}$		-	-	-
Sandy Shale	1.8	$4.5x10^{-5}$	$2.2x10^{-6}$	1.8	$6.2x10^{-3}$	$1.5x10^{-6}$
Sandstone	70.2	$4.5x10^{-5}$	$1.5x10^{-6}$	1.8	$6.2x10^{-3}$	$1.5x10^{-6}$
Sandstone/ Shale	20.8	0.5	$1.5x10^{-6}$	1.8	$6.2x10^{-3}$	$1.5x10^{-6}$

Plots of calculated drawdowns and observed drawdowns from the aquifer test are shown on Figure 2. It should be noted that no recovery data are available for well CW-1, due to equipment failure.

Model Predictions

Pumping Scenarios

The calibrated model was run for a period of 25 years to simulate long-term drawdown in the groundwater system and to evaluate corresponding streamflow depletions under two scenarios. The two scenarios include combined production rates for wells PW-1 and PW-3 that reflect conditions related to the actual operation of the plant and the corresponding water demands. The scenarios considered were based on the assumption that: (a) Groundwater is the primary source of water, and (b) Surface water from Meadow River is the primary source of water, with supplemental groundwater withdrawals when the flow in the river falls below given seasonal thresholds.

The pumping rates considered for the first scenario corresponded to the annual average, maximum, and seasonal (April through September and October through March) water demand for the plant. By design, the effluent of the Rainelle Sewage Treatment Plant, which currently is being discharged to the river, will be diverted to the power plant to supply some of the water demand. Given that the treated effluent will not be contributing to streamflow, it is included in the power plant water demand considered herein, in order to assess the effects of both the water withdrawals and reduced treated water discharge to streamflow. Therefore, the pumping rates used for model predictions were:

- Average demand: 1,049 gpm.
- Maximum demand: 1,179 gpm.
- Seasonal demand: 960 gpm for the period October-March, and 1,139 gpm for the period April-September.

For the second scenario, minimum streamflow requirements for direct water withdrawals from the river imposed by the State were considered. According to these requirements, water can be withdrawn directly from the river only when the flow is higher than 118 cubic feet per second (cfs) during the winter season (October-March) and 178 cfs during the summer period (April-September). The pumping rates were calculated based on the average seasonal demand, weighted by the ratio of number of days per season when the flow is below the minimum threshold to the number of total days per season.

For the purposes of calculating the pumping rates for the second scenario, a detailed streamflow analysis was conducted. Historical streamflow data for Meadow River are available from a USGS gauge on Meadow River at McRoss, a few miles north from well BW-1, reflecting conditions nearby the well field, and for a short period of years (1979-1982). The streamflow values for this gauge are shown in Figure 3. Another USGS gauge is located at Mt. Lookout, in

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Nicholas County, WV, approximately 17 miles from Rainelle, with almost continuous data for the period 1966-2007. The streamflow values for this period are shown in Figure 4.

Given the short period covered by the data from the McRoss gauge, and that only the Mt. Lookout gauge provides continuous data that span a much longer period, the correlation of the data from the two gauges was examined, to provide an equivalent streamflow dataset to be used for the streamflow analysis in the model area. The drainage area corresponding to the two gauges was obtained from the USGS NWISWeb Database and is shown in the following table:

USGS Station	Drainage Area (square miles)
McRoss, USGS 03189890	163
Mt. Lookout, USGS 03190400	365

The ratio between the two drainage areas is approximately 2.2. By scaling down the data from the Mt. Lookout gauge by a factor of 2.2, the correlation coefficient between the McRoss dataset and the resulting dataset is 0.87; the average streamflow for the period 1979-1982 is 347.3 cfs and 343.9 cfs respectively; and the median streamflow is 190.0 cfs and 190.9 cfs respectively. Therefore, the resulting dataset could be considered representative of the streamflow conditions in Meadow River near the well field and for a period of more than 40 years. In addition, it is assumed that the same conditions will prevail in the next 40 years and so the same dataset can be used to evaluate the impacts of model predicted river leakage to streamflow.

The average seasonal pumping rates used in Scenario 2 were weighted to reflect the operating schedule of the wells as a function of the number of days the wells will be turned on. It was determined that the weighted seasonal pumping rates for Scenario 2 is 707 gpm (1.58 cfs) for the period April-September, and 280 gpm (0.62 cfs) for the period October-March. Figure 5 illustrates the number of days per season per year that the wells will have to be operating due to low flow conditions in Meadow River. The values in this Figure represent the percentage of days of operation against the total number of days per season. The results of this analysis are tabulated in the following Table:

Year	# of Days Apr-Sep	# of Days Flow > 178 cfs	# of Days Flow < 178 cfs	Average Pumping Rate Apr-Sep (cfs)	Annual Pumping Rate Streamflow Apr-Sep (cfs)	# of Days Oct-Mar	# of Days Flow > 118 cfs	# of Days Flow < 118 cfs	Average Pumping Rate Mar-Oct (cfs)	Annual Average Pumping Rate Mar-Oct (cfs)
1966	30	6	24	2.03	1.58	92	66	26	0.60	0.62
1967	183	64	119	1.65		182	146	36	0.42	
1968	183	71	112	1.55		183	124	59	0.69	
1969	183	74	109	1.51		182	119	63	0.74	
1970	183	59	124	1.72		182	133	49	0.58	
1971	183	87	96	1.33		182	149	33	0.39	
1972	183	100	83	1.15		183	173	10	0.12	
1973	183	97	86	1.19		182	152	30	0.35	
1974	183	73	110	1.53		182	145	37	0.43	
1975	183	82	101	1.40		182	144	38	0.45	
1976	183	30	153	2.12		183	177	6	0.07	
1977	183	44	139	1.93		182	136	46	0.54	
1978	183	54	129	1.79		182	107	75	0.88	
1979	183	128	55	0.76		182	162	20	0.24	
1980	183	70	113	1.57		183	108	75	0.88	
1981	183	92	91	1.26		182	117	65	0.76	
1982	183	74	109	1.51		182	131	51	0.60	
1983	183	81	102	1.41		182	131	51	0.60	
1984	183	47	136	1.89		183	61	122	1.43	
1985	183	0	183	2.54		182	48	134	1.57	
1986	183	44	139	1.93		182	140	42	0.49	
1987	183	44	139	1.93		182	115	67	0.79	
1988	183	57	126	1.75		183	119	64	0.75	
1989	183	104	79	1.10		182	156	26	0.31	
1990	183	73	110	1.53		182	157	25	0.29	
1991	183	38	145	2.01		182	124	58	0.68	
1992	183	80	103	1.43		183	108	75	0.88	
1993	183	56	127	1.76		182	132	50	0.59	
1994	183	72	111	1.54		182	109	73	0.86	
1995	183	59	124	1.72		182	133	49	0.58	
1996	183	103	80	1.11		183	171	12	0.14	
1997	183	65	118	1.64		182	90	92	1.08	
1998	183	80	103	1.43		182	102	80	0.94	
1999	183	32	151	2.09		182	120	62	0.73	
2000	183	109	74	1.03		183	89	94	1.10	
2001	183	66	117	1.62		182	79	103	1.21	
2002	183	64	119	1.65		182	143	39	0.46	
2003	183	130	53	0.73		182	153	29	0.34	
2004	183	87	96	1.33		183	172	11	0.13	
2005	183	67	116	1.61		182	140	42	0.49	
2006	183	52	131	1.82		182	136	46	0.54	
2007						46	36	10	0.46	

Model Results – Drawdown

The results of the model run using the parameters obtained from calibration to aquifer test results are shown in Figure 6, for the combined annual average pumping rate of 1,049 gpm. The calculated drawdown after 25 years of pumping at well CW-1 is approximately 53 feet. The calculated drawdown at production well PW-1 is approximately 59 feet and the calculated drawdown at production well PW-3 is approximately 53 feet.

The results of the model run for the combined annual maximum pumping rate of 1,179 gpm are shown in Figure 7. The calculated drawdown after 25 years of pumping at well CW-1 is approximately 62 feet. The calculated drawdown at production well PW-1 is approximately 69 feet and the calculated drawdown at production well PW-3 is approximately 64 feet.

The results of the model run for the combined seasonal pumping rate of 1,139 gpm during the summer period and 960 gpm during the winter period are shown in Figure 8. The calculated drawdown after 25 years of pumping at well CW-1 is approximately 56 feet. The

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calculated drawdown at production well PW-1 is approximately 64 feet and the calculated drawdown at production well PW-3 is approximately 60 feet.

For Scenario 2, with groundwater being the supplemental source of water, the results of the model run for the combined weighted annual seasonal pumping rate of 707 gpm during the summer period and 280 gpm during the winter period are shown in Figure 9. The calculated drawdown after 25 years of pumping at well CW-1 is approximately 33 feet. The calculated drawdown at production well PW-1 is approximately 36 feet and the calculated drawdown at production well PW-3 is approximately 33 feet.

As discussed in the previous modeling report (S.S. Papadopulos and Associates, Inc., 2005), in order to address concerns regarding short-term drought periods, an analysis of available data from observation wells in Greenbrier, Fayette, and Nicholas Counties, which encompass the drainage basin of Rainelle, was performed. The data were downloaded from the USGS NWISWeb Database. Water level data were considered only for wells with available data spanning more than one year and with sufficient number of measurements each, regardless of the formation in which they were completed. The maximum water level fluctuation for all wells did not exceed 12 feet, which could be considered as additional drawdown to reflect short-term drought conditions.

Drawdowns at the monitoring wells measured during a period of 35 days prior to the aquifer test are shown in Figure 10. The drawdowns indicate no long-term upward or downward trend during that period. However, during the pumping phase the drawdowns exhibit a downward trend. The trend is not considered significant and the calibration results are satisfactory.

A conservative estimate of the total potential drawdown at wells CW-1, PW-1, and PW-3 could be expressed as the sum of the predicted drawdown and the maximum water level fluctuation corresponding to possible drought conditions (12 ft). Well construction data and the range of potential groundwater elevations at wells CW-1, PW-1, and PW-3 are shown in the following table:

Well	Casing Elevation (ft amsl)	Well Depth (ft)	Groundwater Elevation prior to Aquifer Test (ft amsl)	Range of Drawdown (ft)	Groundwater Elevation after 25 years (ft amsl)
CW-1	2,392	200	2,376	33-62	2,331-2,302
PW-1	2,400	220	2,373	36-69	2,325-2,292
PW-3	2,388	168	2,372	33-64	2,327-2,296

It should also be noted that, based on information obtained from the Rainelle Water Department, the pump in well CW-1 is set at 180 ft below ground surface (approximately 2,212 ft above mean sea level). This suggests that the city well will be capable of meeting the city

water demands. Similarly, the estimated drawdowns at wells LW-1 and BW-1 (26-55 ft and 23-46 ft respectively) suggest that those wells will also be capable of meeting their corresponding demands.

The pumping rates considered under Scenario 1 are higher than the maximum pumping rate during the 60-day aquifer test. Although the aquifer response was evaluated under lower pumping conditions, it is common hydrologic practice to extrapolate given that in most aquifer systems the response is proportional to the stress.

Model Results – Streamflow Depletion

An analysis of the sources of the pumped water during the 25-year simulations was conducted to determine the amount of water coming from reduced discharge to the rivers and the amount coming from aquifer storage depletion. The relationships of aquifer storage depletion over time and reduced river discharge over time were examined for the cases of continuous pumping at 1,049gpm, 1,179 gpm, seasonal pumping at 1,139 gpm/960 gpm, and the weighted seasonal pumping at 707 gpm/280 gpm. The results of this analysis are shown in Figures 11, 12, 13, and 14 respectively. The impact from pumping to streamflow increases with time to a total of approximately 1.8 to 2.2 cfs, for the various cases under Scenario 1. The impact of pumping to streamflow for Scenario 2 increases with time to a total of approximately 1.0 cfs. It should be noted that this impact includes a baseline river leakage induced by pumping at well CW-1. The relationship of aquifer storage depletion over time and reduced river discharge over time for CW-1 is illustrated in Figure 15. It is estimated that the impact of well CW-1, when pumping 150 gpm for 25 years approaches 0.2 cfs. Therefore, the impact to streamflow from pumping at wells PW-1 and PW-3 is approximately 1.6 to 2.0 cfs for Scenario 1 and 0.8 cfs for Scenario 2.

In all cases, initially most of the pumped water comes from aquifer storage depletion; only after approximately 8 to 9 years of pumping does the amount of water coming from reduced river discharge equal the amount coming from aquifer storage depletion. However, when groundwater is the primary source of water, and therefore constant pumping occurs throughout the entire 25-year period, the amount of water coming from reduced river discharge is higher than when weighted seasonal pumping is considered.

The results demonstrate the limited hydraulic connection between the alluvium and the sandstone unit. Storage depletion is immediate when pumping begins and remains significant throughout the entire pumping period. River leakage increases gradually but it never equals the pumped water volume.

Figure 16 shows the annual minimum streamflow value for the adjusted dataset for McRoss and the calculated expected annual minimum streamflow value, when the weighted seasonal pumping of Scenario 2 is considered.

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Section 3
Summary and Conclusions

The groundwater flow model was revised and recalibrated based on the lithologic logs from two new monitoring wells and a long-term aquifer pump test. These new data have greatly improved our understanding of the aquifer system and the modified model better incorporates more regional hydrogeologic conditions. Simulations of long-term pumping at combined rates were conducted considering groundwater as primary source of water (Scenario 1) and surface water from Meadow River as primary source of water, with supplemental withdrawals for groundwater (Scenario 2).

Our analysis shows that it is feasible to meet the seasonal water demand with groundwater as the primary source of water (Scenario 1) and with surface water as the primary source of water and supplemental groundwater withdrawals during a 25 year period (Scenario 2). In addition, the city well will still be capable of meeting the city water demand. The analysis also shows that the impact of pumping to streamflow at the end of the same period is approximately 1.6-2.0 cfs for Scenario 1 and approximately 0.8 cfs for Scenario 2.

Section 4
References

Doherty, J. 2005. PEST Version 9 User's Guide. Brisbane, Queensland, Australia: Watermark Numerical Computing.

S.S. Papadopulos and Associates, Inc., 2005. Evaluation of Groundwater Pumping in Rainelle, West Virginia. Prepared for Potomac-Hudson Engineering, Bethesda, Maryland. December 2005.

Price, P.H. 1937. *General and Economic Map of Greenbrier County.* West Virginia Geological Survey.

Wyrick, G.G., and J.W. Bochers. 1981. *Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley*. U.S. Geological Survey. Water-Supply Paper 2177.

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FIGURES

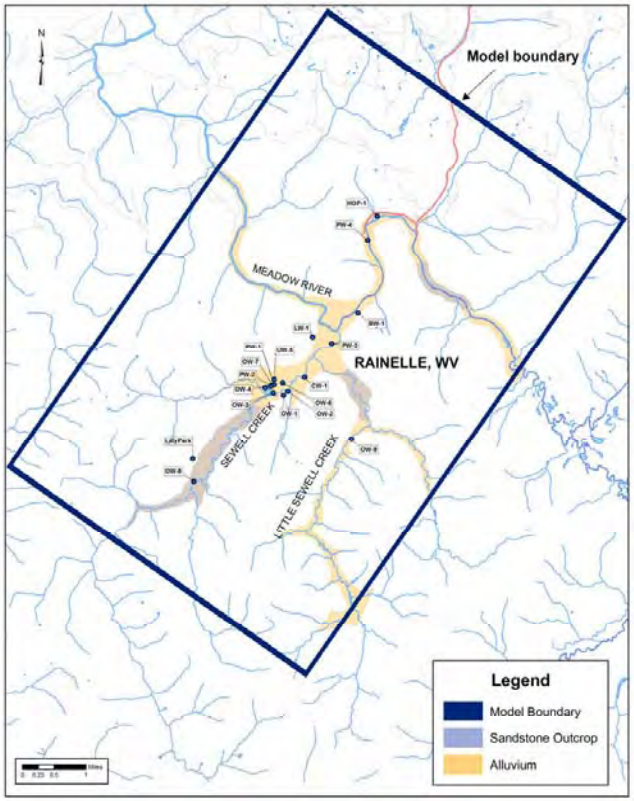


Figure 1 Location Map.

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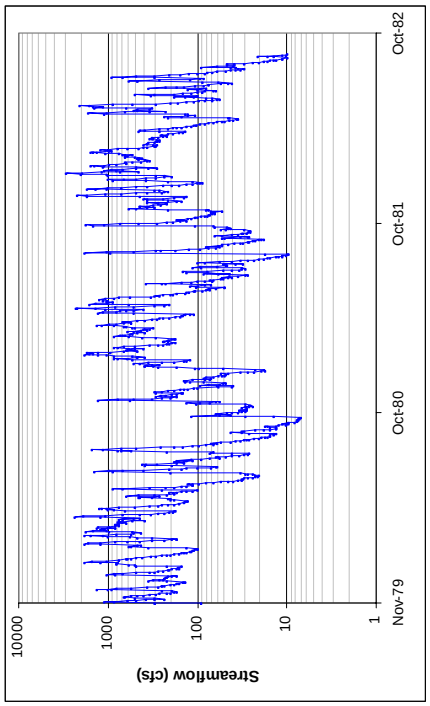


Figure 3 Streamflow Data for Meadow River (USGS 03189890, McRoss WV).

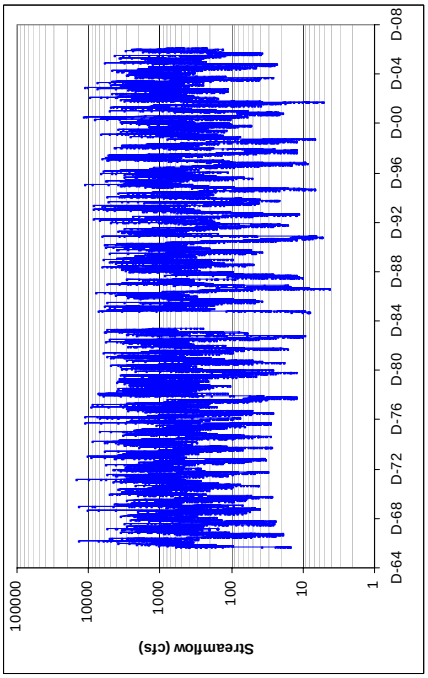


Figure 4 Streamflow Data for Meadow River (USGS 03190400, Mt. Lookout WV).

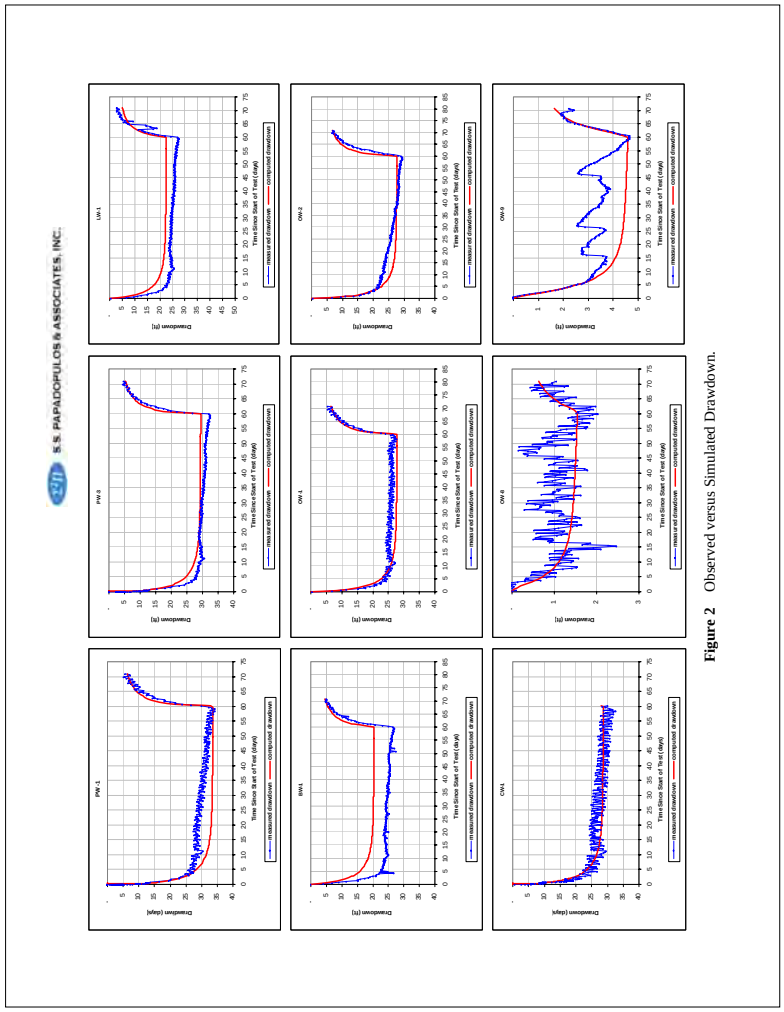


Figure 2 Observed versus Simulated Drawdown.

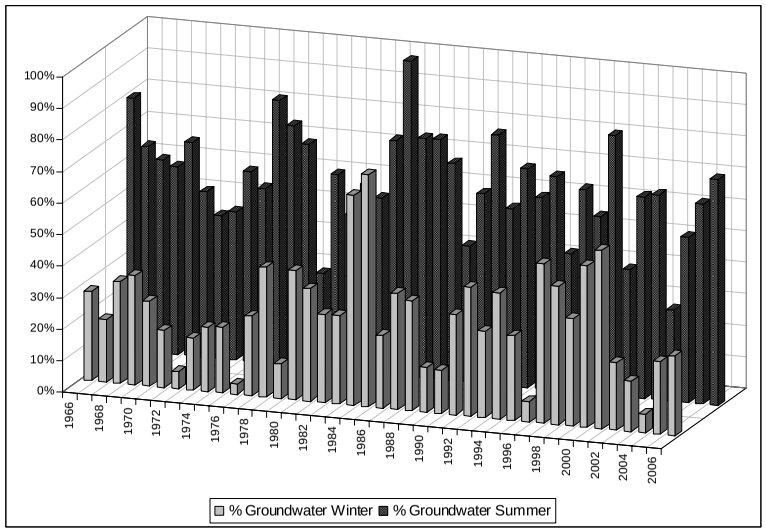


Figure 5 Annual Number of Days per Season for Groundwater Pumping

S.S. PAPADOPULOS & ASSOCIATES, INC.

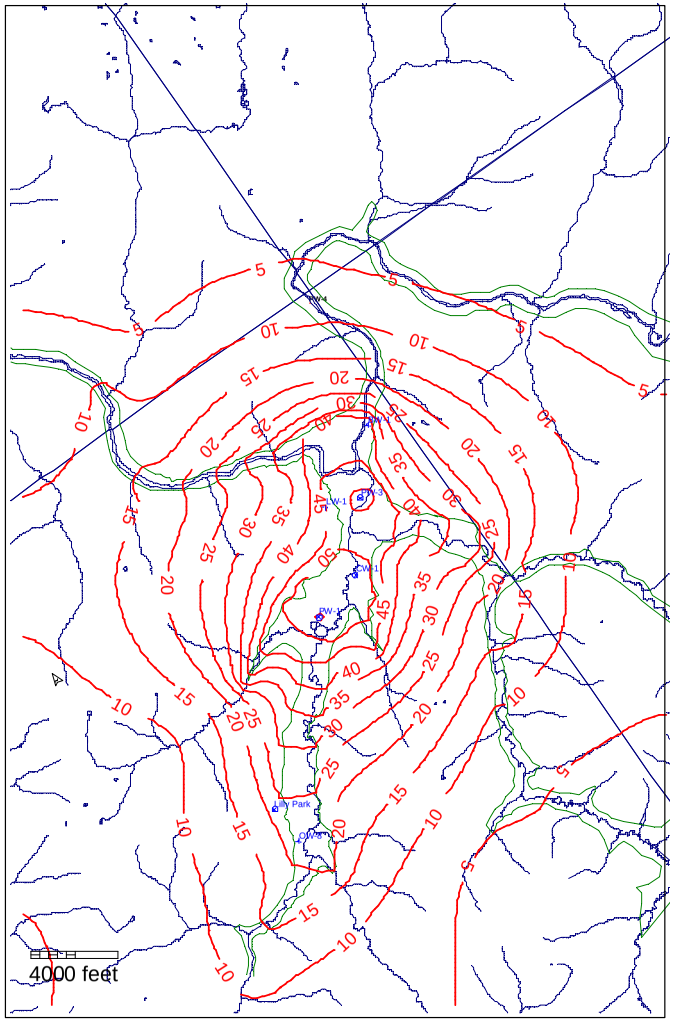


Figure 6 Simulated Drawdown after 25 years (Q=1,049 gpm).

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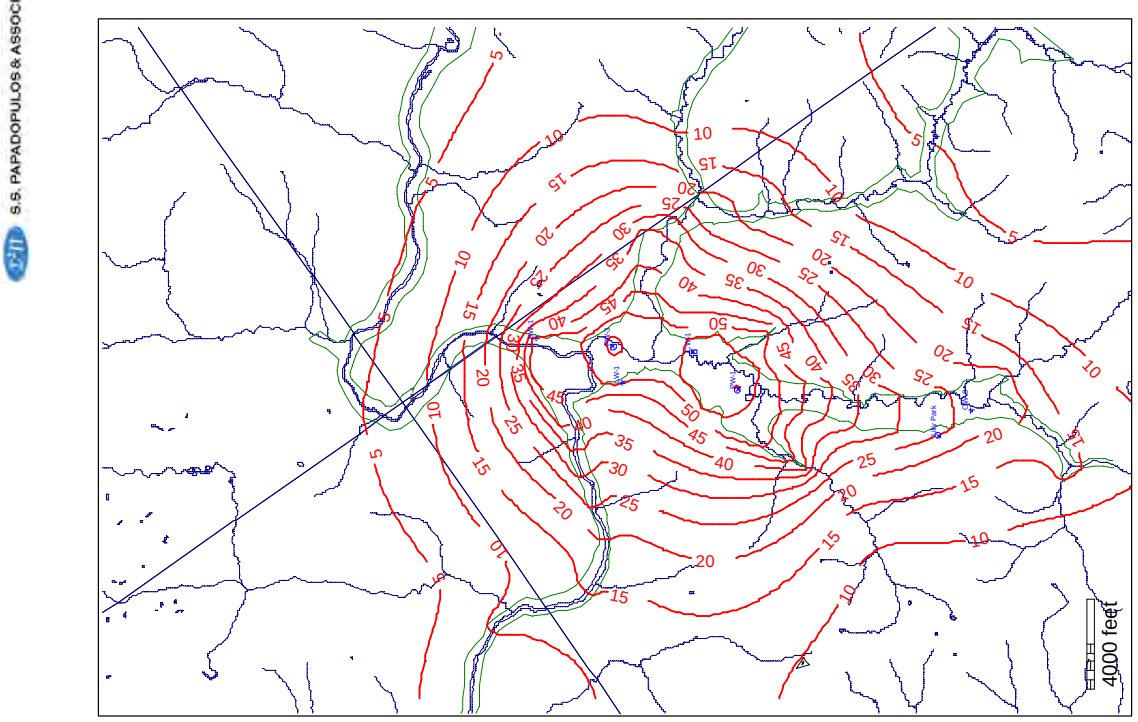


Figure 8 Simulated Drawdown after 25 years (Q=960 gpm Winter – 1,139 gpm Summer).

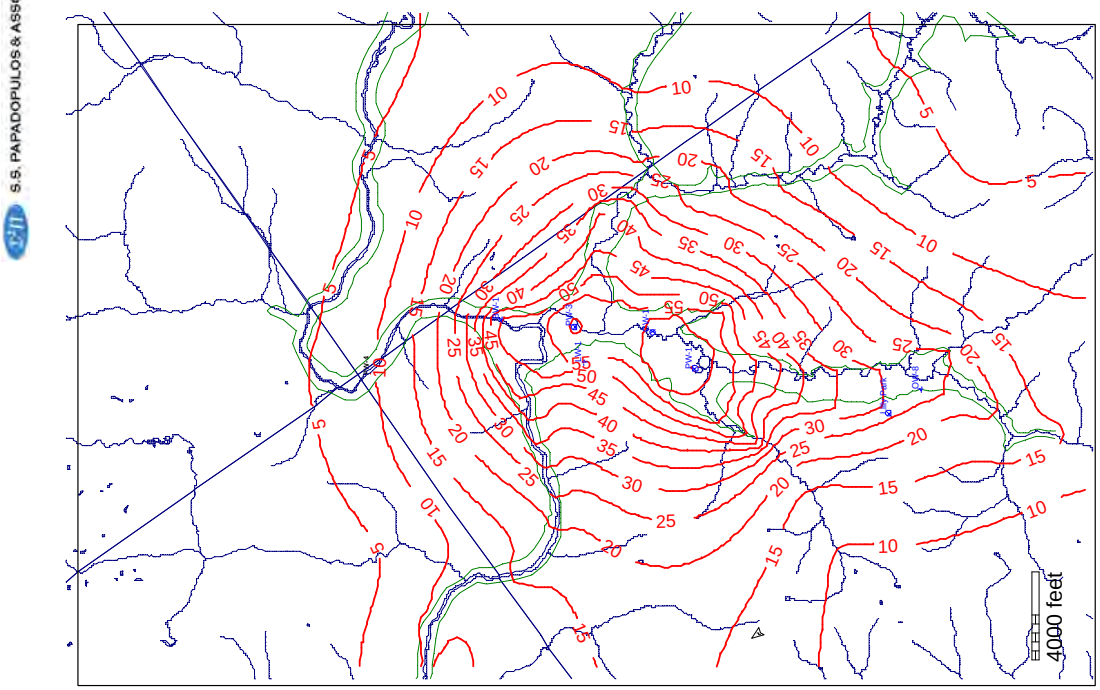


Figure 7 Simulated Drawdown after 25 years (Q=1,179 gpm).

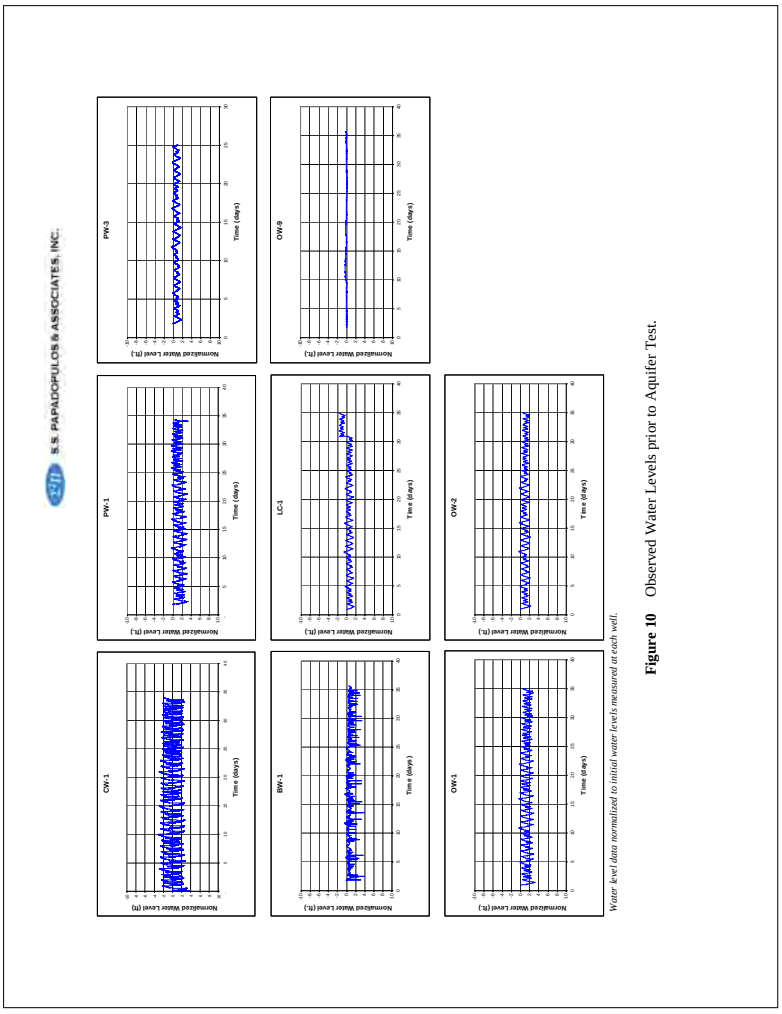


Figure 10 Observed Water Levels prior to Aquifer Test.

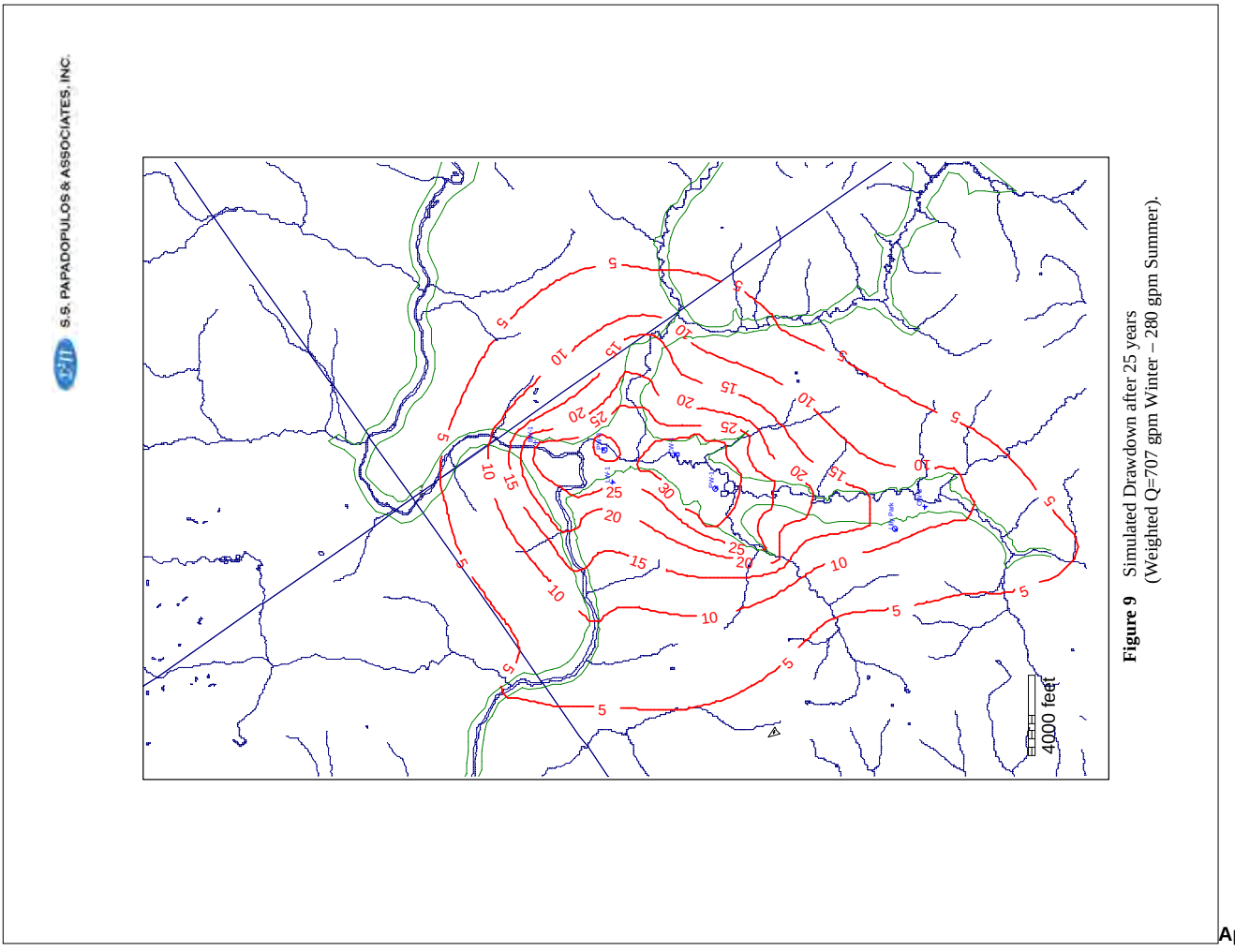


Figure 9 Simulated Drawdown after 25 years
(Weighted Q=707 gpm Winter – 280 gpm Summer).

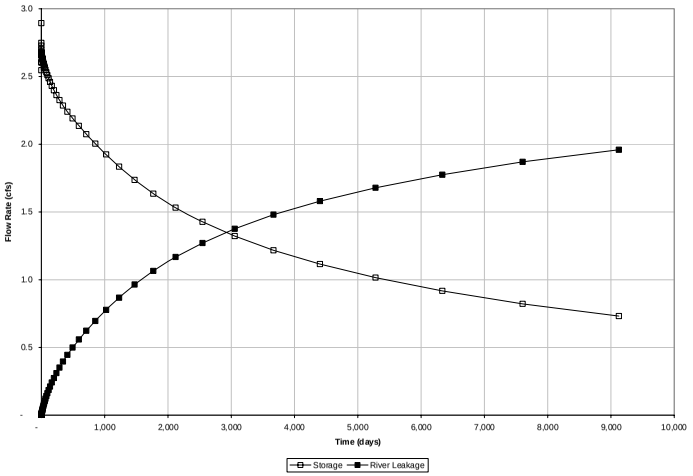


Figure 11 Storage Depletion versus River Leakage over a 25 Year Period (Q=1,049 gpm)

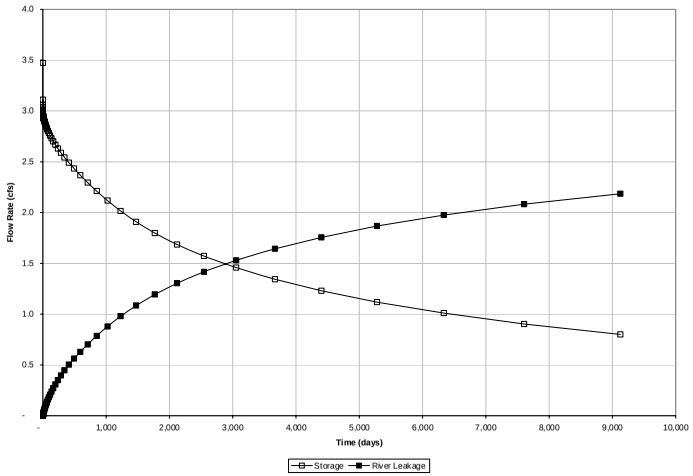


Figure 12 Storage Depletion versus River Leakage over a 25 Year Period (Q=1,179 gpm)

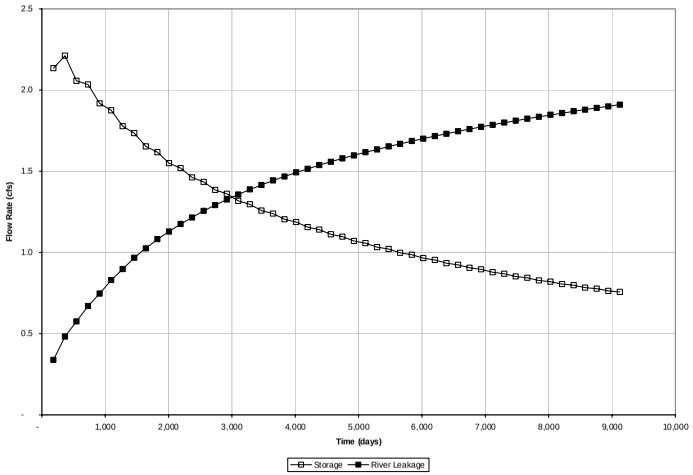


Figure 13 Storage Depletion versus River Leakage over a 25 Year Period (Q=960 gpm Winter – 1,139 gpm Summer)

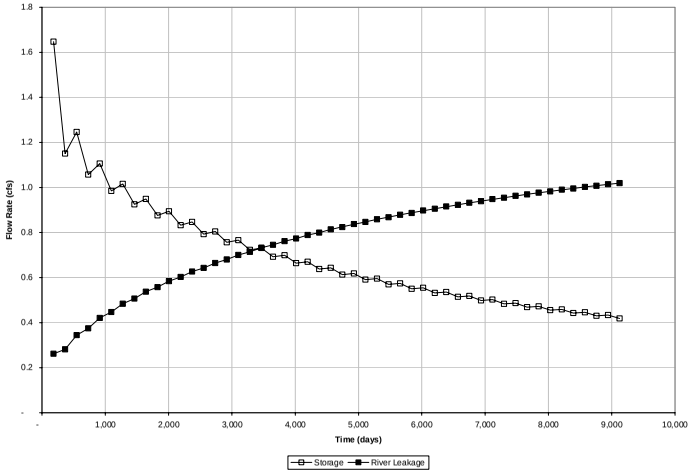


Figure 14 Storage Depletion versus River Leakage over a 25 Year Period (Weighted Q=707 gpm Winter – 280 gpm Summer)

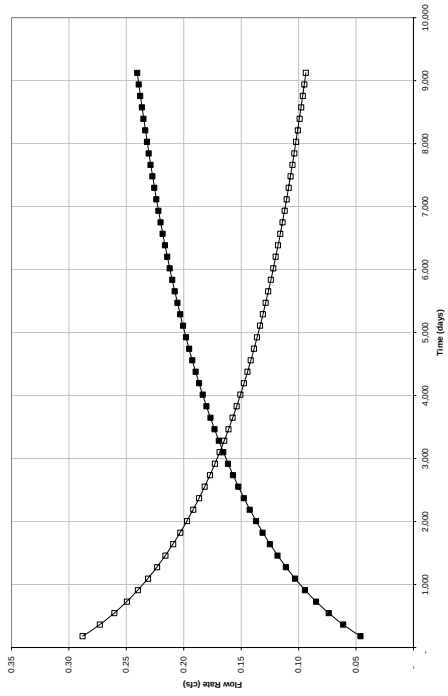


Figure 15 Storage Depletion versus River Leakage over a 25 Year Period, CW-1 (Q=150 gpm)

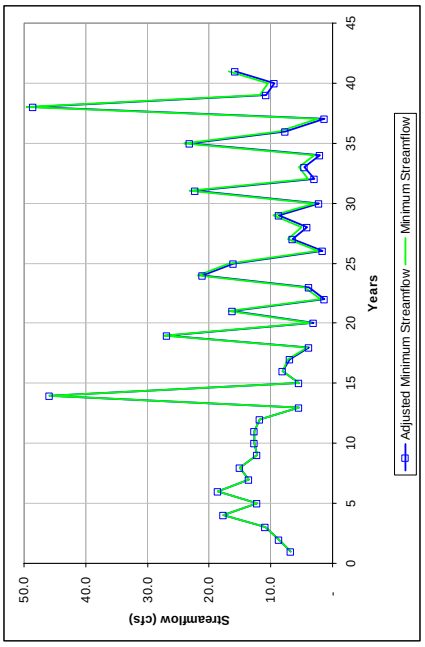


Figure 16 Minimum and Adjusted Minimum Streamflow Values for Meadow River.

Log of PW-1 based on geophysical log and video by Ed Custer, Jr

Top Elevation: 2,400.29 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	45.00	45.00	Casing or surface matter	
45.00	66.00	21.00	Shale, sandy, red, with sandstone streaks	
66.00	71.00	5.00	Shale, red, with interbedded sandstone	
71.00	89.00	18.00	Shale, sandy, red, with sandstone streaks	
89.00	90.00	1.00	Sandstone, gray	
90.00	91.00	1.00	Shale, sandy, red, with sandstone streaks	
91.00	126.00	35.00	Sandstone, gray	
126.00	150.00	24.00	Shale, sandy, red, with sandstone streaks	

Log of PW-3 based on geophysical log and video by Ed Custer, Jr

Top Elevation: 2,388.95 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	52.00	52.00	Casing	
52.00	54.30	2.30	Sandstone, gray crossbedded	Horizontal fracture at base no H20 or iron staining
54.30	77.00	22.70	Shale, sandy, red and green	Annealed 45-75 degree fractures
77.00	87.45	10.45	Sandstone, gray crossbedded	
87.45	92.35	4.90	Sandstone, gray crossbedded	Horizontal Broken Zones and fractures H20, iron staining on fractures
92.35	110.00	17.65	Sandstone, gray crossbedded	
110.00	111.00	1.00	Conglomerate, gray	Pebbles and Cobbles
111.00	114.00	3.00	Sandstone, gray crossbedded	Fracture At 113.55 some iron staining
114.00	146.00	32.00	Shale, sandy, red and green	
146.00	148.50	2.50	Sandstone, gray with shale streaks	Near horizontal Fracture at 147 iron staining
148.50	168.44	19.94	Sandstone, gray crossbedded	

Log of PW-4 based on geophysical log and video by Ed Custer, Jr

Top Elevation: 2,446.88 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	39.00	39.00	Casing	H20 9.5 Rock reported at 22.5 ft by driller
39.00	43.00	4.00	Sandstone, gray, crossbedded	
43.00	46.50	3.50	Sandy Shale	
46.50	66.00	19.50	Sandstone, gray, crossbedded	
66.00	67.00	1.00	Sandy Shale	
67.00	81.75	14.75	Sandstone, gray, crossbedded	H20 horizontal bedding fracture 80.5'
81.75	92.00	10.25	Sandy Shale, light grey green, ripple bedded	Horizontal bedding fractures @86, 88.5
92.00	126.00	34.00	Sandy Shale,red & green	
126.00	136.00	10.00	Shale,red & green, interbedded sandstone beds	
136.00	139.00	3.00	Sandstone, gray, crossbedded	
139.00	212.50	73.50	Sandy Shale,red & green	
212.50	215.00	2.50	Sandstone, gray, crossbedded	
215.00	226.50	11.50	Sandy Shale,red & green	
226.50	234.00	7.50	Shale,red & green, interbedded sandstone beds	
234.00	247.32	13.32	Sandy Shale,red & green	

Log of OW-1A (Danny McCoy, Rob Ridgeway, Engineering & Testing 2000, Inc.)

Top Elevation: 2,397.51 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	4.50	4.50	CL, Clay, Red Brown, sandstone gravel	Moist
4.50	5.00	0.50	CH, Dark gray, medium plastic	Moist
5.00	6.50	1.50	CH, Gray, sandy, plastic	Moist
6.50	10.00	3.50	CH, Gray, slightly silty,medium plastic	Water 9 feet
10.00	11.50	1.50	CH, Gray, trace silt and organics, plastic	Wet
11.50	15.00	3.50	CH, Gray, trace silt and organics, plastic	Wet
15.00	16.50	1.50	10" SP, Sand, Gray 6" CL, Clay, Gray, sandy 2" SP, Sandy, Gray	Wet
16.50	17.50	1.00	SP, Sand, Gray	Wet
17.50			Did not go to auger refusal	

Log of OW-1B (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,397.29 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	2.00	2.00	Fill	
2.00	5.00	3.00	Clay/silt	
5.00	19.00	14.00	Sand	
19.00	30.00	11.00	Shale, Red	
30.00	35.00	5.00	Sandstone	
35.00	81.00	46.00	Shale, Sandy, Red	Water at 81 feet
81.00	96.00	15.00	Sandstone	
96.00	98.00	2.00	Shale, Sandy, Red	
98.00	100.00	2.00	Sandstone	
100.00	104.00	4.00	Shale	
104.00	121.00	17.00	Sandstone	
121.00	138.00	17.00	Shale, Sandy, Red	Water at 138 feet
138.00	148.00	10.00	Sandstone	Fractured at 148 feet
148.00	160.00	12.00	Shale, Sandy, Blue	

Log of OW-2A (Danny McCoy, Rob Ridgeway, Engineering & Testing 2000, Inc.)

Top Elevation: 2,391.50 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	0.25	0.25	Top Soil	
0.25	2.50	2.25	CL, Clay, Red Brown, weathered shale chips	Moist
2.50	3.50	1.00	CH, Clay, Gray, medium plastic	Moist
3.50	5.00	1.50	CH, Clay, Tan, medium plastic	Moist
5.00	6.50	1.50	CH, Clay, Gray, plastic	Moist
6.50	9.00	2.50	CH, Clay, Gray, plastic	Moist
9.00	10.00	1.00	SP, Sand, Gray, clayey	Water 9 feet
10.00	11.50	1.50	5" SP, Sand, Gray, medium grained 1.5" SP, Sand, Gray, clayey, orgaincs 11.5" SP, Sand, Gray, clayey	Wet
11.50	15.00	3.50	SP, Sand, Gray, clayey	Wet
15.00	16.50	1.50	SP, Sand, Gray, medium to fine grained, This material probably was from material that flowed into the auger	Wet
15.50			Auger Refusal	

Log of OW-2B (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,393.19 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	3.00	3.00	Fill	
3.00	18.00	15.00	Sand	
18.00	32.00	14.00	Shale, Red	
32.00	40.00	8.00	Sandstone	
40.00	50.00	10.00	Shale, Sandy, Red	Water at 50 feet
50.00	71.00	21.00	Sandstone	Hard
71.00	87.00	16.00	Shale, Sandy, Red	Water at 87 feet
87.00	96.00	9.00	Sandstone	
96.00	128.00	32.00	Shale, Sandy, Red	Water at 128 feet
128.00	135.00	7.00	Sandstone	
135.00	140.00	5.00	Shale, Sandy, Red	
140.00	160.00	20.00	Shale, Sandy, Blue	

Log of OW-3A (Danny McCoy, Rob Ridgeway, Engineering & Testing 2000, Inc.)

Top Elevation: 2,394.39 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	0.50	0.50	Top Soil, Clay, Dark Brown, with organics	
0.50	5.00	4.50	CL, Clay, Tan, silty	Moist
5.00	6.50	1.50	3" SP, Sand, Tan, Moist 2" Clay, Black, Moist 13" SP, Sand, Tan, fine grained, clayey, Wet	
6.50	10.00	3.50	SP, Sand, Tan, clayey	Wet
10.00	11.50	1.50	5 SP, Sand, Tan, clayey, 13" SP, Sand, Gray, medium-fine grained	Wet
11.50	12.25	0.75	SP, Sand, Gray	Wet
12.25			Auger Refusal	

Log of OW-3B (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,393.66 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	2.00	2.00	Fill	
2.00	18.00	16.00	Sand	
18.00	20.00	2.00	Clay and Wood	
20.00	50.00	30.00	Shale, Sandy, Red	Water at 38 feet
50.00	65.00	15.00	Shale, Sandy, Blue	
65.00	95.00	30.00	Sandstone, white	
95.00	113.00	18.00	Shale, Sandy, Blue	
113.00	128.00	15.00	Shale, Sandy, Red	
128.00	134.00	6.00	Shale, Sandy, Blue	
134.00	138.00	4.00	Shale, Sandy, Red	
138.00	160.00	22.00	Shale, Sandy, Blue	

Log of OW-4A (Danny McCoy, Rob Ridgeway, Engineering & Testing 2000, Inc.)

Top Elevation: 2,402.57 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	0.25	0.25	Top Soil	
0.25	1.50	1.25	Fill, CL, Clay, Green Gray, silty	Moist
1.50	2.50	1.00	Fill, CL, Clay, Tan, coal chips	Hard Augering
2.50	3.50	1.00	Fill, Clay, coal and rock chips	
3.50	5.00	1.50	CL, Clay, Black, Fill?	
5.00	6.50	1.50	Fill, Clay, silt, wood chips	Moist
6.50	7.50	1.00	Fill, Clay, silt, wood chips	Moist
7.50	10.00	2.50	CL, Clay, Black, slightly plastic	Moist
10.00	11.50	1.50	CH, Clay, Gray, plastic	Moist
11.50	13.00	1.50	CH, Clay, Gray, plastic	Moist
13.00	15.00	2.00	SP/CH, Sand, Gray, Clayey	Wet
15.00	16.50	1.50	SP/CH, Sand, Gray, Clayey	Wet
15.00			Did not go to auger refusal	

Log of OW-4B (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,403.17 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	2.00	2.00	Fill	
2.00	18.00	16.00	Clay, sandy	
18.00	48.00	30.00	Shale, Red	
48.00	61.00	13.00	Sandstone	Water at 50 feet
61.00	88.00	27.00	Shale, Sandy, Red	
88.00	91.00	3.00	Shale, Sandy, Blue	
91.00	121.00	30.00	Sandstone	Water at 91 and 121 feet
121.00	138.00	17.00	Shale, Sandy, Blue	
138.00	148.00	10.00	Shale, Sandy, Red	
148.00	160.00	12.00	Shale, Sandy, Blue	

Log of OW-5A (Danny McCoy, Rob Ridgeway, Engineering & Testing 2000, Inc.)

Top Elevation: 2,415.29 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	0.50	0.50	Top Soil	
0.50	2.00	1.50	Fill, CL, Clay, Black, slightly plastic	Moist
2.00	3.50	1.50	CL, Clay, Dark Gray to Tan	Moist
3.50	5.00	1.50	CH, Clay, Tan, plastic	Moist
5.00	6.50	1.50	5" CH, Clay, Dark Gray, organics, plastic 10" CH, Clay, Tan, plastic	Moist
6.50	8.00	1.50	CH, Clay, Tan, plastic	Moist Water at 8 feet
8.00	10.00	2.00	SP, Sand, Gray, clayey, fine-medium grained	Wet
10.00	11.50	1.50	2" CH, Clay, Gray, plastic, Wet 6" SP, Sand, Tan, Wet 10" MH, Silt, Gray, very fine sandy, moist to wet	Wet
11.50	13.00	1.50	MH, Silt, Gray, sandy,	
13.00			Did not go to auger refusal	

Log of OW-5B (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,413.62 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	2.00	2.00	Fill	
2.00	15.00	13.00	Clay, sandy	
15.00	28.00	13.00	Shale, Soft	
28.00	51.00	23.00	Shale, Red	
51.00	54.00	3.00	Shale, Red, Hard	
54.00	58.00	4.00	Sandstone, Hard	
58.00	71.00	13.00	Shale, Red	
71.00	76.00	5.00	Shale, Red, Hard	
76.00	85.00	9.00	Shale, Sandy, Red	
85.00	91.00	6.00	Sandstone	Water 85-91 Feet
91.00	108.00	17.00	Sandstone	
108.00	109.00	1.00	Sandstone	Water 108-109 feet
109.00	121.00	12.00	Sandstone	
121.00	137.00	16.00	Sandstone	Water at 137 feet
137.00	144.00	7.00	Shale, Sandy, Blue	
144.00	160.00	16.00	Shale, Sandy, Red	

Log of OW-6A (Danny McCoy, Rob Ridgeway, Engineering & Testing 2000, Inc.)

Top Elevation: 2,400.83 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	0.25	0.25	Top Soil	
0.25	3.50	3.25	Fill, Clay, gravel, pieces of concrete	
3.50	5.00	1.50	CL, Clay, Black, sandy, fill?	Moist
5.00	6.50	1.50	12" CL, Gray, sandy, fine grained, Wet 6" CH, Clay, Gray, Organics	Wet/Moist
6.50	10.00	3.50	CH, Clay, Gray, plastic	Water at 7 feet
10.00	11.50	1.50	8" MH, Silt, tan/brown, clayey, sticky 10" CH, Clay, Tan and Gray, Plastic	Moist/Wet
11.50	15.00	3.50	CH, Clay, Tan and Gray, Plastic	Wet, Slow Augering
15.00	16.50	1.50	CH/MH, Clay and Silt, Tan and Gray, Plastic, Trace of coal and sand	
16.50	20.00	3.50	CH, Clay, silty, dark gray, sticky	Wet, Slow Augering
20.00	25.00	5.00	CH/MH, Clay, silty, sandy, dark gray, sticky	Water at 21 feet
25.00			No Auger Refusal	

Log of OW-6B (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,401.34 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	3.00	3.00	Fill	
3.00	24.00	21.00	Clay, silty	
24.00	70.00	46.00	Shale, Red	
70.00	92.00	22.00	Sandstone, Hard, Red	Water 92 Feet
92.00	125.00	33.00	Sandstone, Hard, salt and pepper	
125.00	135.00	10.00	Shale, Sandy	
135.00	160.00	25.00	Shale, Red	

Log of OW-7A (Danny McCoy, Rob Ridgeway, Engineering & Testing 2000, Inc.)

Top Elevation: 2,403.76 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	9.00	9.00	Clay, Tan/Dark Brown	Moist
9.00	12.00	3.00	SP - Sand, gray, medium grained, Wet	Water at 9 feet
12.00			Auger Refusal	Water at 2.5 feet after drilling

Log of OW-8 (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,410.75 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	40.00	40.00	Overburden	
40.00	60.00	20.00	Blue sand shale (little water encountered at 51 feet)	
60.00	98.00	38.00	White sand rock (water encountered at 89 feet)	
98.00	100.00	2.00	Blue and black rock with sulphur odor	
100.00	120.00	20.00	White sandstone	
120.00	147.00	27.00	Blue and white sand stone	
147.00	200.00	53.00	Red shale	

Log of OW-9 (Earl Tuckwiller, Tuckwiller Well Drilling)

Top Elevation: 2,413.38 ft amsl

Top_Depth	Bot_Depth	Thickness (ft)	Lithologic_Description	Comments
0.00	14.00	14.00	Overburden	
14.00	34.00	20.00	Red shale	
34.00	60.00	26.00	Reddish-blue shale	
60.00	80.00	20.00	Blue Shale	Little water at 60 ft.
80.00	99.00	19.00	Blue sandy shale	
99.00	100.00	1.00	Red shale	
100.00	120.00	20.00	Blue shale with little red shale	15 gpm of water at 110 ft.
120.00	125.00	5.00	Blue shale	
125.00	140.00	15.00	Red shale	More water encountered at 135 ft.
140.00	160.00	20.00	Red Shale	

Appendix E
Habitat Survey

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HABITAT ASSESSMENTS AND SURVEYS FOR ENDANGERED MAMMALS AT PROPOSED DEVELOPMENT AREAS FOR WESTERN GREENBRIER CO-GEN, GREENBRIER COUNTY, WEST VIRGINIA

29 April 2005

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1.0 Regulatory Setting

The federal Endangered Species Act (ESA) [16 U.S.C. 1531 *et seq.*] became law in 1973 and provides for the listing, conservation, and recovery of endangered and threatened species of plants and wildlife. Under the ESA, the U.S. Fish and Wildlife Service (USFWS) strives to protect and monitor the numbers and populations of listed species. Many states enacted similar laws.

Section 7(a)(2) of the ESA states that each federal agency shall insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in destruction or adverse modification of designated critical habitat. Federal actions include (1) expenditure of federal funds for roads, buildings, or other construction projects, and (2) approval of a permit or license, and the activities resulting from such permit or license. This is true regardless of whether involvement is apparent, such as issuance of a federal permit, or less direct, such as federal oversight of a state-operated program.

Section 9 of the ESA prohibits take of listed species. Take is defined by the ESA as "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.*" The definition of harm includes adverse habitat modification. Actions of federal agencies that do not result in jeopardy or adverse modification, but that could result in a take, must be addressed under Section 7.

As part of the environmental studies performed to determine the potential impacts of siting the Western Greenbrier Co-Gen plant near Rainelle, West Virginia, habitat assessments and summer mist netting surveys for the endangered Indiana bat (*Myotis sodalis*) and Virginia big-eared bat (*Corynorhinus townsendii virginianus*), and a habitat assessment for the Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) were conducted within proposed project development areas. Surveys were conducted in the vicinity of the proposed power plant and transmission line corridor in Rainelle, West Virginia, and at the Anjean waste coal pile. After coordination with U.S. Fish and Wildlife Service (Appendix G), the level of effort required for the Rainelle power plant area was one net site, as well as one net site for the transmission line corridor. Therefore, a total of two net sites were selected and netted.

ESI completed field efforts under Federal Endangered Species Permit TE 023664 and a Scientific Wildlife Collecting Permit # 2004.188 from West Virginia Department of Natural Resources (WVDNR).

2.0 Project Setting

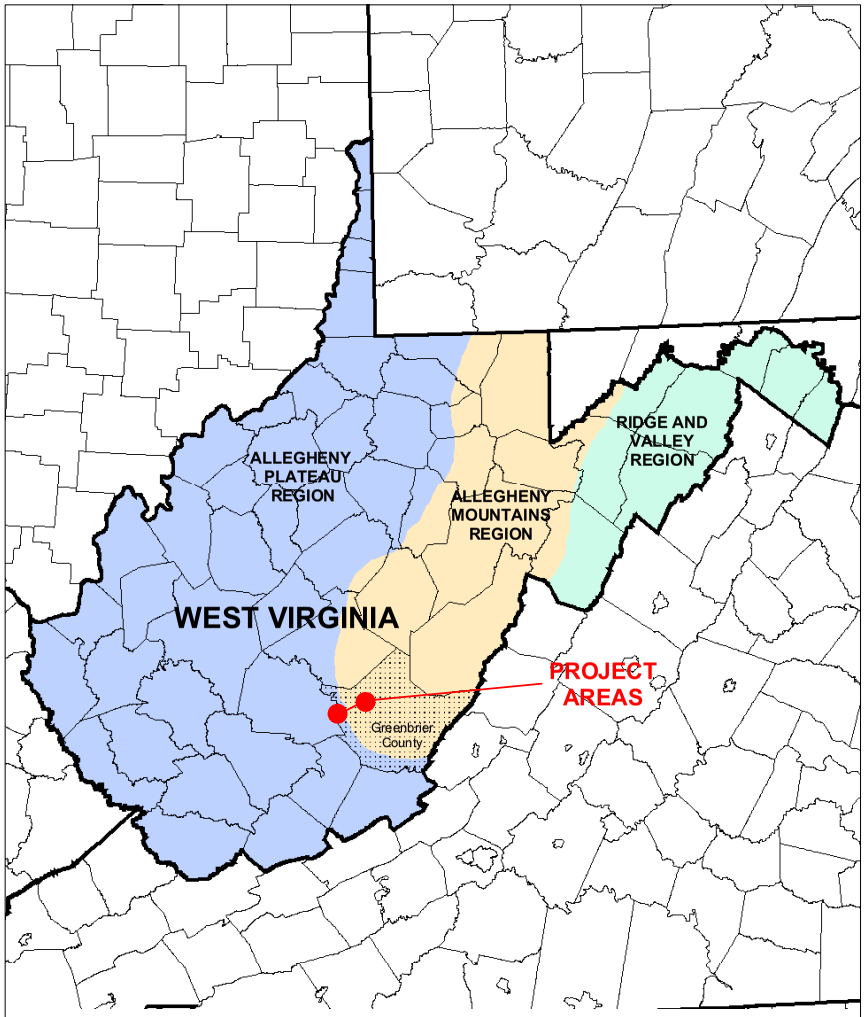
2.1 Location

The proposed co-generation facility and transmission line corridor are located within and near the City of Rainelle, just east of the Fayette/Greenbrier County line (Figure 1). Separate habitat assessments and netting surveys were conducted in these areas to assess the potential impact to endangered species. A habitat assessment for endangered species was also conducted on a previous surface mine facility on Anjean Mountain, located approximately 7 miles northeast of Rainelle, near the Town of Rupert.

West Virginia is divided between three physiographic regions (Green and Pauley 1987). The Eastern Panhandle of West Virginia lies in the Ridge and Valley region. The Allegheny Mountains region is located on the central portion of state that borders Virginia, and continues north into Pennsylvania and Maryland. Immediately to the west of the Allegheny Mountains, and including over 60 percent of the state, is the Allegheny Plateau. The steep, rugged mountains of the Allegheny Front mark the northern part of the boundary between the Ridge and Valley province and the Allegheny Plateau. The project areas are in Greenbrier County (near the border of Fayette County), where the eastern border of the Allegheny Plateau meets the Allegheny Mountains. Sometimes steep (but gently rolling) hills characterize this area. Ridges, valleys, and associated watersheds tend to run longitudinally northeast to southwest. Abundant caves, caverns, and sinkholes exist in the karst region of Greenbrier County, found several miles east of the project areas.

According to Braun (1950), the project areas are within the Cumberland and Allegheny Plateau Section of the Mixed Mesophytic Forest Region. Originally, undisturbed upper slopes and ridge tops were dominated by red maple (*Acer rubrum*) and several species of oak, including: white (*Quercus alba*), chestnut (*Q. montana*), black (*Q. velutina*), and northern red (*Q. rubra*). Some upland areas were mined and now have early successional forest dominated by black locust (*Robinia pseudo-acacia*), and tree-of-heaven (*Ailanthus altissima*), an invasive exotic species. Forests on relatively undisturbed mesic coves and steep slopes are dominated by tulip poplar (*Liriodendron tulipifera*), sugar maple (*A. saccharum*), American beech (*Fagus grandifolia*), sweet birch (*Betula lenta*), and northern red and white oaks. Mines in the area have created early successional forest and/or openings dominated by herbaceous species. Some areas have no riparian forest, and when present, it is in varying stages of succession, dominated by American sycamore (*Platanus occidentalis*), ironwood (*Carpinus caroliniana*), sweet birch, tulip poplar, and northern red oak.

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Source: Buckelew and Hall, The West Virginia Breeding Bird Atlas, 1994.

Figure 1. Location of Rainelle Power Plant and Anjean Project Areas in Greenbrier County, West Virginia

Project No. 115

ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

2.2 Regional Species Occurrence

2.2.1 Indiana Bat

The Federally-endangered Indiana bat is known from the region that includes central West Virginia and western Virginia, and has been reported in Greenbrier County. Winter hibernacula occur along the eastern and southern border of Virginia, including Greenbrier, Hardy, Mercer, Monroe, Pendleton, Pocahontas, Preston, Randolph, and Tucker counties. In western Virginia, winter hibernacula have been reported from Bath, Bland, Craig, Giles, Dickenson, Highland, Lee, Montgomery, Tazewell, and Wise counties. Summer records for the area consist primarily of adult males, with sites in Clay and Nicholas counties, West Virginia. Two reproductive female Indiana bats were captured during the summer of 2003 in Boone County, West Virginia, indicating the presence of a summer maternity colony. These captures, located approximately 50 miles west of the project area, represent the first confirmed reproductive records for Indiana bats in West Virginia (Linda Smith, USFWS, pers. comm., 2003).

2.2.2 Virginia Big-eared Bat

The Federally-endangered Virginia big-eared bat is the subspecies of Townsend's big-eared bat that occurs in Kentucky, North Carolina, Virginia, and West Virginia. It inhabits caves during both summer and winter. In winter, the species hibernates in clusters in cool portions of caves, while summer maternity colonies are formed in warmer portions of caves. WVDNR (Craig Stihler, pers. comm., 2002) and USFWS (2001) have been monitoring Virginia big-eared bat populations in West Virginia since 1983. Eleven summer colonies (including eight maternity colonies) and nine winter colonies are surveyed by WVDNR on a regular basis (annually in summer, biannually in winter). In addition to those caves, Virginia big-eared bats have been found in 29 additional caves. Usually these records are for occasional or sporadic occurrences, transients, and historic records. Caves used by the species are concentrated in the northeastern portion of the state: Grant, Tucker, Pendleton, Hardy, Preston, and Randolph counties. The largest single colony is approximately 90 miles to the northeast in Pendleton County. In Virginia, two active Virginia big-eared bat maternity colonies are currently known (Rick Reynolds, VDGIF, pers. comm., 2002); both are over 60 miles away from the project area in Tazewell County.

2.2.3 Virginia Northern Flying Squirrel

The Federally-endangered Virginia northern flying squirrel (*G. s. fuscus*) is known only from the Appalachian Mountains in West Virginia and Virginia. In West Virginia, it has been captured in Greenbrier, Pendleton, Pocahontas, Randolph, Tucker, and Webster counties (USFWS 1990). Known locations in Virginia include Highland, Smyth, Grayson, and Montgomery counties (USFWS 1990). The closest known population is in Cranberry Wildlife Management Area on Monongahela National Forest, about 15 miles northwest of the project areas. This species is closely

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associated with higher elevations (>1000 m; >3,280 ft) and coniferous forests of spruce and fir (USFWS 1990). Recent, detailed studies in the southern Appalachians, however, have demonstrated that this squirrel occasionally uses lower elevations (down to approximately 710 m; 2,330 ft) and hardwood forests in proximity to spruce or hemlock (C. Stihler, pers. comm.).

3.0 Natural History of the Indiana Bat

3.1 Status

Federal Register Documents

41 FR 41914; 24 September 1976: Final Critical Habitat, Critical habitat—mammals
40 FR 58308 58312; 16 December 1975: Proposed Critical Habitat, Critical habitat—mammals
32 FR 4001; 11 March 1967: Final Listing, Endangered

The USFWS listed the Indiana bat (*Myotis sodalis*) as endangered on 11 March 1967. The most current range-wide estimate of the population is 382,000 individuals (Clawson 2002), which represents about 43 percent of the estimated population of 1960. Long-term, detailed documentation of population changes are lacking in many areas, although Indiana is an exception (Brack et al. 1984, 2003; Johnson et al. 2002). It is probable that summer habitat losses (USFWS 1999) and winter disturbances (Johnson et al. 1998) contributed to the overall decline of the species.

The Indiana bat is a "tree bat" in summer and a "cave bat" in winter. There are four ecologically distinct components of the annual life cycle: winter hibernation, spring staging and autumn swarming, spring and autumn migration, and the summer season of reproduction. The U.S. Fish and Wildlife Service Recovery Plan (1999) provides a description of the life history. Figure 2 provides an annual chronology of seasonal activities.

3.2 Winter Hibernation



The winter range of the Indiana bat is large and is restricted to regions of well-developed limestone caves where it overwinters in approximately 300 known hibernacula. Most hibernacula are in caves, but abandoned mines (Kath 2002; Hicks and Novak 2002; Brack et al. in prep) are sometimes used. There are large populations of Indiana bats in only a few caves, while most hibernacula contain only a few bats. Hibernacula with large populations of Indiana bats are concentrated in southern Missouri, Indiana, and Kentucky. Smaller wintering populations occur in Alabama, Arkansas, Connecticut, Georgia, Illinois, Iowa, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia.

Hibernation is an adaptation that allows survival through the winter months when food and water are not abundant. Indiana bats hibernate from mid-November to mid-April. Many species of bats (including the Indiana bat) make relatively characteristic and recognizable use of hibernacula, including temperature regimes and spatial

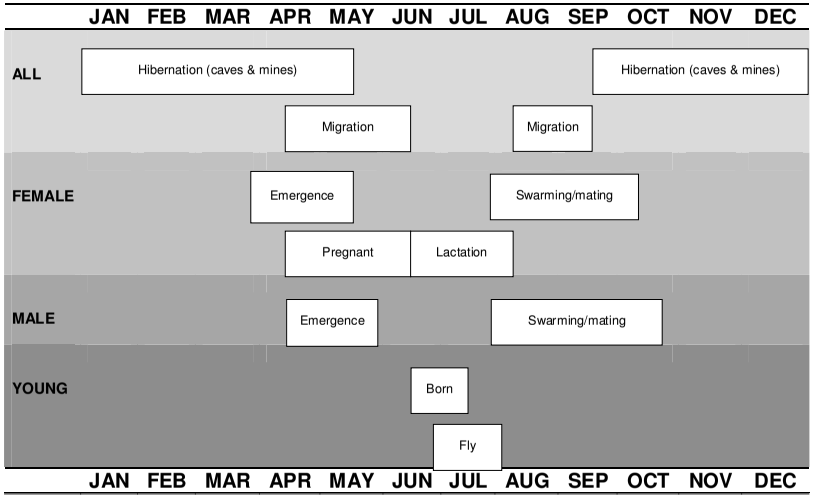


Figure 2. Seasonal chronology of Indiana bat activities.

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associations (Brack 1979, Brack et al. 2003; Brack and Twente 1985; Twente et al. 1985). Hibernating Indiana bats often form dense clusters on cave ceilings in portions of the cave where winter temperatures are suitable. Initially, this temperature was believed to be 4 to 8ºC (or perhaps more narrowly 3 to 6ºC during mid-winter (USFWS 1999), but these assertions (Hall 1962; Henshaw and Folk 1966; Humphrey 1978) were supported with scant data. Recent analysis of long-term data in hibernacula with increasing numbers of Indiana bats indicates the optimal range is closer to 6 to 8ºC (Myers 1964; Clawson et al. 1980; Brack et al. 2003; Brack in prep; Brack and Reynolds in Prep: Brack et al. in prep; Brack and Reynolds in prep). Therefore, Indiana bats use areas that are cool, but thermally stable. Colder areas, especially areas closer to the entrance, are often unstable. Clusters of bats are not sexually segregated.

3.3 Spring Staging and Autumn Swarming

3.3.1 Spring

Female Indiana bats leave hibernacula earlier in spring (beginning in mid-April) than do males (peak of departure in early May). This part of spring activity is referred to as staging. In spring, after emerging from hibernation, bats may remain near hibernacula caves for a few days before leaving for summer maternity areas. They may use this time to help prepare for migration.

3.3.2 Autumn

Autumn swarming is a term used to describe the activity of microchiropteran bats at hibernacula in North America (Cope and Humphrey 1977) and Europe (Parsons et al. 2003) during autumn. It is the use and visitation of hibernacula and nearby habitats in late summer and early autumn, and for many species is associated with the opportunity for sexes to meet and mate.

In autumn, Indiana bats swarm at caves used for hibernation, although individuals probably come and go throughout the autumn season. Cope and Humphrey (1977) indicated that “waves” of Indiana bats begin to return to a hibernacula in southern Indiana in low to moderate numbers in mid to late August. Also in Indiana, Brack (1983) found the first individuals arriving as early as late July. In Missouri, LaVal and LaVal (1980) indicated that individuals begin to return to hibernacula in early August.

During swarming, the abundance of females increases and decreases with the season, but males are always more common (Cope and Humphrey 1977; Laval and LaVal 1980). Numbers of swarming females peak in September. By late September, many females are hibernating while many males remain active until mid-October or later, apparently in an effort to breed late-arriving females. Small males with insufficient fat reserves to survive winter may remain active in hibernacula seeking to copulate before dying (Richter et al. 1993). Temperature and precipitation likely influence swarming chronology. For example, rain has been shown to depress

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Appendix E

swarming activity in Europe (Parsons et al. 2003). Large, wet cold-weather systems may be part of the seasonal cycle driving the timing of swarming (Brack in prep). Females store sperm through hibernation and delay fertilization until spring (Wimsatt 1944). It is not known if juvenile females mate their first autumn. Limited mating may occur in spring (Hall 1962).

During early stages of autumn swarming, Indiana bats visit hibernacula at night, but may roost in woodlands during the day, often near the cave: 0.5 mi (0.8 km) in Virginia (Brack in prep) and 1 mi (1.9 km) in Kentucky (Gumbert 2001). In Virginia, Indiana bats used a variety of species of live, dying, and dead roost trees (Brack in prep). Individual bats roosted in multiple roost trees, which were sometimes used for 2 to 3 consecutive days. Many roosts were near canopy openings including selective cut, clear-cut, and pastured woodlands with scattered trees. Roosts were also found near or along logging roads or powerline corridors. Bats also used roost trees in forests with moderate to high canopy closure. Compared to availability, roost trees were located disproportionately more often in open, intermediate, and closed deciduous forests rather than mixed deciduous/evergreen forest. Roosts found in agricultural areas bordered croplands. In Virginia, there was no difference between sizes of roost trees used by females and males (17.5 vs. 15.5 in; 44.4 vs. 39.3 cm), height of roost above ground (37 vs. 40 ft; 11.4 vs. 12.2 m), or elevation where roost trees were found (2,750 vs. 2.950 ft; 839 vs. 900 m). There was no difference between species of roost trees used by male and female bats throughout the autumn season, as well as no discrimination between living or dead trees (Brack in prep). As the autumn season progresses, more bats roost in the hibernacula caves.

In Virginia, nocturnal activity areas were 237 to 907 ac (96 - 367 ha; $\bar{X}$ = 251 ha), with a great deal of overlap among activity areas of individuals (Brack in prep). Bats in the Virginia project area were proportionately more active in open deciduous forests, even though there was less of that habitat available in the area (19.0% vs. 9.5%). They were less active in mixed deciduous-evergreen forests and closed deciduous forests, even though the habitat types were significantly more abundant in the area (Brack in prep). Thus, Indiana bats foraged in relatively open habitats, consisting primarily of pastures with scattered trees, within this Virginia project area. Many pastures (agricultural lands) in the Virginia project area had scattered trees that abutted woodlands, with a gradation from pasture to woodlands, and open woodlands were generally recently-logged tracts with a scattering of individual trees. Bats were active across all elevations in the Virginia project area. Many bats included an existing powerline ROW (a notable feature on a forested landscape) in their active area. Bat activity shifted among habitats over the autumn season (Brack in prep). Use of agricultural lands dropped steadily over the season; conversely, use of deciduous forests (combined open, intermediate, and closed) increased, possibly in response to insect availability.

As the autumn season progresses, nightly bat activity begins earlier in the evening. As temperatures cool seasonally, nocturnal insects have a limited activity period; consequently, so do the bats (Brack in prep; Parsons et al. 2003). It is probable that many bats leave the hibernaculum area periodically during autumn swarming (Brack in prep; Gumbert 2001). It is not known why bats leave, but departures during swarming have implications for reproductive fitness since it reduces or eliminates the opportunity to mate. Possibly, bats visit and mate at other swarming locations. Alternatively, males actively seeking mating opportunities may need to intermittently leave the swarming area to forage and replenish energy supplies.

3.4 Spring and Autumn Migration

Little is known about bats during migration. In general, females are more migratory than males (Whitaker and Brack 2002; Brack 1983). Females from a single hibernaculum may end up at maternity colonies over a large geographic area, and females from a single maternity colony may end up in different hibernacula (Barbour and Davis 1969; Gardner and Cook 2002; Kurta and Murray 2002). It is probable that bats use a variety of roosts, including trees, caves, mines, holes of various types, and possibly a variety of non-traditional roosts during migration. Bats migrating from hibernacula in southeastern New York to summer maternity sites roosted in trees and on a building – in a gap between a cinderblock wall and a joist under an elevated deck (Sanders and Chenger 2001), as well as in the siding of a house and in trees of suburban yards. In late summer, a juvenile Indiana bat was found on the side of a building in central Indiana that had a roughed cement exterior (Brack, unpublished data). In northern Ohio, several Indiana bats have been caught in autumn in sandstone crevices that likely serve as a migratory stop-over (Summit County Metro Parks 2003). During migration, other species of bats have been found in a variety of unlikely locations, including ships at sea, log piles, and rodent holes in treeless areas (Brack and Carter 1985).

3.5 Summer Roosting Ecology

The summer range of the Indiana bat is large and includes much of the eastern deciduous forestlands between the Appalachian Mountains and Midwest prairies. Distribution throughout the range is not uniform and summer occurrences are more frequent in southern Iowa and Michigan, northern Missouri, Illinois, and Indiana. Greater tree densities do not equate to more bats (Brack et al. 2002). Cooler summer temperatures associated with latitude or altitude likely affect reproductive success and the summer distribution of the species (Brack et al. 2002).

3.5.1 Males

Some males remain near hibernacula throughout summer while others migrate varying distances (Whitaker and Brack 2002). Males can be caught at hibernacula on most nights during summer (Brack 1983; Brack and LaVal 1985), although there may be a large turnover of individuals between nights (Brack 1983).

Woodland roosts appear similar to maternity roosts (Kiser and Elliott 1996; Schultes and Elliott 2002; Brack et al. 2004; Brack and Whitaker 2004), although smaller diameter trees may be used. Less space may be required for a single bat than a colony of bats, or thermal requirements may differ. Males appear somewhat nomadic; over time, the number of roosts and the size of an area used increases. Activity areas encompass roads of all sizes, from trails to interstate highways. Roosts have also been located near roads of all sizes (Kiser and Elliott 1996; Schultes and Elliott 2002; Brack et al 2004), including adjacent to an interstate highway (Brack et al. 2004).

3.5.2 Females and Maternity Colonies

When female Indiana bats emerge from hibernation, they migrate to maternity colonies that may be located up to several hundred miles away (Kurta and Murray 2002). Females form nursery colonies under exfoliating bark of dead, dying, and living trees in a variety of habitat types, including uplands and riparian habitats. A wide variety of tree species (occasionally including pines [Britzke et al. 2003]) are used as nursery colonies, indicating that it is tree form, not species, which is important for roosts. Since many roosts are in dead or dying trees, they are often ephemeral. Roost trees may be habitable for one to several years, depending on the species and condition of the tree (Callahan et al. 1997). Indiana bats exhibit strong site fidelity to summer roosting and foraging areas (Kurta and Murray 2002; Kurta et al. 2002).



A maternity colony typically consists of 25 to 325 adult females. Nursery colonies often use several roost trees (Kurta et al. 1993; Foster and Kurta 1999; Kurta et al. 2002), moving among roosts within a season. Most members of a colony coalesce into a single roost tree about the time of parturition, which begins to break up again as soon as young are volant. Roosts that contain large numbers of bats (>20 bats) are often called primary roosts, while secondary roosts hold fewer bats. Primary roost trees are often greater than 18 inches (45 cm) dbh and secondary roost trees are often greater than 9 inches (22 cm) dbh (Gardner et al. 1991; Callahan et al. 1997; Kurta et al 2002; Miller et al. 2002; Carter 2003). Numerous suitable roosts may be required to support a single nursery colony, possibly about 20 stems per acre (45/ha) (Gardner et al. 1991; Miller et al. 2002; Carter 2003).

Roost trees are often located where they have solar exposure, with 20 to 80 percent canopy closure (Humphrey et al. 1977; Gardner et al. 1991; Kurta et al. 1993, 1996, 2002; Carter 2003). They are often exposed to 10 or more hours of solar radiation per day (Kurta et al 2002). The need for solar exposure may vary with latitude. Although maternity colonies of Indiana bats typically roost under the exfoliating bark

of dead and dying trees, they have also been found roosting in buildings, one in Pennsylvania (Butchkoski and Hassinger 2002) and one in a barn in Iowa (unpubl. report), and bat boxes (Whitaker et al., in submission). Individuals that were likely part of maternity colonies have been found in bat boxes (Carter 2002), and various tree hollows and tree cracks (L. C. Watkins in Humphrey et al. 1977; Kurta et al. 1993, 2002).

Females are pregnant when they arrive at maternity roosts. Fecundity of the species is low, for females produce only one young per year. Parturition typically occurs between late June and early July. Lactating females have been caught 11 June to 29 July in Indiana, 26 June to 22 July in Iowa, and 11 June to 6 July in Missouri (Humphrey et al. 1977; LaVal and LaVal 1980; Brack 1983; Clark et al. 1987). Juveniles become volant between early July and early August. Reproductive phenology is likely dependent upon seasonal temperatures and the thermal character of the roost (Humphrey et al. 1977; Kurta et al. 1996). Like many microchiropterans, Indiana bats are thermal conformists (Stones and Wiebers 1967), with prenatal, neonatal, and juvenile development temperature dependent (Racey 1982). Cooler summer temperatures associated with latitude or altitude likely affect reproductive success and therefore the summer distribution of the species (Brack et al. 2002).

Nightly non-foraging behavior of Indiana bats is poorly documented. In Michigan, pregnant bats from a maternity colony foraged most of the night, but lactating females returned two to four times to feed young. Both pregnant and lactating females roosted up to six times per night for 14 minutes each (*SD* = 1; Murray and Kurta 2004). Foraging areas were 0.3 to 2.5 mi (0.5 - 4.2 km) from diurnal roosts. Kiser et al. (2002) found 82 bats under three bridges over a 6-night period in late July and August. Temperatures under the bridges were warmer and less variable than ambient, apparently providing a location to hang and digest food between foraging bouts. These bridges were 0.6 to 1.2 mi (1.0 - 1.9 km) from diurnal roost trees.

Indiana bats live on anthropogenic landscapes and recent research indicates females do include roads in their active area. Although bats do cross roads, the studies that document this behavior were not designed to gauge a graded response. On Camp Atterbury, Indiana, female and juvenile Indiana bats routinely night roosted under bridges on 2-lane paved roads (Kiser et al. 2002). Activity areas of nursery colonies in Illinois (Gardner et al. 1991) and Michigan (Kurta et al. 2002) included paved roads. On the campus of Wright State University, Ohio, a roost tree was located at the edge of a large parking lot, and about 60 ft (20 m) from a moderately traveled road. Emerging bats crossed the parking lot and radio-tagged bats crossed highway 444, a 4-lane divided highway to forage in a 180-ac (73 ha) woodlot (Brown et al. 2001). A female Indiana bat from a maternity roost tree on the west edge of the Indianapolis, Indiana, Airport and north of Interstate 70, routinely crossed this 6-lane interstate to forage (Brack, unpublished data). In eastern Indiana, adjacent to Newport Chemical Depot, a reproductive female Indiana bat was radio-tracked

across a 4-lane divided highway to a maternity colony in a small (1.7 ac; 0.7 ha), isolated woodlot (Brack and Whitaker, in prep). The roost tree was on the west edge of the woodlot, adjacent to the highway and the woodlot was surrounded on other sides by open, farmed agricultural lands.

3.6 Food Habits and Foraging Ecology

The diet of Indiana bats differs depending on age and sex, but often includes a variety of insects that vary by habitat and season. Based on diets of males, Brack and LaVal (1985) considered the species selective opportunists. In Indiana, aquatic-based insects were more common in the diet of a maternity colony than in the diet of males collected at caves (Brack 1983). The maternity colony was located along the Big Blue River, where only about 11 percent of the land within 2 mi (3.2 km) of the roost was forested (most was riparian), whereas males were caught at a cave where 42 percent of the area within 2 mi (3.2 km) was forested and only a small portion was riparian. In late summer, the diets of males, females, and juveniles captured at caves were similar to one another and to males' summer diets. Diets reported by Belwood (1979) from a colony along a stream and by Kurta and Whitaker (1998) from a colony within a wooded wetland contained more aquatic-based insects than diets of males foraging in an upland habitat (Brack and LaVal 1985). The repeated seasonal occurrence of the Asiatic oak weevil, *Cyrtepistomus castaneus* and sporadic abundance of hymenopterans in the diet (Brack 1983; Brack and LaVal 1985; Brack and Whitaker 2004; Brack in submission) are both indicative of opportunistic feeding. Insects may be less common late at night, forcing bats to eat a greater variety of insects (Brack 1983). Later in the season when insect abundance is greater, they may eat a less diverse diet (Brack and LaVal 1985; Brack 1983). Diet also varies by lunar cycle (Brack 1983; Brack and LaVal 1985; Brack in submission), because the cycle affects insects. Murray and Kurta (2002) found that the diet was flexible across the range and potentially affected by regional and local differences in bat assemblages and availability of foraging habitat and prey.

Distances Indiana bats travel to forage may be quite variable. Using reflective wristbands, Humphrey et al. (1977) found that a maternity colony foraged in areas ranging in total from 3.7 to 11.1 ac (1.5 - 4.5 ha). In Illinois, individuals traveled up to 2.5 mi (4.2 km) from maternity colonies (Gardner et al. 1991). In Michigan, foraging areas were 0.3 to 2.5 mi (0.5 - 4.2 km) from diurnal roosts (Murray and Kurta 2004), and members of a maternity colony moved a maximum distance among roosts of 3.6 mi (5.8 km) overnight, but 5.7 mi (9.2 km) over 4 years (Kurta et al. 2002). In Missouri, adult males traveled 3.1 miles while foraging (LaVal and LaVal 1980), and Brack (1983) observed foraging light-tagged bats within 2 miles of caves used during autumn swarming. In Hoosier National Forest, the mean active foraging area of four adult male bats ranged from 95.1 to 151.9 ha based on the method of estimation, while the means of individual bats across three methods of estimation (95% minimum convex polygon, capture radius, and non-circular) ranged from 43.1 to 314.2 ha (Brack et al. 2004). Active areas used by individual bats often overlap. Individuals of

many species of bats that roost colonially forage independently of one another (Kerth et al. 2001). Like many other species of microchiropterans, the Indiana bat often uses travel corridors that consist of open flyways such as streams, woodland trails, small infrequently used roads, and possibly utility corridors, regardless of suitability for foraging or roosting (Brown and Brack 2003).

Members of maternity colonies forage in a variety of woodland settings, including upland and floodplain forest (Humphrey et al. 1977; Brack 1983; Gardner et al. 1991). Foraging activity is concentrated above and around foliage surfaces, such as over the canopy in upland and riparian woods, around crowns of individual or widely spaced trees, and along edges. They forage less frequently over old fields, and occasionally over bushes in open pastures. Forest edges, small openings, and woodlands with patchy trees provide more foraging opportunities than dense woodlands. Most species of woodland bats forage prominently along edges, less in openings, and least within forests (Grindal 1996). Openings also provide a better supply of insects than do wooded areas (Tibbels and Kurta 2003).

4.0 Natural History of the Virginia Big-eared Bat

4.1 Status

On 30 November 1979, the Virginia big-eared bat (C*orynorhinus t. virginianus*) was listed as a federally endangered subspecies of Townsend's big-eared bat (*C. townsendii*) under the Endangered Species Act of 1973. Listing was related to the small population size, an isolated and limited range, and the potential for human disturbance. A recovery plan for the species was completed on 8 May 1984 (USFWS, 1984). Critical habitat was designated for the species on 30 November 1979. Critical habitat includes five caves in Pendleton and Tucker counties, which are in the northeastern part of the West Virginia.

Federal Register Documents

44 FR 69206 69208; 30 November 1979: Final Critical Habitat, Critical habitat—mammals/final Listing, Endangered

44 FR 51144 51145; 30 August 1979: Proposed Critical Habitat, Critical habitat—mammals

44 FR 12382 12384; Notice Withdrawal of Critical Habitat

42 FR 61290 61292; 02 December 1977: Proposed Critical Habitat, Critical habitat—mammals/Proposed Listing, Endangered



The Virginia big-eared bat occurs in Kentucky, North Carolina, Virginia, and West Virginia. It inhabits caves during both summer and winter. In winter, the species hibernates in clusters in cool portions of caves, while summer maternity colonies are formed in warmer portions of caves (Lacki et al. 1993; Clark et al. 1996). Bats migrate between cold winter hibernacula and warm summer maternity caves, but colonies appear to occupy nearly the same geographic area year round. If a cave has areas that cool properly in winter and areas that warm adequately in summer, the same cave may be used during both summer and winter (Whitaker and Hamilton, 1998). Virginia big-eared bats are rarely recovered more than 20 miles (32.2 km) from the banding site (Harvey, 1992); however, a long-distance record of 40 miles (64.4 km) is known from Kentucky (Barbour and Davis, 1969). Harvey et al. (1981) found that Ozark big-eared bats (*C. t. ingens*) in Arkansas moved approximately 4 miles (6.5 km) from hibernaculum to maternity roost. In Virginia, movements of 14 miles (22.5 km) between maternity roosts and hibernacula have been recorded; in West Virginia, movements of 7.3 miles (11.7 km) have been recorded.

4.2 Winter

Virginia big-eared bats often use colder or well-ventilated areas of the cave during hibernation (Barbour and Davis 1969; Humphrey and Kunz 1976). Hibernating Virginia big-eared bats are often found in loose clusters, although some roost singly

(Adam 1992). Age and sex segregation does not occur during hibernation (Whitaker and Hamilton 1998).

In Oklahoma, Ozark big-eared bats move among hibernacula throughout winter (Clark et al. 2002). In West Virginia, clusters of hibernating big-eared bats are seemingly more easily aroused than are other species of bats (Brack pers. obs.). In Oklahoma, the Ozark big-eared bat (Clark et al. 2002), and in West Virginia, the Virginia big-eared bat (Stihler and Brack 1992) hibernated in colder portions of the cave (above freezing) than most concentrations of other bat species.

Copulation occurs in autumn, but ovulation, fertilization, and gestation do not occur until the following spring. Ovulation takes place around the time that females leave the hibernaculum (Pearson et al. 1952). Juvenile females typically mate during their first season while juvenile males do not (Adam 1992).

4.3 Summer

Female Virginia big-eared bats form maternity colonies in late March or early April that may number from several to hundreds of individuals. Colonies are usually located in warm caves (or portions of caves) or rock shelters (Pearson et al. 1952; USFWS 1984). Females leave their young nightly to forage, but may return to the cave to nurse early in the season after parturition. As the season progresses, females typically remain gone all night and sometimes use an alternate day roost. During the maternity period, males are apparently solitary (Pearson et al. 1952; Barbour and Davis 1969; Humphrey and Kunz 1976), although bachelor colonies (loose aggregations of individuals) may be formed.

Parturition typically occurs in late spring and results in one large pup weighing nearly 25 percent of the post-partum mass of females. Newborn bats are naked and their large ears lie over their unopened eyes for the first few days. Within a few hours after birth, they can produce audible chirps that may play an important role in mother-infant recognition. Young bats grow rapidly, nearly reaching adult size in one month. Juveniles become volant at 2.5 to 3 weeks and are weaned by 6 to 8 weeks (Adam 1992; USFWS 1995; USFWS 1984; Kunz and Martin 1982; Pearson et al. 1952).

Natality rates are comparable throughout the range of the species, varying from 90 to 100 percent (USFWS, 1995; Humphrey and Kunz 1976; Pearson et al. 1952). Pre-weaning post-natal mortality was 4 percent in Kansas and Oklahoma (Humphrey and Kunz, 1976). In California, Pearson et al. (1952) found that only 38-40 percent of yearlings returned to maternity colonies, but nearly 80 percent of each cohort returned in 3rd and 4th years. Maximum longevity is 16 years 5 months, based on band recoveries in California (Paradiso and Greenhall 1967 *in* USFWS 1995).

4.4 Food Habits and Foraging Ecology

Like many other bats, the Virginia big-eared bat uses echolocation to capture insect prey in flight (Kunz and Martin 1982; Whitaker and Hamilton 1998). The presence of spiders in the diet provides evidence of gleaning (Brack and Dalton in prep). In Tazewell County, Virginia, moths (Lepidoptera) were the most commonly eaten insect prey (Dalton et al. 1986; Brack and Dalton in prep). The bats ate predominately moths (often with a body length of about 20 mm), but forage over, near, and around foliage in several habitats: pastures, croplands (alfalfa and corn), shrub lands, riparian strips, and wooded corridors and woodlands. The bat eats a variety of pest species and may be susceptible to impacts from insecticides and other lepidoteracides such as Dimilin and the bacterium *Bacillus thuringiensis*. In 1,222 samples from April to September, Dalton et al. (1986) found that moth remains were in 97 percent of samples, and accounted for at least 80 percent of the material in most samples. Coleopterans (beetles), Dipterans (flies), Hymenopterans (bees, ants, wasps, and kin), Homopterans (cicadas and kin), and Neuropterans (net-veined insects) were also consumed.

In West Virginia, moths were 96.7 percent of the food volume eaten by Virginia big-eared bats at three maternity colonies (Sample and Whitmore 1993). Light tagging and telemetry studies in West Virginia (Stihler 1994; 1995) indicated that the species forages in woodlands, old fields, hay fields, and sometimes-grazed pastures; however, recent clear cuts were not used. In West Virginia, forested habitats appear to be used with greater frequency in July than in May.

In Kentucky, the Virginia big-eared bats spent a large amount of time over grassy fields (Burford and Lacki 1995). The Ozark big-eared bat in Oklahoma used edge habitats of intermittent streams and mountain slopes more than expected based on available habitat (Clark et al. 1993), while range, edge, and forest habitats were generally used in proportion to their availability, although males in September showed a disproportionately high use of forested habitats (Wethington et al. 1996). Gary P. Bell (pers. comm. *in* Kunz and Martin 1982) noted that the western subspecies forages mostly along forested edges. In coastal California, this species foraged primarily along edges of riparian vegetation (Fellers and Pierson 2002).

Virginia big-eared bats may travel several miles to forage. Individuals from a maternity colony in West Virginia (Cave Mountain Cave, Pendleton County) often traveled 3.1 to 4.3 miles (5 to 7 km) from the maternity cave to feed (Stihler 1994). The closest point in Pendleton County is at least 70 miles (113 km) away from the Rainelle/Anjean project areas (Figure 1). These bats usually foraged in the same general area on consecutive nights, but some bats used more than one foraging area. In a similar study, Stihler (1995) documented a maximum foraging distance of 6.5 miles (10.5 km) and noted that most bats appeared to utilize more than one foraging area. Bats often used anthropogenic structures (abandoned houses, barns, out buildings, and bridges) as night-roosts near the foraging area, and sometimes did

not return to the main roost at dawn. In Tazewell County, Virginia, some bats returned to the cave to night roost, but some roosted in woodlands and on two occasions, bats roosted in a shed (Brack and Dalton in prep). In autumn, very little time was spent night roosting (0.2%), but in spring, 18.3% of time was spent night roosting. In Kentucky, big-eared bats night-roosted extensively in sandstone cliffs with a wide variety of physical features (Lacki et al. 1993). In Oklahoma, distances traveled by foraging female big-eared bats increased and nightly visits to the roost decreased as lactation progressed (Clark et al. 1993; 2002). In September, in California, females consistently traveled farther than males from the maternity roost site, and alternate day roost consisted mainly of tree hollows (Fellers and Pierson 2002).

In Oklahoma (Clark et al. 2002) and California (Fellers and Pierson 2002), traveling big-eared bats apparently followed tree lines and forest edges in preference to crossing open areas. Interestingly, none of the foraging studies cited above document the use of free water (i.e., drinking).

5.0 Natural History of the Virginia Northern Flying Squirrel

5.1 Status

Federal Register Documents

67 FR 71192 71193; 29 November 2002: Notice plan HCP
50 FR 26999 27002; 01 July 1985: Final listing, Endangered
49 FR 45880 45884; 21 November 1984: Proposed listing, Endangered

The Virginia northern flying squirrel was listed as endangered by the USFWS on 1 July 1985. There are 25 subspecies of *Glaucomys sabrinus*; and only two, *G. s fuscus* and G. s. *coloratus*, are endangered. While the range of both is restricted to mountaintops of the Appalachians, *G. s. fuscus* is found along the border between Virginia and West Virginia, while *G. s. coloratus* is found along the border between Tennessee and North Carolina. *G. s fuscus* is susceptible to natural and human-caused events because of its small, isolated range (USFWS 1990); it is known from only six counties in West Virginia (including Greenbrier County) and four in Virginia. Therefore, destruction of habitat and other human-caused disturbances could cause further fragmentation to already disjunct populations.

Because of the vulnerability of *G. s. fuscus*, a recovery strategy was enacted by the USFWS. This recovery strategy includes a survey of capture sites and other suitable habitats to identify the distribution of *G. s. fuscus* in the southern Appalachians. Once the distribution is determined, habitats that support the species must be protected from human disturbances, more information on the ecology of these squirrels and their relationship with *G. volans* must be collected, and enhancements of habitats and the subsequent responses of squirrels to these changes must be monitored.



Northern flying squirrels are small squirrels with large eyes and loose, furred skin that connects their wrists and ankles. Total body length is 260 to 305 mm and weight varies from 90 to 140 g (USFWS 1990). They have soft, dense fur and a relatively long, flattened tail that aid in gliding (Wells-Gosling and Heaney 1984). Color of the fur varies depending on sub-species; however, the fur typically is grayish-brown dorsally and grayish-white to buffy-white ventrally (Wells-Gosling and Heaney 1984). Northern flying squirrels sometimes have gray on the face and sides of the head (Wells-Gosling and Heaney 1984).

The northern flying squirrel is distributed throughout forests of northern North America; however, *G. s. fuscus* is limited to the Appalachian Mountains of west-central Virginia and eastern West Virginia (Odum et al., 2001; USFWS 1990; Wells-Gosling and Heaney 1984). Within this restricted range, these squirrels occupy

forested habitats at high elevations. In Virginia, individuals typically inhabit forests at 3,840 to 5,350 ft (1,170 to 1,630 m); in West Virginia, they generally occur at 3,280 to 4,430 ft (1,000 to 1,350 m) (USFWS 1990). Forested regions inhabited by *G. s. fuscus* include coniferous and deciduous forests, as well as ecotones of these two forest types (USFWS 1990). Coniferous forest that includes spruce (*Picea* spp.), hemlock (*Tsuga* sp.), or fir (*Pseudotsuga* sp.) seemed to be preferred (Payne et al. 1989; Weigl 1978; Weigl and Osgood 1974); however, *G. s. fuscus* is sometimes found in mature, deciduous forest. The composition of these woodlands usually consists of beech (*Fagus grandifolia*), yellow birch (*Betula alleganiensis*), sugar maple, red maple (*A. rubrum*), and black cherry (*Prunus serotina*) (USFWS 1990; Weigl 1978). Although *G. s fuscus* has been documented in forests of varying age and understory composition, most individuals have been captured in mesic, old-growth forests with many mature trees and snags (Payne et al. 1989; USFWS 1990). In West Virginia, these squirrels are known from mixed conifer-hardwood forests containing old growth and open understories (Weigl and Brinson, unpubl. data).

5.2 Life History

These nocturnal mammals occupy relatively large home ranges for their size, traveling long distances during the night (Weigl and Brinson unpubl. data). They are active throughout the year despite low temperatures. Individuals use a variety of nest types, including cavities of trees in winter, outside nests in trees, and even underground nests (Hackett and Pagels 2003; USFWS 1990; Wells-Gosling and Heaney 1984). Shredded bark, moss, lichens, grass, and other available materials are used to line nests (Wells-Gosling and Heaney 1984). Suitable nesting sites are important to the species because of adverse weather and the variety of predators that eat them (USFWS 1990). Many owls, as well as other avian predators and mammalian predators, are known to prey on northern flying squirrels (Wells-Gosling and Heaney 1984).

Northern flying squirrels are social animals and often share nests. For example, in West Virginia, seven adults were observed together in one nest box and four in another (USFWS 1990). Little information is available on reproduction in *G. s. fuscus*; however, data suggest they have only a single litter in spring or summer (USFWS 1990). In Virginia and West Virginia, litters ranged from one to five individuals (USFWS 1990).

5.3 Food Habits and Foraging Ecology

Although the northern flying squirrel feeds on a variety of nuts, fruits, insects, and animal material, fungi and lichens are important food items in certain parts of their distribution (Loeb et al. 2000; Wells-Gosling and Heaney 1984). In West Virginia, tree buds, lichens, and hypogeous fungi were the most predominant food items eaten by *G. s. fuscus* in spring; in fall, hypogeous and epigeous fungi and beechnuts were most common (Mitchell 2001). Because hypogeous fungi eaten by *G. s. fuscus* form mychorrhizal relationships with trees, northern flying squirrels may contribute to the

health of mixed coniferous and hardwood forests by aiding dispersal of various species of mycorrhizal fungi (Mitchell 2001).

Boreal forests in northern North America, particularly spruce-fir and northern hardwood forests, are critical habitats for northern flying squirrels. The endangered *G. s. fuscus* currently occupies only isolated patches of suitable forests in the Appalachian Mountains (USFWS 1990). Evidence suggests that a combination of hardwoods and conifers, such as spruce and fir, are important to this species in the southern Appalachians (USFWS 1990). Loss of this habitat from timber harvest, mining, pollution, introduced pests, and other human-related events has reduced the available habitat and further isolated populations (USFWS 1990). Furthermore, competition from southern flying squirrels in areas where they are sympatric may be contributing to the decline. Both species of flying squirrels occur in Virginia and West Virginia and laboratory data suggest that *G. volans* may displace *G. s. fuscus* from nesting sites (Weigl 1978). In addition, a parasitic nematode (*Strongyloides robustus*) carried by southern flying squirrels may be lethal if transferred to northern flying squirrels (USFWS 1990).

6.0 Methods

6.1 Bat Habitat Assessment

Bat habitat assessments focused on features indicative of suitability for Indiana bats and Virginia big-eared bats. Separate habitat descriptions were completed for each project area (Rainelle, Transmission Line, and Anjean) and at each individual net site (Appendix A). The emphasis of these descriptions was habitat form: size and relative abundance of large trees and snags that potentially serve as roost trees for Indiana bats, canopy closure, understory clutter/openness, distance to water, stream or pond characteristics, and flight corridors. Habitat form was emphasized because the Indiana bat roosts in numerous tree species. Although Virginia big-eared bats only roost in caves, they forage in wooded areas. Tree species composition was included because it provides insight to edaphic conditions of each site.

Habitat characterization identifies components of canopy and subcanopy layers. Trees that reach into the canopy are canopy trees, regardless of diameter/size. As defined in the Indiana Bat Habitat Suitability Index Model (3D/Environmental, 1995), dominant trees are the large trees in the canopy (>16" dbh) that have the greatest likelihood of being used by maternity colonies of Indiana bats. Many smaller trees are often also found in the canopy, and in some situations, the canopy can be entirely composed of small-diameter trees. ESI's habitat characterization identifies dominant and subdominant elements of the canopy.

The subcanopy vegetation layer is well defined in classical ecological literature. It is that portion of the forest structure between the ground vegetation (to approximately 2 ft (0.6 m)) and the canopy layers, usually beginning at about 25 ft (7.6 m).

Vegetation in the understory may come from:

- Lower branches of overstory trees
- Young overstory trees
- Small trees and shrubs that are confined to the understory

The amount of vegetation in the understory is termed clutter. Many species of bats, including the Indiana bat and Virginia big-eared bat, tend to avoid areas of high clutter.

Other site-specific parameters pertinent to assessing the quality of the habitat were also recorded, such as distance to water, stream habitat (if present), standing water in an upland site, and travel corridors – or lack thereof. Each net site was documented with a sketch when possible. Figures 3 and 4 identify the specific locations of each habitat assessment site within the project areas.

6.2 Flying Squirrel Habitat Assessment

Flying squirrel habitat assessments focused on features indicative of suitability for Virginia northern flying squirrels. Separate habitat descriptions (Appendix B) were completed for each project area (Rainelle, Transmission Line, and Anjean). The emphasis of these descriptions was location and habitat form. Overall habitat suitability, including nesting and foraging potential, were evaluated using the following characteristics: elevation, size and relative abundance of large trees and snags that potentially serve as nesting areas, presence of cavities in trees, species composition of trees and understory, presence of lichens and fungi, and distance to water. Elevation was emphasized because *G. s. fuscus* typically inhabits elevations above 3,280 ft (1,000 m). Presence of lichens and fungi, potential food sources, was noted. Tree species composition was included because *G. s. fuscus* prefers coniferous forest that includes spruce, hemlock, or fir, although mature, deciduous forest is sometimes used. Figures 3 and 4 identify the specific locations of each habitat assessment site within the project areas.

6.3 Visual Inventory of Mammals

Visual inventories of existing mammals were conducted in the three project areas, primarily using pedestrian surveys. Separate species lists were made for each project area (Rainelle, Transmission Line, and Anjean). The presence of mammalian species was determined by visually observing live or dead animals, or by locating tracks or scat. Appendix C contains completed Mammal Inventory Checklists.

6.4 Mist Netting

Efforts to survey for endangered bats are difficult to standardize because of the large amount of variability that exists in a field situation. However, implementation of netting guidelines provided by the U.S. Fish and Wildlife Service (1999) in the most recent (Agency Draft) revision of the Indiana Bat Recovery Plan have provided some structure. These guidelines (Table 1) were employed during netting of the 2 sites (Rainelle and Transmission Line).

The survey at each site consisted of two net sets run for two nights, for a total of four net nights of effort per site. Since there were two sites, netting was completed in four calendar nights. Netting at both sites was conducted between 13 to 16 July 2004. Nights of netting were consecutive, but needed not be. Net placement was based upon canopy cover, presence of a flight corridor, water, and habitat conditions near the site. Nets were set to maximize coverage of flight paths potentially used by Indiana bats and Virginia big-eared bats along suitable corridors. Site selection was based upon an expectation of greatest bat activity and an effort to provide survey coverage of the study area. Nets are often placed over streams used as travel corridors and sometimes for foraging. However, survey areas were mainly upland, so nets were set in upland corridors, which are very effective for bat capture (Brown and Brack 2003), particularly near sources of drinking water (Wilhide et al. 1998). The precise location and specific orientation of each net was determined in the field.

Table 1. Mist Netting guidelines.

1. Netting Season: 15 May to 15 August, when Indiana bats occupy summer habitat.
2. Equipment (Mist Nets): constructed of the finest, lowest visibility mesh commercially available – monofilament or black nylon – with the mesh size approximately 1½ inch (1¼ –1¾) (38 mm).
3. Net Placement: mist nets extend approximately from water or ground level to tree canopy and are bounded by foliage on the sides. Net width and height are adjusted for the fullest coverage of the flight corridor at each site. A "typical" net set consists of three (or more) nets "stacked" on top of one another; width may vary up to 60 feet (20 m).
4. Net Site Spacing:
   - Streams – one net site per 0.5 mile (1 km)
   - Land Tracts – two net sites per 250 acres (1 square km)
5. Minimum Level of Effort Per Net Site:
   - Two net locations (sets) per net site, with locations (sets) at least 100 feet (30 m) apart
   - Two (calendar) nights of netting
   - At least three net–nights (1 net–night = 1 net set deployed for 1 night); typically, two net sets are deployed at one site for two nights, resulting in four net-nights
   - Sample Period: begin at dusk and net for 5 hours (approximately 0200h)
   - Nets are monitored at approximately 20-minute intervals
   - No disturbances near the nets between checks
6. Weather Conditions: net only if the following weather conditions are met:
   - No precipitation
   - Temperature $\geq$ 10°C (50°F)
   - No strong winds
7. Moonlight: avoid net sets with direct exposure to a moon ½ -full or greater – typically by utilizing forest canopy cover

Source: U.S. Fish and Wildlife Service

Appendix E

Mist net sites were also selected based upon habitat characterizations described for the Indiana bat and Virginia big-eared bat in current literature and experience of ESI personnel with these species. Habitat with the following characteristics was selected to the degree feasible:

- Large trees (>16 inches dbh) for maternity roosts
- An open canopy, apparently important for warming Indiana bat roost sites
- An open, uncluttered understory, used for travel and forage

6.4.1 Bat Capture

The netting setup allows bats to be caught live and released unharmed near the point of capture. Bats were identified to species using a combination of morphological characteristics (e.g., ear and tragus, calcar, pelage, size/weight, length of right forearm, and overall appearance of the animal). The species, sex, reproductive condition, age, weight, length of right forearm, and time and location of capture were recorded for all bats captured. Age (adult or juvenile) of bats is determined by examining ephiphyseal-diaphyseal fusion (calcification) of long bones in the wing. Weight was measured to 0.1 grams using a Pesola spring scale. Length of right forearm was measured to the nearest 0.1 or 1.0 mm using a dial calipers or metric ruler, respectively. The reproductive condition of captured bats was classified as non-descended male, descended male, non-reproductive female, pregnant female (based on gentle abdominal palpation), lactating female, or post-lactating female. Bats were not banded. Bat processing and data collection was typically completed within 30 minutes of the time the bat was removed from the net. Data recorded in the field are provided in Appendix D.

6.4.2 Flying Squirrel Capture

Mist nets are predominantly deployed at night to capture bats. Sometimes non-target species are also captured, including nocturnal birds, moths, beetles, and flying squirrels. Although netting was not specifically intended for (nor was the sampling designed for) the capture of flying squirrels, they can be caught as they use volplane in open portions of the forest, including corridors used by bats (Brack and Mumford 1983). If flying squirrels are captured, they are released unharmed after being identified to species and processed for morphometric data. Data for non-target species was recorded on bat capture data sheets (Appendix D).

Flying squirrels are identified to species using a combination of morphological characteristics (e.g., pelage color, size/weight, hind foot length, tail length, and overall appearance of the animal). Species, sex, reproductive condition, age, weight, length of tail, length of hind foot, and time and net site of capture are recorded. Information is typically collected within 30 minutes of the time that squirrels are removed from the net.

6.4.3 Weather

Weather conditions were monitored each night of survey. Conditions recorded include: temperature, wind speed and direction, percent cloud cover, and moon phase (if visible). A standard mercury thermometer was used to record temperature, wind speed was determined by use of the Beaufort wind scale, and cloud cover was estimated. Appendix E contains completed Weather Data Sheets.

In general, precipitation and cloud cover were average and temperatures slightly below average across the region. A trend of decreasing temperature persisted during the four calendar nights of netting. High and low temperatures during the survey are listed in Table 5. The average high during July for the nearby city of Beckley, West Virginia is normally 80°F; the average low is normally 61°F. Weather conditions during each survey night fell within netting parameters as outlined by the USFWS (1999). On the last night of netting (16 July 2004), the temperature dropped to 50°F by 0200 h, just after both nets were taken down. Wind speeds varied between 0 and 3 mph during all survey nights, except on 14 July when winds reached speeds up to 15 mph. Nighttime skies ranged from clear to cloudy. A new moon persisted during the entire netting period. Appendix E contains completed Weather Data Sheets.

Table 2. Weather Data.

Netting Dates (2004)	High Temp. (°F)	Low Temp. (°F)
13 July	70	62
14 July	66	64
15 July	60	54
16 July	60	50

Appendix E

7.0 Results

7.1 Bat Habitat Assessment

Separate habitat assessments were completed for each site in the project area. Appendix A contains completed Habitat Description data sheets for endangered bats.

7.1.1 Rainelle

Rainelle Site #01 (RNL1) was located in a wooded area to the south of the proposed Rainelle Power Plant, on the south side of Sewell Creek. This 40-acre piece of land is an upland forest with a thick canopy and little undergrowth. Overstory tree species include sugar maple, black oak, tulip poplar, and American beech. The understory is very open beneath, and consists of herbaceous cover such as ferns, violets, and grape vines (*Vitis* spp.). Possible roosting habitat for the Indiana bat does exist in this area, including large trees and snags. Roost tree potential is considered moderate, due to the presence and abundance of these trees. Upland foraging habitat is available for many species of bats. Figure 3 identifies the specific location of RNL1 within the project area.

Rainelle Site #02 (RNL2) was located in a moderately disturbed area along Sewell Creek. This area consists of small, early successional trees such as black willow (*Salix nigra*) and black locust. Assorted weeds, grasses, goldenrods (*Solidago* spp.), blackberry (*Rubus* spp.), and greenbrier (*Smilax* sp.) comprise the understory. No large overstory trees are present. Roost potential for Indiana bats was considered low. Figure 3 identifies the specific location of RNL2 within the project area.

7.1.2 Transmission Line

The proposed transmission line corridor runs east-to-west across Wolf Pen Ridge on Sewell Mountain. Bat habitat assessments were completed in three segments.

Transmission Line Site #01 (TL1) was located on the west side of Sewell Mountain. The hillside consists of a mature upland deciduous forest with large and small canopy trees and a moderately cluttered understory. Dominant overstory species include American beech, black cherry, and tulip poplar. Subdominant overstory species include American beech, mountain magnolia (*Magnolia fraseri*), and sugar maple. Many suitable roosting cavities are present within the large trees in this area. The understory is sparse, containing some American beech and witchhazel (*Hamamelis virginiana*), which lends to good flight corridors for foraging bats. Ferns and violets

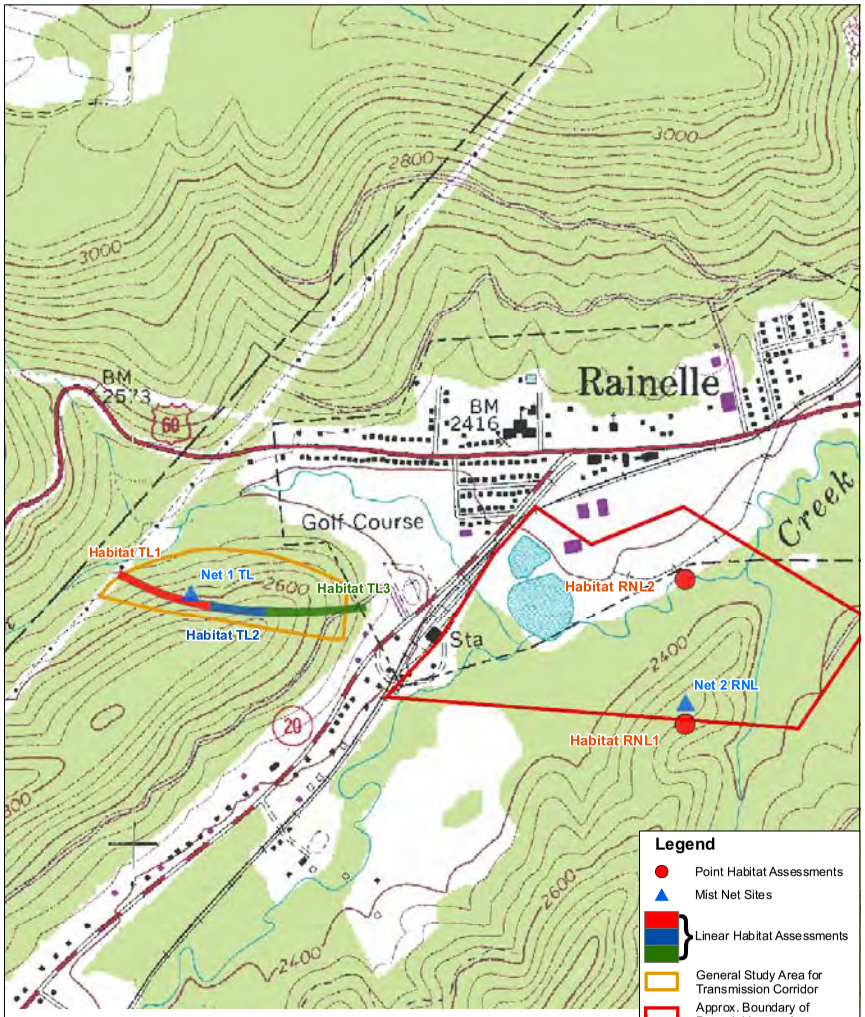


Figure 3: Location of Net Sites and Habitat Assessments at the Rainelle and Transmission Line Corridor Project Areas, Greenbrier County, West Virginia.

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comprise much of the herbaceous cover. Roost tree potential for the Indiana bat was considered moderate. Figure 3 identifies the specific location of TL1 within the project area.

Transmission Line Site #02 (TL2) was on top of Wolf Pen Ridge on Sewell Mountain. The habitat was a young upland deciduous forest with many smaller trees reaching into the canopy. Dominant overstory species include northern red oak, sugar maple, and tulip poplar. Subdominant overstory species include American beech, sugar maple, and black cherry. The subcanopy was considered moderately cluttered. Very few flight corridors were present, thus foraging potential was low for Indiana and Virginia big-eared bats. Moderate potential for Indiana bat roosting does exist, due to the presence of some large trees and snags. Figure 3 identifies the specific location of TL2 within the project area.

Transmission Line Site #03 (TL3) was on the east side of Sewell Mountain. The hillside consisted of a young upland deciduous forest with mostly small trees reaching to the canopy. Dominant overstory species included shagbark hickory (*Carya ovata*), sugar maple, and white oak. Subdominant overstory species include American beech, sugar maple, and tulip poplar. Roost tree potential for the Indiana bat was considered low. The subcanopy was closed and therefore was not ideal foraging habitat for bats. Figure 3 identifies the specific location of TL3 within the project area.

7.1.3 Anjean

Anjean Site #01 (ANJ1) was on Anjean Mountain at an abandoned surface mine. Habitat consisted of open areas and old fields primarily containing herbaceous weeds, grasses, and flowering plants. No large trees were present. Small trees such as black locust, red maple, and sugar maple were found scattered in the area. No mist netting was conducted at Anjean. A few abandoned buildings were inspected for bats, but no signs of bats or guano was found. Some large areas of exposed rock outcrops were present that could provide roosts for Virginia big-eared bats; however, the degraded foraging habitat nearby makes this unlikely. Roost potential for Indiana bats was low due to the lack of trees in the area. Figure 4 identifies the specific location of ANJ1 within the project area.

7.2 Flying Squirrel Habitat Assessment

Habitat assessments for Virginia northern flying squirrel were completed at the same times and locations as habitat assessments for endangered bats. Vegetation composition and analysis for flying squirrel sites is consistent with those described in Section 7.1. In addition, sites were searched for particular tree species favored by *G. s. fuscus*. Also, the potential for nesting sites and food availability was addressed.

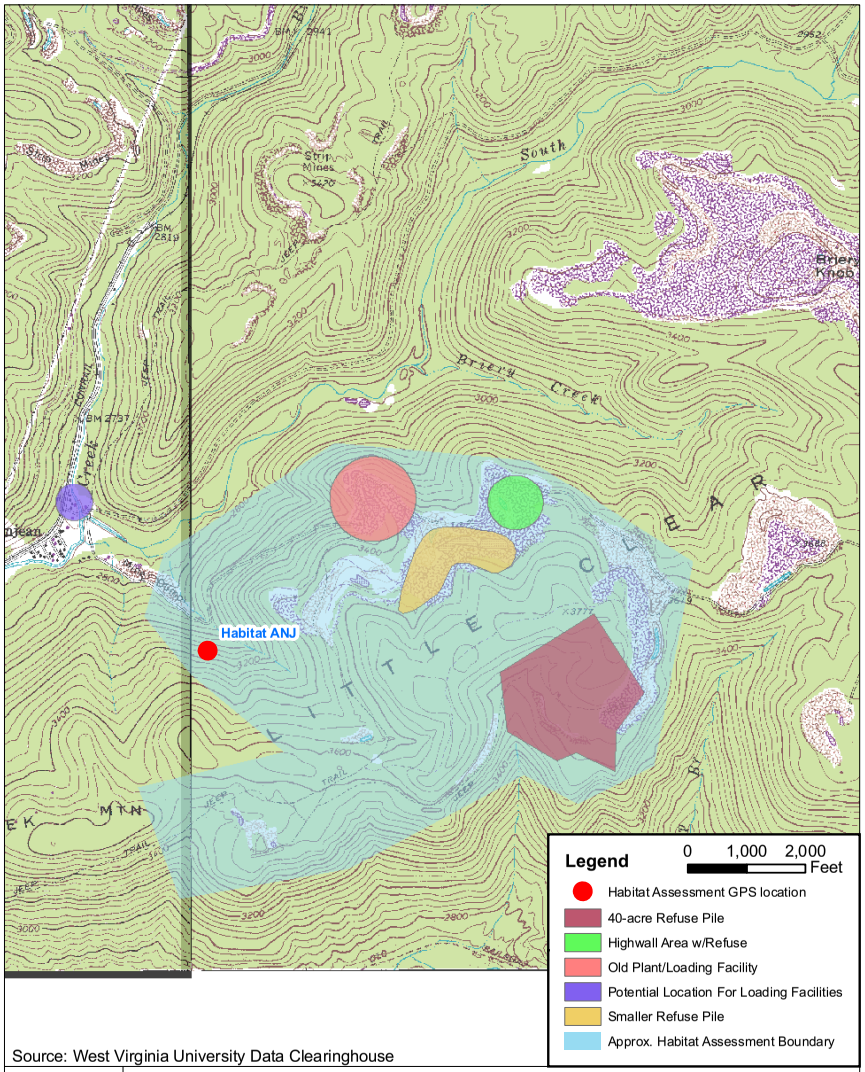


Figure 4: Location of Habitat Assessment at the Anjean Project Area, Greenbrier County, West Virginia.

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7.2.1 Rainelle

Rainelle Site #01 (RNL1) was surveyed for its ability to support a population of Virginia northern flying squirrels. Due to the disturbed nature of the site along Sewell Creek, Site #02 (RNL2) was not surveyed. RNL1 is at an elevation of 2,462 ft, which is below the lower limit at which *G. s. fuscus* is typically found (3,280 ft; 1,000 m), but within the elevation occasionally used (2,330 ft; 710 m). The 40-acre site is comprised of deciduous tree species. Species present used by *G. s. fuscus* include American beech, sugar maple, and black cherry. The understory is very open underneath, with numerous sugar maple saplings. Only one snag was seen during the assessment, and a few holes (that could serve as nest sites) were found in large sugar maples and American beeches. Some fungi were also found. Overall, nest site availability and foraging potential for *G. s. fuscus* was moderate. Figure 3 identifies the specific location of RNL1 within the project area.

7.2.2 Transmission Line

The proposed transmission line corridor runs east-to-west for approximately 2,000 ft across Sewell Mountain. At the time of this investigation, the corridor was not expected to exceed 75 ft (23 m) in width, thus giving a total maximum potential impact area of approximately 3.5 acres (1.4 ha). Assessment of Virginia northern flying squirrel habitat was completed in three segments in this area.

Transmission Line Site #01 (TL1) was at an elevation of 2,490 ft, which is below the lower limit at which *G. s. fuscus* is typically found (3,280 ft; 1,000 m), but within the elevation occasionally used (2,330 ft; 710 m). The site is comprised of primarily mesic, deciduous trees; however, several small eastern hemlocks (*Tsuga canadensis*) are present. Deciduous species present that are used by *G. s. fuscus* include birch (*Betula* spp.), American beech, sugar maple, and black cherry. Approximately 20 good snags were found. Natural cavities are plentiful in the large, hollow trees (primarily American beech) present in this area. Many fungi are present in the area. Ground cover consists of mostly rock outcrops and leaf litter with little herbaceous cover except ferns and mosses. Nest site availability for *G. s. fuscus* was considered high in this area; foraging potential was determined to be moderate. Figure 3 identifies the specific location of TL1 within the project area.

Transmission Line Site #2 (TL2) was on the ridge top of Sewell Mountain at an elevation of 2,700 ft to 2,750 ft, which is within the range occasionally occupied by *G. s. fuscus*. The site is comprised of deciduous tree species. Species present that are used by *G. s. fuscus* include American beech, sugar maple, and black cherry. Snags, natural nest cavities, and lichens/fungi were present, although less abundant than on the west side of the mountain (TL1). In this area, nest site availability and foraging potential for *G. s. fuscus* were considered moderate. Figure 3 identifies the specific location of TL2 within the project area.



Transmission Line Site #3 (TL3) was at an elevation between 2,593 ft to 2,724 ft, which is within the range occasionally occupied by *G. s. fuscus*. The site is comprised of deciduous tree species. Species present that are used by *G. s. fuscus* include American beech, sugar maple, and black cherry. The forest on this side of the mountain was younger than on the west side; most trees were of small diameter. Snags, natural nest cavities, and lichens/fungi were present, although much less abundant than on the west side of the mountain (TL1). In this area, nest site availability and foraging potential for *G. s. fuscus* was determined to be low. Figure 3 identifies the specific location of TL3 within the project area.

7.2.3 Anjean

Anjean Site #01 (ANJ1) is a highly disturbed site, due to previous surface mining activities. ANJ1 was located at an elevation between 2,750 ft to 3,769 ft, which is within the range occasionally occupied by *G. s. fuscus*. Abundant new growth and weedy ground cover were present. All trees in the area were deciduous and of small diameter. There were very few snags or trees with natural cavities. Nest site availability and foraging potential for *G. s. fuscus* was low. Figure 4 identifies the specific location of ANJ1 within the project area.

7.3 Visual Inventory of Mammals

No endangered or threatened species were encountered. A total of 7 mammal species were observed (visually or by animal sign) during pedestrian surveys of the three project areas. Many of the animals observed are common in woodlands, open fields, and disturbed habitats such as those in the project areas. Evidence of white-tailed deer (*Odocoileus virginianus*) was found at all sites. During the survey, a black bear (*Ursa americanus*) was seen at the Anjean site. West Virginia DNR considers this species "uncommon", or seldom seen due to the lack of suitable habitat and/or its secretive nature. Appendix C contains completed Mammal Inventory Checklists.

Table 3. Mammals observed in the project areas during pedestrian surveys on 24 June 2004.

Sites	Common Name	Scientific Name	Observation Method
Rainelle (Sites 1 & 2)	Eastern gray squirrel	*Sciurus carolinensis*	Visual
	Common raccoon	*Procyon lotor*	Tracks
	White-tailed deer	*Odocoileus virginianus*	Tracks
Transmission Line (Sites 1 – 3)	Eastern chipmunk	*Tamias striatus*	Visual
	Eastern cottontail	*Sylvilagus floridana*	Scat
	White-tailed deer	*Odocoileus virginianus*	Tracks
Anjean	Eastern chipmunk	*Tamias striatus*	Visual
	Groundhog	*Marmota monax*	Visual
	Black bear	*Ursa americanus*	Visual
	White-tailed deer	*Odocoileus virginianus*	Tracks



7.4 Mist Netting

Two mist net sites, located at Rainelle and in the vicinity of the transmission line corridor, were selected to provide sufficient coverage of the project areas. The Transmission Line net site (Net 1 TL) was located on an old logging road that traversed Sewell Mountain in an east-to-west direction. Bats could potentially use this trail as a flight corridor. Nets were placed near the ridge top. Typically, one net site is required per linear kilometer of corridor; however, since the transmission line corridor is less than 1 kilometer, only one site was needed. The Rainelle net site (Net 2 RNL) was located on a recently improved logging road in the off-site wooded area (south of Sewell Creek), near an adjacent ridge top. Both sites were surveyed for two nights each during the period 13 to 16 July 2004. Figure 3 identifies the specific locations of each mist net site.

7.4.1 Bat Capture

No endangered bats were captured during the survey efforts. Only 3 bats representing 2 species were caught in the nets, including the big brown bat (*Eptesicus fuscus*) and northern bat (*Myotis septentrionalis*). A red bat (*Lasiurus borealis*) was seen flying in the vicinity of a net, but was not caught. Evidence of reproduction, namely reproductive (lactating) females or juveniles, was found at each site. Information regarding sex, age, and reproductive status for all bats is included in Table 3. Bats were caught at both net sites (Table 4). Appendix D contains completed Bat Capture Data Sheets.

Table 4. Bat captures by species, sex, and age between 13 and 16 July 2004.

Species	Adult Male	Lac[1] Female	PL or NR[2] Female	Juvenile	Escape[3]	Total
Big brown bat	1	0	0	1	0	**2**
Red bat	0	0	0	0	1	**1**
Northern bat	0	1	0	0	0	**1**
Total	**1**	**1**	**0**	**1**	**1**	**4**

1 Lactating
2 Post-Lactating or Nonreproductive
3 Seen in vicinity of net, but was not captured or processed

Table 5. Bat captures by net site and date.

Site	Date	Big brown bat	Northern bat
Transmission Line Corridor	13 July 2004	1	1
(Net 1 TL)	14 July 2004	0	0
Rainelle	15 July 2004	0	0
(Net 2 RNL)	16 July 2004	1	0

7.4.2 Flying Squirrel Capture

No flying squirrels were caught during mist net surveys at either of the locations.



8.0 Discussion and Conclusions

To investigate potential presence of the Indiana bat, Virginia big-eared bat, and Virginia northern flying squirrel, habitat assessments and mist net surveys were conducted at various portions of the project area, including the vicinity of the proposed power plant, the proposed transmission line corridor, and adjacent property where development might occur. All-inclusive mammal inventories were also conducted at each area using pedestrian surveys. Habitat assessments focused on determining the potential for use by the above-mentioned endangered species. Mist net survey sites were used to survey for bats (and incidentally for flying squirrels), focusing on areas that provided suitable traveling and foraging habitat. No endangered or threatened species were seen or captured during these assessments or surveys performed in June and July 2004.

8.1 Indiana Bat

Netting efforts provided no evidence that Indiana bats use the project area during summer months. The species complement, diversity, and number of bats captured in the project area were very low, which could be indicative of relatively poor habitat in this geographic location. Brack et al. (2002) found that the occurrence of reproductive females of several species of bats was lower at higher elevations in the Appalachian Mountains. The low catch of northern bats was surprising, for they are often relatively common in woodland areas. Big brown bats, which were two of the three captures, are common residents of areas that have been disturbed, and are often found in or near human residences or structures. Of the bats captured, both sexes and age classes (adult and juvenile) were represented, indicating evidence of reproduction in the area.

Habitat at the Rainelle location is of moderate value for the Indiana bat, due to the presence of large trees and snags that could serve as potential roosts. This suitable habitat is only located off-site (in a nearby wooded area on the south side of Sewell Creek known as the Plum Creek Property), outside of the power plant development footprint (which is on the north side of Sewell Creek). Roosting and foraging potential is low to moderate in the vicinity of the transmission corridor, and varies depending on aspect and position. Possible roosting areas are located on the west side and ridge top of the mountain, due to the presence of some larger trees and snags. Roosting and foraging potential at the Anjean facility is low, due to the disturbed nature of the area and lack of suitable vegetation.

Based upon the known presence of the Indiana bat in Greenbrier County, presence of reproductively active females in nearby (≈50 miles west) Boone County, but the apparent absence of the Indiana bat in the survey area, a May Affect – Not Likely to Adversely Affect determination is anticipated from the U.S. Fish and Wildlife Service.



8.2 Virginia Big-eared Bat

Netting efforts provided no evidence that Virginia big-eared bats use the project area during summer months. Unlike Indiana bats, these bats are usually found in association with caves that are required for summer roosting (as well as winter hibernation). Foraging potential for these bats is considered low to moderate at all sites in the project areas. Roosting potential is low due to the apparent absence of suitable caves. Man-made structures and rock outcrops at the Anjean site contained no signs of use by bats, including the Virginia big-eared bat.

Occasional occurrence of this species is possible due to migratory and foraging behavior; however, based upon the closest occurrence of the Virginia big-eared bat being at least 60 miles south, a May Affect – Not Likely to Adversely Affect determination is anticipated from the U.S. Fish and Wildlife Service.

8.3 Virginia Northern Flying Squirrel

Visual searches and subsequent mist netting efforts provided no evidence that Virginia northern flying squirrels are present in the project areas; however, these animals are shy, secretive, and rarely encountered. Assessments of squirrel habitat were therefore performed in all areas. Assessment criteria were based on elevation, habitat type, the presence and abundance of snags, large trees and/or natural cavities, and lichens/fungi, a known food source.

Most elevations in the Anjean and Rainelle project areas are below those typically used by *G. s. fuscus*, although they are within elevations that are occasionally used. Similarly, the habitat type (hardwood forest) of both areas is not typically used by the species, although it is occasionally used. Some parts of Anjean (i.e., the mountaintop) are within the typical elevation range of *G. s. fuscus* (>3,280 feet). At the time of survey, the Anjean project area lacked suitable habitat for foraging and nesting; however, reclamation efforts are currently planned. Planting suitable tree species and installing nest boxes in the area could benefit the species.

The proposed location for the co-generation facility on the north side of Sewell Creek contained no suitable habitat for *G. s. fuscus*, and thus was not considered suitable for the squirrel. Wooded areas adjacent to the proposed co-generation site (on the south side of Sewell Creek) were of only moderate value for foraging and nesting, which when combined with elevation and habitat type consideration, provides a habitat of low quality.

Along the transmission line corridor, foraging potential and nest site availability ranged from high to low along various portions of the line. Generally, habitat was less favorable for the squirrel as Sewell Mountain is traversed up and down the ridge from west to east. The entire corridor is above the lower limit that *G. s. fuscus* is occasionally found (>2,330 feet); however, the typical elevation range for the species (>3,280 feet) is only reached close to the ridge top. The western slope is comprised

of several species of mature hardwood trees used by the species when coniferous species are not available. Natural tree cavities, snags, and potential food sources for *G. s. fuscus* were abundant only on the western slope; the ridge top and eastern slope of Sewell Mountain represent marginal to poor potential (respectively) for the presence of *G. s. fuscus*. The ridge top and eastern side of the mountain have some species of hardwoods used by the squirrel. Natural cavities, snags, and potential food sources are much less abundant than on the western slope. Overall, a corridor of 75 feet wide would only remove approximately 3.5 acres of total habitat on Sewell Mountain.

In summary, the Virginia northern flying squirrel is known from the region, although the closest known population is on Bearwallow Knob in northern Greenbrier County, West Virginia, which is approximately 28 kilometers (17.5 miles) northeast of the Anjean project area (Jennifer Wykle, WVDNR, pers. comm., 2005). In general, the project areas currently contain poor to moderate roosting and foraging potential at elevations below those most frequently used by the species. They are predominantly hardwood habitat, which is used less frequently by the squirrel than conifers. Only approximately one-third of the transmission line corridor, on the western slope of Sewell Mountain, contains hardwood habitat with good foraging and roosting potential, although it is at an elevation below that most frequently used by *G. s. fuscus*. In total, the transmission line includes only about 3.5 acres, and the portion of the corridor on the west side of the mountain is only about one-third this, or less than 1.2 acres. In addition, mist netting and visual inventories failed to document the presence of any flying squirrels within the project areas. Based on these criteria, a May Affect – Not Likely to Adversely Affect determination is anticipated from the U.S. Fish and Wildlife Service.

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Appendix E

Appendix A

Completed Bat Habitat Description Data Sheets

Appendix E

Property of: Environmental Solutions & Innovations, Inc.
781 Neeb Road. Cincinnati, OH 45233 (Phone: 513-451-1777)

HABITAT DESCRIPTION

Project No. _____ **Date:** 24 JUNE 2004 **Initials:** M.Gillen & P.Johnson

State/County WV - Greenbrier | **Site #:** Rainelle - woods off site #01 (also Net 2 RNL)

GPS: Longitude: N 37° 57' 40.3" Latitude: W 80° 46' 31.1"

Distance to water: _____ Quad name: _____

ESTIMATED STREAM CHARACTERISTICS:

Bank Height: _____ Channel Width: _____ Stream Width: _____

Substratum: ☐ Sand ☐ Gravel ☐ Cobble ☐ Bedrock ☐ Silt/mud other _____

Average Water Depth: _____ Clarity: ☐ High ☐ Moderate ☐ Low

VEGETATION:

Estimated Canopy Closure: ☒ Closed ☐ Moderate ☐ Open

Dominant Overstory Species (>38cm/15"): Estimated DBH range: Lg: 30" dbh Sm 16" dbh

1. Acer saccharum
2. Quercus velutina
3. Liriodendron tulipifera

Roost Tree Potential – Large Trees and Snags: ☐ High ☒ Moderate ☐ Low

Subdominant Overstory Species (<38cm/15"):

1. Acer saccharum 2. Fagus grandifolia 3. —

Relative Abundance of Dominant vs. Subdominant: 20:80

Subcanopy Clutter: ☐ Closed ☒ Moderate ☐ Open

Is Subcanopy Vegetation Lay Comprised Largely of: ☐ Lower Branches of Canopy Trees? ☒ Saplings ☐ Shrubs

Dominant Understory Species: 1. A. saccharum 2. — 3. — Very open underneath

Description of Habitat Form:
Upland hardwood forest with thick canopy & little undergrowth. Leaf litter dense. Nice habitat with roost & forage potential for M. sodalis

Herbaceous Cover: Ferns, violets, grapevine

Revised 19 March 2002

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HABITAT DESCRIPTION

Photo - Sewell Creek 100-4386

Project No. _____ **Date:** 24 June 2004 **Initials:** MG & PJ

State/County WV - Greenbrial | **Site #:** Rainelle - Sewell Creek #02

GPS: Longitude: N 37° 57' 52.5" Latitude: W 80° 46' 31.1"

Distance to water: ON H2O Quad name: SEWELL CREEK

ESTIMATED STREAM CHARACTERISTICS:

Bank Height: 10ft Channel Width: 30ft Stream Width: 15ft

Substratum: ☒ Sand ☐ Gravel ☐ Cobble ☐ Bedrock ☐ Silt/mud other _____

Average Water Depth: 3ft Clarity: ☐ High ☒ Moderate ☐ Low

VEGETATION:

Estimated Canopy Closure: ☐ Closed ☐ Moderate ☒ Open

Dominant Overstory Species (>38cm/15"): Estimated DBH range: Lg: — dbh Sm — dbh

1. NONE
2. —
3. —

Roost Tree Potential – Large Trees and Snags: ☐ High ☐ Moderate ☒ Low

Subdominant Overstory Species (<38cm/15"):

1. Salix nigra 2. Robinia pseudoacacia 3. —

Relative Abundance of Dominant vs. Subdominant: 0:100 %

Subcanopy Clutter: ☐ Closed ☐ Moderate ☒ Open

Is Subcanopy Vegetation Lay Comprised Largely of: ☐ Lower Branches of Canopy Trees? ☐ Saplings ☒ Shrubs

Dominant Understory Species: 1. Dogwood shrubs 2. — 3. —

Description of Habitat Form:
Disturbed. Early successional growth with mostly black locust, shrubs, & weeds along banks.

Herbaceous Cover: Grasses, goldenrod (Solidago), blackberry (Rubus), greenbriar (Smilax)

Revised 19 March 2002

Property of: Environmental Solutions & Innovations, Inc.
781 Neeb Road. Cincinnati, OH 45233 (Phone: 513-451-1777)

HABITAT DESCRIPTION

Project No. 115.02 **Date:** 7-13-04 **Initials:** CL & MG

State/County WV - Greenbrier **Site #:** Trans Line Net Site (Net 1 TL)

GPS: Longitude: N 32° 52' 516" Latitude: W 80° 47' 234"

Distance to water: 1000 ft Quad name:

ESTIMATED STREAM CHARACTERISTICS: Wolf Pen Creek

Bank Height: 3-5 ft Channel Width: 7 ft Stream Width: 5 ft

Substratum: ☒ Sand ☐ Gravel ☐ Cobble ☐ Bedrock ☐ Silt/mud other _____

Average Water Depth: 1 ft Clarity: ☐ High ☒ Moderate ☐ Low

VEGETATION:

Estimated Canopy Closure: ☒ Closed ☐ Moderate ☐ Open

Dominant Overstory Species (>38cm/15"): Estimated DBH range: Lg: 50" dbh Sm 16" dbh

1. Fagus grandifolia
2. Liriodendron tulipifera
3. Acer saccharum

& Prunus serotina (huge!)

Roost Tree Potential – Large Trees and Snags: ☒ High ☐ Moderate ☐ Low

↳ Many large hollow trees & snags

Subdominant Overstory Species (<38cm/15"):

1. F. grandifolia 2. A. saccharum 3. L. tulipifera

Relative Abundance of Dominant vs. Subdominant: 50:50

Subcanopy Clutter: ☐ Closed ☐ Moderate ☒ Open

Is Subcanopy Vegetation Lay Comprised Largely of: ☒ Lower Branches of Canopy Trees? ☐ Saplings ☐ Shrubs

Dominant Understory Species:
1. F. grandifolia
2. Magnolia fraseri
3. A. saccharum

Description of Habitat Form:
Upland hardwood forest with many large trees & open mid/under story. Snags abundant & flight corridors exist (ATV trail & 2 skid roads)

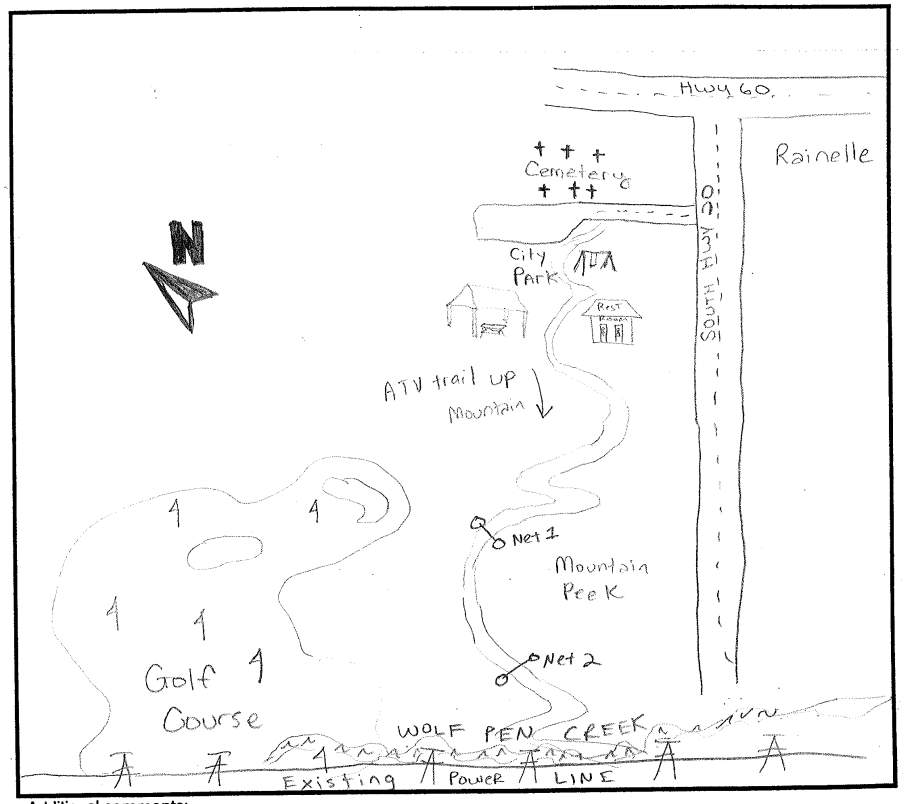
Herbaceous Cover: Very sparse. Dense leaf litter. Some ferns & maple leaf

Revised 19 March 2002

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Please draw a map of the portal location. Include land features such as streams, forests, roads (hardtop and mine access), railroads, spoil piles, houses, any other relevant structures or features, and ANABAT placement. Include a north arrow and an estimated scale.

Problem Area and AMLF #(s): _____



Additional comments:

revised: 12 April 2004

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HABITAT DESCRIPTION

Project No. _____ **Date:** 24 JUNE 2004 **Initials:** M Gilley

State/County WV/Greenbriar	**Site #:** Transmission Line #01

GPS: Longitude: N 37° 57' 52.8" Latitude: W 80° 47' 30.8"

Distance to water: 250 ft Quad name:

ESTIMATED STREAM CHARACTERISTICS: DID NOT SEE CREEK

Bank Height: _____ Channel Width: _____ Stream Width: _____

Wolf Pen Creek

Substratum: ☐ Sand ☐ Gravel ☐ Cobble ☐ Bedrock ☐ Silt/mud other _____

Average Water Depth: _____ Clarity: ☐ High ☐ Moderate ☐ Low

VEGETATION:

Estimated Canopy Closure: ☐ Closed ☒ Moderate ☐ Open

Dominant Overstory Species (>38cm/15"): Estimated DBH range: Lg: __ dbh Sm __ dbh

1. Fagus grandifolia
2. Prunus serotina
3. Liriodendron tulipifera

Roost Tree Potential – Large Trees and Snags: ☐ High ☒ Moderate ☐ Low

Subdominant Overstory Species (<38cm/15"):

1. F. grandifolia 2. Magnolia fraseri 3. Acer saccharum

Relative Abundance of Dominant vs. Subdominant: 15% : 85%

Subcanopy Clutter: ☐ Closed ☒ Moderate ☐ Open

Is Subcanopy Vegetation Lay Comprised Largely of: ☐ Lower Branches of Canopy Trees?

☒ Saplings ☐ Shrubs

Dominant Understory Species: 1. F. grandifolia
2. Witch hazel
3. _____

Description of Habitat Form:

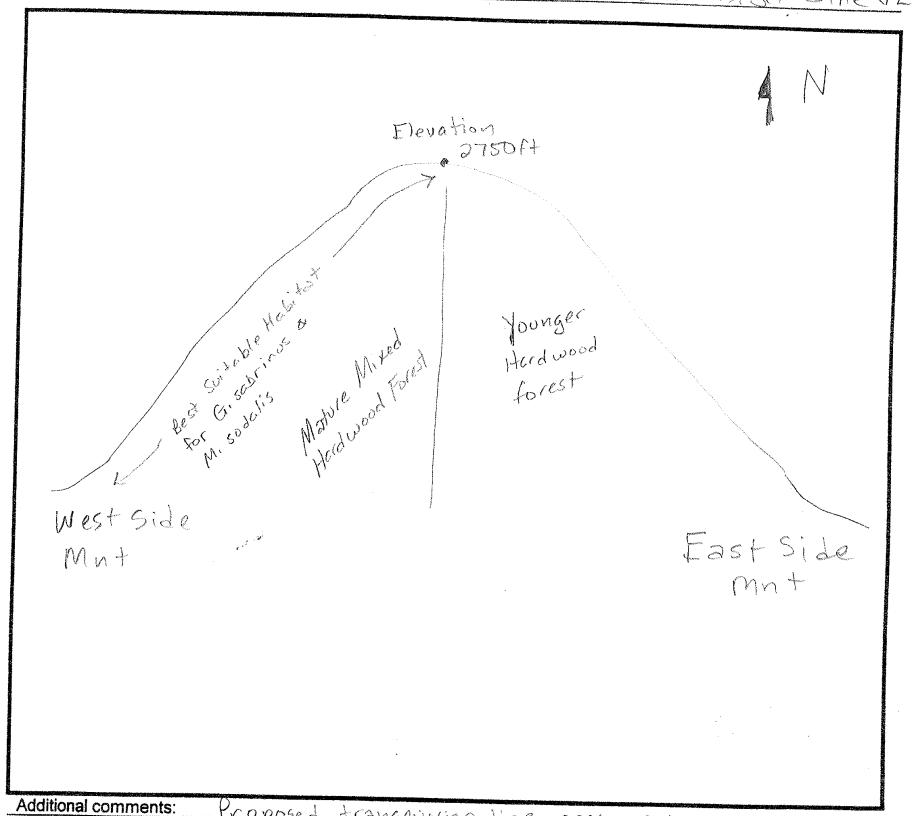
Upland hardwood forest. Mostly large beech. Habitat provides many good roosting cavities. Multiple large hollow beech trees. Undergrowth sparse - many good flight corridors.

Herbaceous Cover: Christmas fern, Mosses, violets

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Please draw a map of the portal location. Include land features such as streams, forests, roads (hardtop and mine access), railroads, spoil piles, houses, any other relevant structures or features, and ANABAT placement. Include a north arrow and an estimated scale.

Problem Area and AMLF #(s): Sewell Mnt Transmission Line (TL1)



Additional comments: Proposed transmission line goes up & over Mountain. 100ft ROW

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HABITAT DESCRIPTION

Project No. _____ **Date:** 24 JUNE 2004 **Initials:** MGilley

State/County WV Greenbriar	**Site #:** Transmission Line #02

GPS: Longitude: N 37° 57' 50.4" Latitude: W 80° 47' 21.0"

Distance to water: 1000ft. Quad name:

Wolf Pen Creek

ESTIMATED STREAM CHARACTERISTICS:

Bank Height: _____ Channel Width: _____ Stream Width: _____

Substratum: ☐ Sand ☐ Gravel ☐ Cobble ☐ Bedrock ☐ Silt/mud other _____

Average Water Depth: _____ Clarity: ☐ High ☐ Moderate ☐ Low

VEGETATION:

Estimated Canopy Closure: ☐ Closed ☒ Moderate ☐ Open

Dominant Overstory Species (>38cm/15"): Estimated DBH range: Lg: __ dbh Sm __ dbh

1. Quercus rubrum
2. Acer saccharum
3. Liriodendron tulipifera

Lg Shagbark x 27 60's

Roost Tree Potential – Large Trees and Snags: ☐ High ☒ Moderate ☐ Low

Subdominant Overstory Species (<38cm/15"):

1. Fagus grandifolia 2. Acer saccharum 3. Prunus serotina

Relative Abundance of Dominant vs. Subdominant: 25:75%

Subcanopy Clutter: ☐ Closed ☒ Moderate ☐ Open

Is Subcanopy Vegetation Lay Comprised Largely of: ☐ Lower Branches of Canopy Trees?

☒ Saplings ☐ Shrubs

Dominant Understory Species: 1. A. saccharum
2. Vitis spp.
3. F. grandifolia

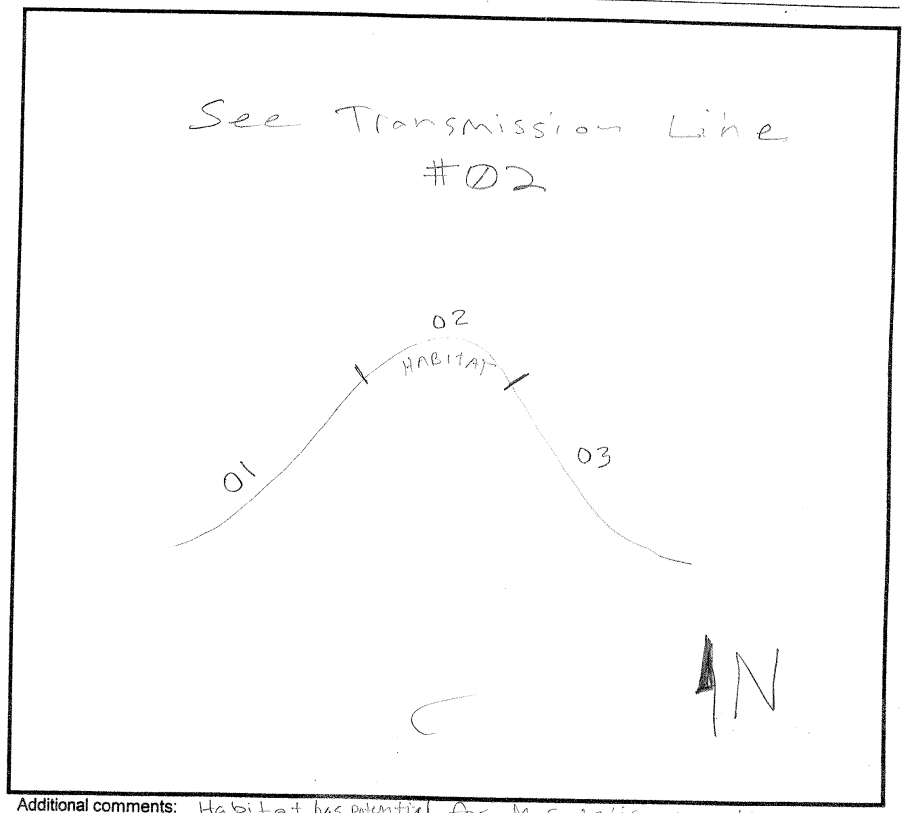
Description of Habitat Form:
Young mixed hardwood forest

Herbaceous Cover: Ferns, violets, mosses

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Please draw a map of the portal location. Include land features such as streams, forests, roads (hardtop and mine access), railroads, spoil piles, houses, any other relevant structures or features, and ANABAT placement. Include a north arrow and an estimated scale.

Problem Area and AMLF #(s): TL2



Additional comments: Habitat has potential for M. Sodalis - roosting. Foraging potential not as good. No good corridors - Habitat not good for C. townsendii

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HABITAT DESCRIPTION

Project No. _____ **Date:** 24 June 2004 **Initials:** M. Gilley

State/County WV-Greenbriar | **Site #:** Transmission Line #03

GPS: Longitude: N 37° 57' 50.3" Latitude: W 80° 47' 04.6"

Distance to water: 1500+ft Quad name:

ESTIMATED STREAM CHARACTERISTICS: Wolf Pen Creek

Bank Height: _____ Channel Width: _____ Stream Width: _____

Substratum: ☐ Sand ☐ Gravel ☐ Cobble ☐ Bedrock ☐ Silt/mud other _____

Average Water Depth: _____ Clarity: ☐ High ☐ Moderate ☐ Low

VEGETATION:

Estimated Canopy Closure: ☐ Closed ☐ Moderate ☐ Open

Dominant Overstory Species (>38cm/15"): Estimated DBH range: Lg: ___ dbh Sm ___ dbh

1. Carya ovata
2. Acer saccharum
3. Quercus alba

Roost Tree Potential – Large Trees and Snags: ☐ High ☐ Moderate ☒ Low

Subdominant Overstory Species (<38cm/15"):

1. Fagus grandifolia 2. Acer saccharum 3. L. tulipifera

Relative Abundance of Dominant vs. Subdominant: 10:90%

Subcanopy Clutter: ☒ Closed ☐ Moderate ☐ Open

Is Subcanopy Vegetation Lay Comprised Largely of: ☐ Lower Branches of Canopy Trees?

☒ Saplings ☐ Shrubs

Dominant Understory Species: 1. A. saccharum
2. —
3. —

Description of Habitat Form:

Young upland deciduous forest

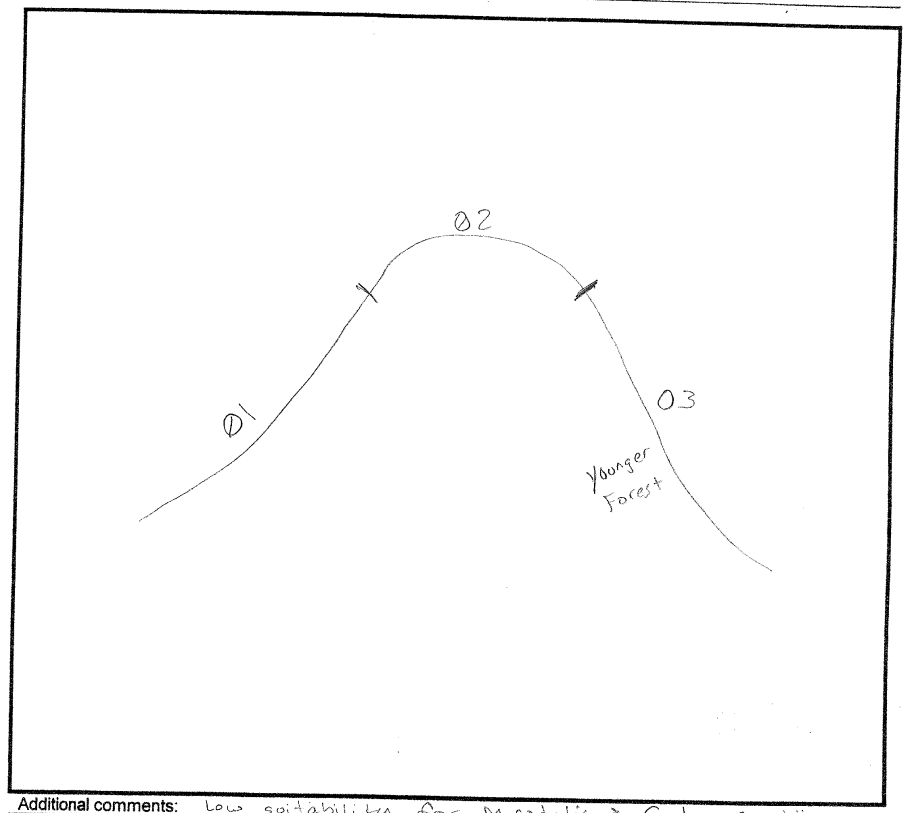
Herbaceous Cover: Ferns, small A. pennsylvanicum & A. saccharum

Revised 19 March 2002

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Please draw a map of the portal location. Include land features such as streams, forests, roads (hardtop and mine access), railroads, spoil piles, houses, any other relevant structures or features, and ANABAT placement. Include a north arrow and an estimated scale.

Problem Area and AMLF #(s): See Transmission Line #03



Additional comments: Low suitability for M. sodalis & C. townsendii.
** Sight at bottom of E. side of Amarillo did have a couple of large hollow trees

revised: 12 April 2004

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HABITAT DESCRIPTION

Project No. _____ **Date:** 24 JUNE 2004 **Initials:** MG & PJ

State/County WV - Greenbriar **Site #:** Anjean #01

GPS: Longitude: N 38° 01' 00.8" Latitude: W 80° 37' 25.8"

Distance to water: Quad name:

ESTIMATED STREAM CHARACTERISTICS:

Bank Height: _____ Channel Width: _____ Stream Width: _____

Substratum: ☐ Sand ☐ Gravel ☑ Cobble ☐ Bedrock ☐ Silt/mud other _____

Average Water Depth: _____ Clarity: ☐ High ☐ Moderate ☐ Low

VEGETATION:

Estimated Canopy Closure: ☐ Closed ☐ Moderate ☒ Open

Dominant Overstory Species (>38cm/15"): Estimated DBH range: Lg: — dbh Sm — dbh

1. NONE - All New Growth
2.
3.

Roost Tree Potential – Large Trees and Snags: ☐ High ☐ Moderate ☒ Low

Subdominant Overstory Species (<38cm/15"):

1. Robinia pseudoacacia 2. Acer rubrum 3. Acer saccharum

Relative Abundance of Dominant vs. Subdominant: 0:100%

Subcanopy Clutter: ☒ Closed ☐ Moderate ☐ Open

Is Subcanopy Vegetation Lay Comprised Largely of: ☐ Lower Branches of Canopy Trees? ☒ Saplings ☒ Shrubs

Dominant Understory Species: 1. Acer saccharum
2. R. pseudoacacia
3. _____

Description of Habitat Form:

Few abandoned building - No bats or guano observed. Buildings do provide potential roost sites for C. townsendii. Anjean site also contained some large exposed rock outcrops - but due to disturbed habitat surrounding outcrops - not likely good roosting sight for C. townsendii

Herbaceous Cover:

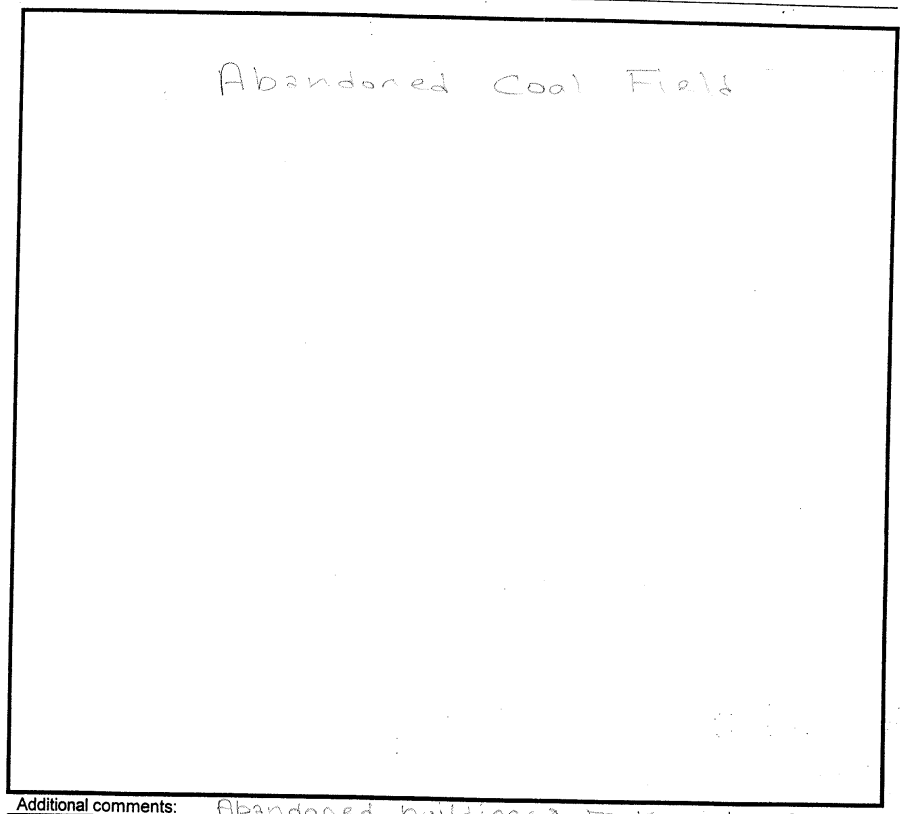
Grasses, Goldenrod (Solidago spp.)

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Please draw a map of the portal location. Include land features such as streams, forests, roads (hardtop and mine access), railroads, spoil piles, houses, any other relevant structures or features, and ANABAT placement. Include a north arrow and an estimated scale.

Problem Area and AMLF #(s): _____



Additional comments: Abandoned buildings & rock outcrops could provide suitable habitat for Virginia big-eared bats.

revised: 12 April 2004

Appendix B

Completed Flying Squirrel Habitat Description Data Sheets

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Photos

HABITAT DESCRIPTION
Glaucomys sabrinus

Project Name Potomac - Hudson — Date: 24 JUNE 2004

Biologist(s) M. Gilley & P. Johnson — Site: 01 } Rainelle Woods off site → may purchase for buffer

State/County WV - Greenbriar Co.

GPS: Longitude: N 37° 57' 40.3" — Latitude: W 80° 46' 31.1"

Elevation 2426ft (> 1000 – 1300m) — Water Source/Distance Sewell Creek

VEGETATION: % Mature conifers (1) — % Mature Hardwoods 100%

Dominant Overstory	Subdominant Overstory
1. Acer saccharum	1. Acer saccharum
2. Quercus vellutina	2. Fagus grandifolia
3. Liriodendron tulipifera	3.

Presence of Preferred Species: (West Virginia)

Conifers	Hardwoods
☐ Red Spruce	☐ Birch
☐ Fir	☑ Beech
☐ Hemlock	☑ Sugar Maple – predominately
	☑ Black Cherry – couple large

→ very little → open understory

Understory (shrubs & young saplings)	Herbaceous Cover
1. A. saccharum	1. Ferns
2. —	2. Violets
3. —	3. Vitis

Herbaceous Cover: sparse

Presence of Snags: NO - saw only one

Presence of Natural Cavities: Few hollow holes in maple, beech

Presence of Lichens & Fungi: some fungi

Nest Site Availability: Low (Medium) High

Foraging Potential: Low (Medium) High

Site - ridge side with mostly Maple. Several logs on ground.

Transmission line

732 619 0511

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Photos - 100-4378 - habitat
100-4379 - Potential Nest Sites
100-4380 " "
100-4381 " "

HABITAT DESCRIPTION
Glaucomys sabrinus

Project Name Potomac-Hudson — Date: 24 JUNE 2004

Biologist(s) M. Gilley & P. Johnson — Site: Transmission Line #01 on Sewell Mnt.

State/County WV - Greenbriar Co.

GPS: Longitude: N 37° 57' 52.8" — Latitude: W 80° 47' 30.8" Center Line

Elevation 2490ft (> 1000 – 1300m) — Water Source/Distance Wolfpen Creek 250ft

* Elevation a little low.

VEGETATION: % Mature conifers 0% — % Mature Hardwoods 100%

Dominant Overstory	Subdominant Overstory
1. Fagus grandifolia	1. Fagus grandifolia
2. Prunus serotina	2. Magnolia fraseri
3. Liriodendron tulipifera	3. Acer saccharum

Presence of Preferred Species: (West Virginia) — See Recovery Plan

Conifers	Hardwoods
☐ Red Spruce	☑ Birch (Mature) Abundant
☐ Fir	☑ Beech N 37° 57' 51.7" W 80° 47' 30.8" Northern
☑ Hemlock (young & small)	☑ Sugar Maple (young)
	☑ Black Cherry (Many Abundant large mature trees) (2) Hi fut.

Understory (shrubs & young saplings)
1. F. grandifolia
2. Witch hazel
3. —

Herbaceous Cover
1. Christmas fern & other ferns
2. Mosses on rock
3. Viola spp.

Most of rocky outcrops

Presence of Snags: Yes - counted 18-20 good snags

Presence of Natural Cavities: Yes - hollow trees present - mostly Beech — MANY

Presence of Lichens & Fungi: YES - many fungi

Nest Site Availability: Low Medium (High)

Foraging Potential: Low (Medium) High

Ground - Mostly rock outcrops & leaf litter. Little herbaceous cover.
** Many downed logs

Southern Boundary of ROW: N 37 57 49.5 W 80 47 31.2

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HABITAT DESCRIPTION
Glaucomys sabrinus

Project Name Potomac - Hudson

Date: 24 June 2004

Biologist(s) M. Gilley & P. Johnson

Site: Transmission Line #02

State/County WV / Greenbriar Co

GPS: Longitude: N 37° 57' 50.4"

Latitude: W 80° 47' 21.0"

Elevation 2700 ft (> 1000 – 1300m)
MAX Elevation 2750

Water Source/Distance Wolfpen Creek 1000 ft

VEGETATION: % Mature conifers Ø

% Mature Hardwoods 100%

Dominant Overstory
1. Quercus rubrum
2. Acer saccharum
3. Liriodendron tulipifera

Subdominant Overstory
1. Fagus grandifolia
2. Acer saccharum
3. Prunus serotina
Yellow birch

Presence of Preferred Species: (West Virginia)

Conifers - NONE
- ☐ Red Spruce
- ☐ Fir
- ☐ Hemlock

Hardwoods
- ☑ Birch
- ☑ Beech
- ☑ Sugar Maple
- ☑ Black Cherry

} Abundant

Understory (shrubs & young saplings)
1. Acer saccharum
2. Vitis spp
3. Fagus grandifolia
Acer - striped maple

Herbaceous Cover
1. Christmas fern & other ferns
2. Viola spp.
3. Mosses

111

Presence of Snags: YES

Presence of Natural Cavities: YES

Presence of Lichens & Fungi: YES

All less abundant than West side of Mountain

Nest Site Availability: Low (Medium) High

Foraging Potential: Low (Medium) High

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HABITAT DESCRIPTION
Glaucomys sabrinus

Project Name Potomac - Hudson

Date: 24 June 2004

Biologist(s) M. Gilley & P. Johnson

Site: Transmission Line #03

State/County WV - Greenbriar

GPS: Longitude: N 37° 57' 50.3"

Latitude: W 80° 47' 04.6"

Elevation 2724 ft to 2593 (> 1000 – 1300m)

Water Source/Distance Wolfpen Creek 1500 ft

VEGETATION: % Mature conifers Ø

% Mature Hardwoods 100%

Dominant Overstory
1. Carya ovata
2. Acer saccharum
3. Quercus alba
4. Prunus serotina

Subdominant Overstory
1. Fagus grandifolia
2. Acer saccharum
3. Liriodendron tulipifera

Presence of Preferred Species: (West Virginia)

Conifers
- ☐ Red Spruce
- ☐ Fir
- ☐ Hemlock

Hardwoods
- ☑ Birch
- ☑ Beech
- ☑ Sugar Maple
- ☑ Black Cherry

} Abundant

Understory (shrubs & young saplings)
1. A. saccharum
2.
3.

Herbaceous Cover
1. Ferns
2. Acer pennsylvanicum
3. Acer saccharum

1111

Presence of Snags: YES - 5-10 snags

Presence of Natural Cavities: YES - observed ≈ 5

Presence of Lichens & Fungi: YES - less abundant on east side of mountain

Nest Site Availability: (Low) Medium High

Foraging Potential: (Low) Medium High

Notes: East side of mountain - younger hardwood stand - more ground cover, DBH range 5-15" most trees - few > 16"

W Green Cogeneration

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HABITAT DESCRIPTION

Glaucomys sabrinus

Photos - 100-4382 coal
- 100-4383 - rock wall
100-4384 - sediment pond
100-4385 - vegetation

Project Name Potomac-Hudson

Date: 24 JUNE 2004

Biologist(s) M. Gilley & P. Johnson

Site: Anjean #01

State/County WV - Greenbriar Co.

ON - Anjean Mnt.

GPS: Longitude: N 38° 01' 00.8"

Latitude: W 80° 37' 25.8"

Elevation MAX - 3769 ft - Top Coal
MIN - 3150ft (> 1000 – 1300m)

Water Source/Distance Big Clear Creek
Briery Creek

VEGETATION: % Mature conifers Ø %

% Mature Hardwoods 100 %

Dominant Overstory - NONE - all New growth

1.
2.
3.

Subdominant Overstory

1. Robinia pseudoacacia
2. Acer rubrum
3. Acer saccharum

Presence of Preferred Species: (West Virginia)

Conifers

- ☐ Red Spruce
- ☐ Fir
- ☐ Hemlock

Hardwoods

- ☐ Birch
- ☐ Beech
- ☒ Sugar Maple - Striped & Red
- ☒ Black Cherry - Fire Cherry

Understory (shrubs & young saplings)

1. Acer saccharum
2. Robinia pseudoacacia
3.

Herbaceous Cover

1. Solidago spp.
2. Vetch
3. Rubus spp.
4. Vitis spp.

Presence of Snags: Very few < 5

Presence of Natural Cavities: NO

Presence of Lichens & Fungi: NONE observed - Ground cover dense with goldenrod & vetch

Nest Site Availability: (Low) Medium High

Foraging Potential: (Low) Medium High

Site - mined for coal. Alot of new growth & dense ground cover (mostly weeds). Some exposed rock walls.

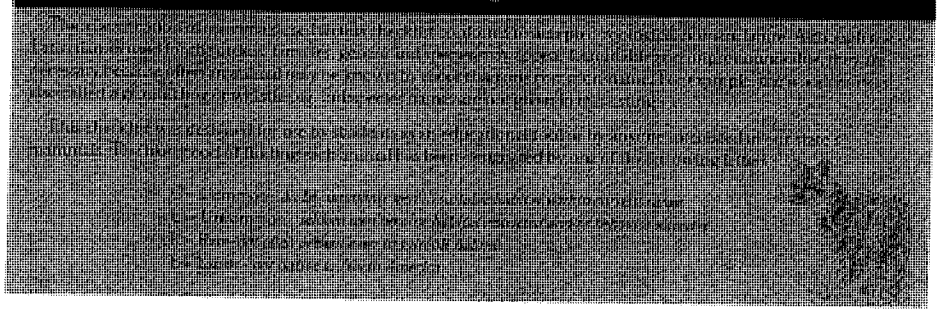
Appendix C

Completed Mammal Inventory Checklists

Mammals observed by:
V = visual
T = tracks
S = scat

Rainelle - offsite & on Sewell Cr.
#01 - 02

Mammals of West Virginia Field Checklist



ORDER DIDELPHIMORPHIA -Marsupials

Family Didelphidae - New World Opossums

_____ Virginia Opossum C
(Didelphis virginiana)

ORDER INSECTIVORA -Shrews and Moles

Family Soricidae-Shrews

_____ Masked Shrew C
Sorex cinereus

_____ Southeastern Shrew U
Sorex longirostris

_____ Smoky Shrew U
Sorex fumeus

_____ Long-tailed Shrew U
Sorex dispar

_____ Water Shrew R
Sorex palustris

_____ Pygmy Shrew U
Sorex hoyi

_____ Northern Short-tailed Shrew C
Blarina brevicauda

_____ Least Shrew R
Cryptotis parva

Family Talpidae -Moles

_____ Hairy-tailed Mole C
Parascalops breweri

_____ Eastern Mole U
Scalopus aquaticus

_____ Star-nosed Mole U
Condylura cristata

ORDER CHIROPTERA -Bats

Family Vespertilionidae -Common Bats

_____ Little Brown Myotis C
Myotis lucifugus

_____ Northern Myotis U
Myotis septentrionalis

_____ Indiana Myotis R
Myotis sodalis

_____ Eastern Small-footed Myotis R
Myotis leibii

_____ Gray Myotis R
Myotis grisescens

_____ Silver-haired Bat U
Lasionycteris noctivagans

_____ Eastern Pipistrelle C
Pipistrellus subflavus

_____ Big Brown Bat C
Eptesicus fuscus

_____ Eastern Red Bat C
Lasiurus borealis

_____ Hoary Bat U
Lasiurus cinereus

_____ Evening Bat R
Nycticeius humeralis

_____ Rafinesque's Big-eared Bat R
Corynorhinus rafinesquii

_____ Virginia Big-eared Bat R
Corynorhinus townsendii

ORDER RODENTIA -Rodents

Family Sciuridae -Squirrels

_____ Eastern Chipmunk C
Tamias striatus

_____ Woodchuck/ Groundhog C
Marmota monax

V ✓ Eastern Gray Squirrel C
Sciurus carolinensis

_____ Fox Squirrel C
Sciurus niger

_____ Red Squirrel C
Tamiasciurus hudsonicus

_____ Southern Flying Squirrel C
Glaucomys volans

_____ WV Northern Flying Squirrel R
Glaucomys sabrinus

Family Castoridae -Beavers

_____ American Beaver C
Castor canadensis

Family Dipodidae -Jumping Mice*

_____ Meadow Jumping Mouse U
Zapus hudsonius

_____ Woodland Jumping Mouse C
Napaeozapus insignis

Family Muridae Mice and Rats

Subfamily Sigmodontinae (New World mice and rats)

_____ Eastern Harvest Mouse R
Reithrodontomys humulis

_____ Deer Mouse C
Peromyscus maniculatus

_____ White-footed Mouse C
Peromyscus leucopus

_____ Golden Mouse U
Ochrotomys nuttalli

_____ Allegheny Wood Rat U
Neotoma magister

Subfamily Arvicolinae (Voles, lemmings, muskrats)

_____ Southern Bog Lemming U
Synaptomys cooperi

_____ Southern Red-backed Vole C
Clethrionomys gapperi

_____ Meadow Vole C
Microtus pennsylvanicus

_____ Rock Vole U
Microtus chrotorrhinus

_____ Woodland Vole/ Pine Vole C
Microtus pinetorum

_____ Prairie Vole R
Microtus ochrogaster

_____ Muskrat C
Ondatra zibethicus

Subfamily Murinae (Old World mice and rats)

_____ House Mouse E
Mus musculus

_____ Norway Rat E
Rattus norvegicus

_____ Black Rat E
Rattus rattus

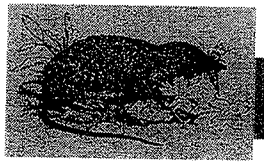
Family Erethizontidae -New World Porcupines

_____ Common Porcupine R
Erethizon dorsatum

ORDER LAGOMORPHA-Lagomorphs

Family Leporidae -Hares and Rabbits

_____ Snowshoe Hare U
Lepus americanus

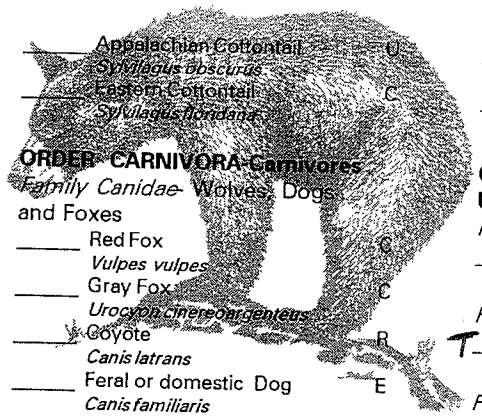


If you should find or observe a rare species or one not listed here, please contact the WVDNR's Wildlife Diversity Program, P.O. Box 67, Elkins, WV 26241 or phone 304-637-0245.

Appendix E

Appendix E

Rainelle #01-02 (continued)



_____ Appalachian Cottontail U
Sylvilagus obscurus
_____ Eastern Cottontail C
Sylvilagus floridanus

ORDER CARNIVORA-Carnivores

Family Canidae- Wolves, Dogs and Foxes

_____ Red Fox E
Vulpes vulpes
_____ Gray Fox C
Urocyon cinereoargenteus
_____ Coyote R
Canis latrans
_____ Feral or domestic Dog E
Canis familiaris

Family Ursidae-Bears

_____ Black Bear U
Ursus americanus

Family Procyonidae -Racoons and Ring-tails

_____ Common Raccoon C
Procyon lotor

Family Mustelidae -Mustelids

_____ Least Weasel U
Mustela nivalis
_____ Long-tailed Weasel U
Mustela frenata
_____ Mink U
Mustela vison
_____ Fisher R
Martes pennanti
_____ River Otter R
Lutra canadensis
Extirpated, Reintroduced

Family Mephitidae -Skunks

_____ Eastern Spotted Skunk U
Spilogale putorius
_____ Striped Skunk C
Mephitis mephitis

Family Felidae -Cats

_____ Bobcat U
Lynx rufus

_____ Mountain Lion or Cougar
Puma concolor *Extirpated*
_____ Feral or house cat E
Felis catus

ORDER ARTIODACTYLA-Even-toed Ungulates

Family Suidae -Pigs

_____ Wild Boar/ Feral Pig E
Sus scrofa

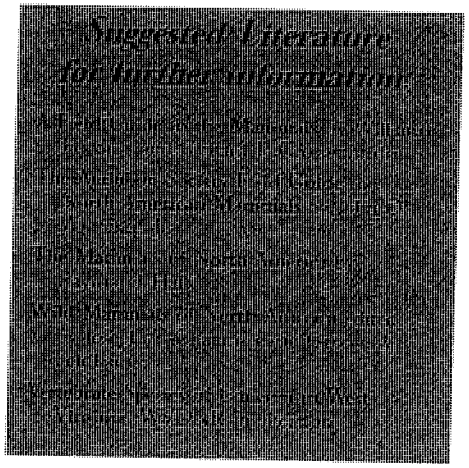
Family Cervidae -Cervids

_____ White-tailed Deer C
Odocoileus virginianus

Family Bovidae -Goats

_____ Domesticated Goat E
Capra hircus

*formerly *Zapodidae*, reduced to subfamily *Zapodinae*



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Mammals Of West Virginia



A Field Checklist

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West Virginia Division of
Natural Resources
Wildlife Resources Section

Appendix E

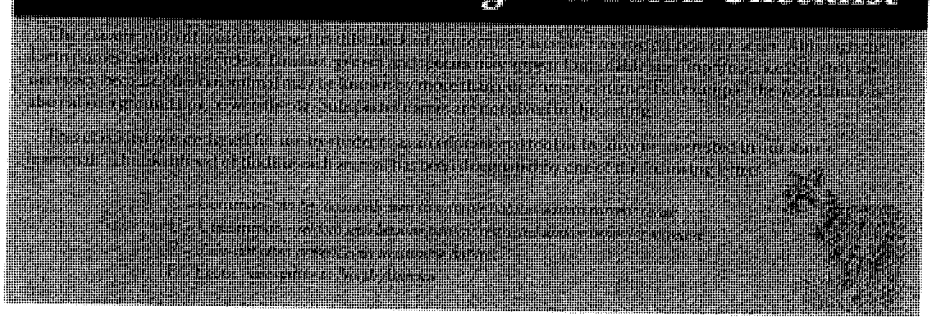
Appendix E

Mammals Observed by:

V = visual
T = tracks
S = Scat

Site - Transmission Line 01-03
Sewell Mountain

Mammals of West Virginia Field Checklist



ORDER DIDELPHIMORPHIA -Marsupials

Family Didelphidae - New World Opossums

_____ Virginia Opossum C
(Didelphis virginiana)

ORDER INSECTIVORA -Shrews and Moles

Family Soricidae-Shrews

_____ Masked Shrew C
Sorex cinereus

_____ Southeastern Shrew U
Sorex longirostris

_____ Smoky Shrew U
Sorex fumeus

_____ Long-tailed Shrew U
Sorex dispar

_____ Water Shrew R
Sorex palustris

_____ Pygmy Shrew U
Sorex hoyi

_____ Northern Short-tailed Shrew C
Blarina brevicauda

_____ Least Shrew R
Cryptotis parva

Family Talpidae -Moles

_____ Hairy-tailed Mole C
Parascalops breweri

_____ Eastern Mole U
Scalopus aquaticus

_____ Star-nosed Mole U
Condylura cristata

ORDER CHIROPTERA -Bats

Family Vespertilionidae -Common Bats

_____ Little Brown Myotis C
Myotis lucifugus

_____ Northern Myotis U
Myotis septentrionalis

_____ Indiana Myotis R
Myotis sodalis

_____ Eastern Small-footed Myotis R
Myotis leibii

_____ Gray Myotis R
Myotis grisescens

_____ Silver-haired Bat U
Lasionycteris noctivagans

_____ Eastern Pipistrelle C
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Eptesicus fuscus

_____ Eastern Red Bat C
Lasiurus borealis

_____ Hoary Bat U
Lasiurus cinereus

_____ Evening Bat R
Nycticeius humeralis

_____ Rafinesque's Big-eared Bat R
Corynorhinus rafinesquii

_____ Virginia Big-eared Bat R
Corynorhinus townsendii

V

ORDER RODENTIA -Rodents

Family Sciuridae -Squirrels

✓2 Eastern Chipmunk C
Tamias striatus

_____ Woodchuck/ Groundhog C
Marmota monax

_____ Eastern Gray Squirrel C
Sciurus carolinensis

_____ Fox Squirrel C
Sciurus niger

_____ Red Squirrel C
Tamiasciurus hudsonicus

_____ Southern Flying Squirrel C
Glaucomys volans

_____ WV Northern Flying Squirrel R
Glaucomys sabrinus

Family Castoridae -Beavers

_____ American Beaver C
Castor canadensis

Family Dipodidae -Jumping Mice*

_____ Meadow Jumping Mouse U
Zapus hudsonius

_____ Woodland Jumping Mouse C
Napaeozapus insignis

Family Muridae Mice and Rats

Subfamily Sigmodontinae (New World mice and rats)

_____ Eastern Harvest Mouse R
Reithrodontomys humulis

_____ Deer Mouse C
Peromyscus maniculatus

_____ White-footed Mouse C
Peromyscus leucopus

_____ Golden Mouse U
Ochrotomys nuttalli

_____ Allegheny Wood Rat U
Neotoma magister

Subfamily Arvicolinae (Voles, lemmings, muskrats)

_____ Southern Bog Lemming U
Synaptomys cooperi

_____ Southern Red-backed Vole C
Clethrionomys gapperi

_____ Meadow Vole C
Microtus pennsylvanicus

_____ Rock Vole U
Microtus chrotorrhinus

_____ Woodland Vole/ Pine Vole C
Microtus pinetorum

_____ Prairie Vole R
Microtus ochrogaster

_____ Muskrat C
Ondatra zibethicus

Subfamily Murinae (Old World mice and rats)

_____ House Mouse E
Mus musculus

_____ Norway Rat E
Rattus norvegicus

_____ Black Rat E
Rattus rattus

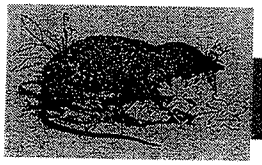
Family Erethizontidae -New World Porcupines

_____ Common Porcupine R
Erethizon dorsatum

ORDER LAGOMORPHA-Lagomorphs

Family Leporidae -Hares and Rabbits

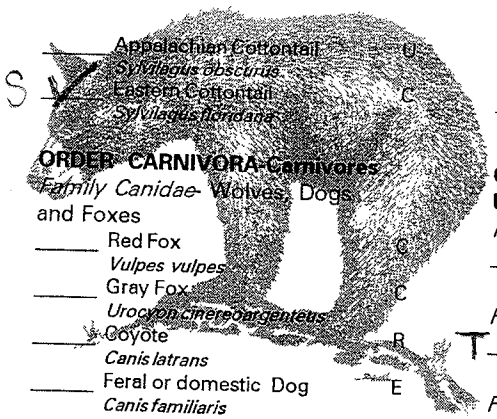
_____ Snowshoe Hare U
Lepus americanus



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Appendix E

Transmission Line 01-03 (continued)
Sewell Mountain



S ✓ ____ Appalachian Cottontail U
Sylvilagus obscurus
____ Eastern Cottontail C
Sylvilagus floridanus

ORDER CARNIVORA-Carnivores

Family Canidae- Wolves, Dogs, and Foxes

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____ Gray Fox C
Urocyon cinereoargenteus
____ Coyote R
Canis latrans
____ Feral or domestic Dog E
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____ Common Raccoon C
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____ Least Weasel U
Mustela nivalis
____ Long-tailed Weasel U
Mustela frenata
____ Mink U
Mustela vison
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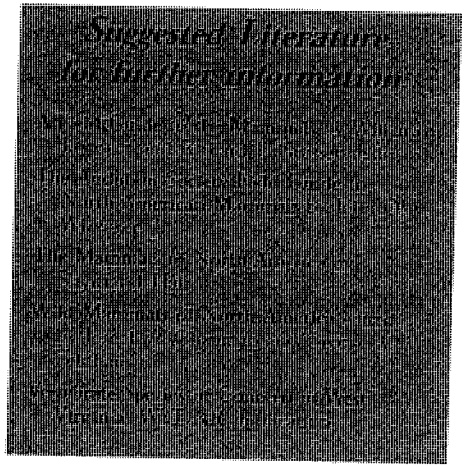
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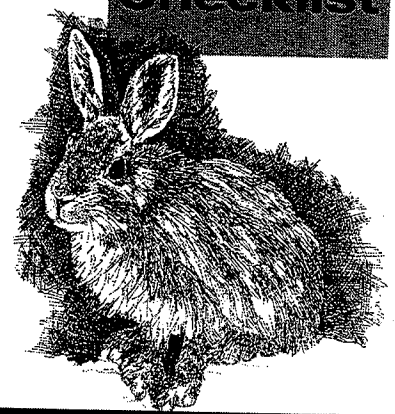
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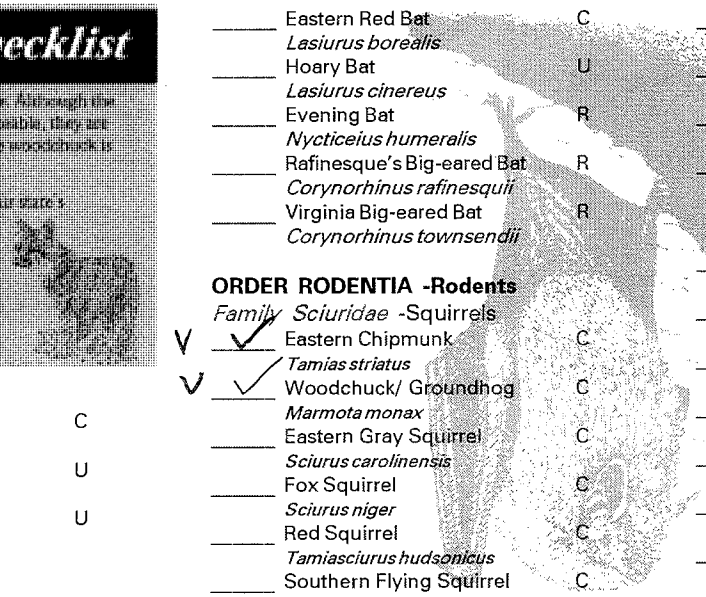
Site - Anjean #01
Anjean Mountain

Mammals of West Virginia Field Checklist

The classification of mammals used in this checklist conforms to accepted zoological nomenclature. Although the Latin names used for the orders, families, genera and species may appear formidable and unpronounceable, they are necessary because often an animal may be known by more than one common name. For example, the woodchuck is also called a ground hog or whistle pig. Subspecies names are not given in this listing.

This checklist was designed for use by students as an educational tool or by anyone interested in our state's mammals. The likelihood of finding each animal has been designated by one of the following letters:

C = Common- can be commonly seen in suitable habitat within current range
U = Uncommon - seldom seen because habitat restricted and/or secretive species
R = Rare- not often present even in suitable habitat
E = Exotic- introduced to North America



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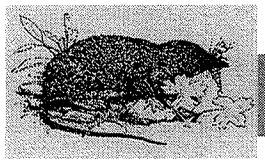
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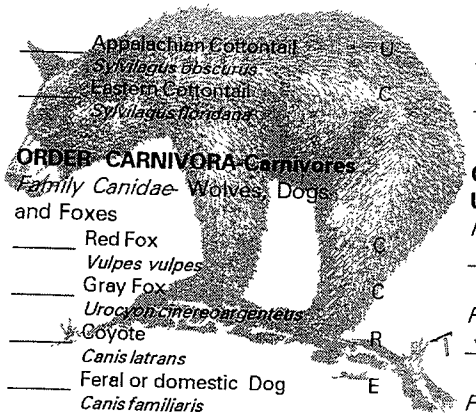
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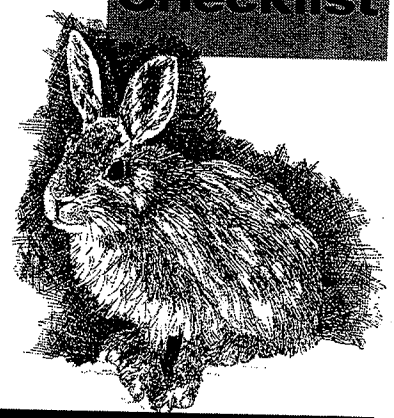
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Mammals Of West Virginia



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Appendix E

Appendix E

Appendix D

Completed Bat Capture Data Sheets

Property of: Environmental Solutions & Innovations, Inc
781 Neeb Road. Cincinnati, OH 45233 (Phone: 513-451-1777)

BAT CAPTURE DATA

Project No.: 115.02 **Project Name:** Potomac - Hudson Page 1 of 1
Date: 7-13-04 **Biologists:** Gilley, Leftwich **Camera #** _____
State: WV **County:** Greenbriar **Site ID:** Transmission Line
GPS –degrees-minutes-seconds
GPS: Latitude: N 37° 57' 516" Longitude: W 80° 47' 234" **ANABAT System #** _____

Trap #	Net #	Net type	Length	Height	Time Up	Time Down
	1	Mono / Old Nylon / New Nylon	18	20	2030	0150
	2	Mono / Old Nylon / New Nylon	18	20	2040	0150
		Mono / Old Nylon / New Nylon				

Site Description/Comments: Both nets over skidder trail midway up hillside

Capt #	Species	Time (2400)	Age Ad or Jv	Sex M/F	Repro-condition	Wt (g)	RFA (mm)	Belly: F, M, E	Feces Sample Y/N	Picture #
1	Eptesicus fuscus (1)	2100	Ad	M		16.5	43.1	M	Y	—
2	Myotis septentrionalis (2)	2220	Ad	F	L	7.5	36.9	F	Y	—

Revised: 9 September 2002

Property of: Environmental Solutions & Innovations, Inc
781 Neeb Road. Cincinnati, OH 45233 (Phone: 513-451-1777)

BAT CAPTURE DATA

Project No.: 115.02 **Project Name:** Potomac-Hudson Page 1 of 1
Date: 7-14-04 **Biologists:** Leftwich & Gilley **Camera #** _____
State: WV **County:** Greenbriar **Site ID:** Trans. Line
GPS –degrees-minutes-seconds
GPS: Latitude: N 37° 57' 516" Longitude: W 80° 47' 234" **ANABAT System #** _____

Trap #	Net #	Net type	Length	Height	Time Up	Time Down
	1	Mono / Old Nylon / New Nylon	18'	20'	2030	0140
	2	Mono / Old Nylon / New Nylon	18'	20'	2040	0140
		Mono / Old Nylon / New Nylon				

Site Description/Comments: _____

Capt #	Species	Time (2400)	Age Ad or Jv	Sex M/F	Repro-condition	Wt (g)	RFA (mm)	Belly: F, M, E	Feces Sample Y/N	Picture #
	No Bats									

Revised: 9 September 2002

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BAT CAPTURE DATA

Project No.: 115.02 Project Name: Potomac - Hudson Page 1 of 1
Date: 7-15-04 Biologists: Billey Leftwich Camera # Unk (4419 - 4420)
State: WV County: Greenbrier Site ID: Rainelle
GPS –degrees-minutes-seconds
GPS: Latitude: N 37° 57' 42.1" Longitude: W 80° 46' 31.2" ANABAT System # N/A

Trap #	Net #	Net type	Length	Height	Time Up	Time Down
	1	Mono / Old Nylon / New Nylon	18'	20'	2030	0150
	2	Mono / Old Nylon / New Nylon	18'	20'	2015	0150
		Mono / Old Nylon / New Nylon				

Site Description/Comments: Both nets over recently improved logging road; upland near ridge top

Capt #	Species	Time (2400)	Age Ad or Jv	Sex M/F	Repro-condition	Wt (g)	RFA (mm)	Belly: F, M, E	Feces Sample Y/N	Picture #
	No Captures									

Revised: 9 September 2002

* Lasiurus borealis seen flying towards net 1 circling

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BAT CAPTURE DATA

Project No.: 115.02 Project Name: Potomac-Hudson Page 1 of 1
Date: 7-16-04 Biologists: Gilley - Leftwich Camera #
State: WV County: Greenbrier Site ID: Rainelle
GPS –degrees-minutes-seconds
GPS: Latitude: N 37° 57' 42.1" Longitude: W 80° 46' 31.2" ANABAT System #

Trap #	Net #	Net type	Length	Height	Time Up	Time Down
	1	Mono / Old Nylon / New Nylon	18'	20'	2050	0150
	2	Mono / Old Nylon / New Nylon	18'	20'	2045	0145
		Mono / Old Nylon / New Nylon				

Site Description/Comments:

Capt #	Species	Time (2400)	Age Ad or Jv	Sex M/F	Repro-condition	Wt (g)	RFA (mm)	Belly: F, M, E	Feces Sample Y/N	Picture #
1	Eptesicus fuscus	2130	SV	M	↑	11.0	44.5	M		—

Revised: 9 September 2002

Appendix E

Completed Weather Data Sheets

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WEATHER DATA

Project No.: 115.02 Project Name: Potomac - Hudson
Date: 2-13-04 Biologists: Leftwich, Gilley
State: WV County: Greenbriar Site Name: Trans. Line

Comments:

Moon Phase Quarter (see chart):

Time (2400 h)	Temp (°F)	Wind Speed (estimated – see chart)	Wind Direction: From ___ to ___	% Cloud Cover (estimated)	Comments (precip., humidity, etc)
2100	70	0	—	10	
2200	66	1	—	20	
2300	64	0	—	0	
2400	64	1	—	0	
0100	62	1-3	S to N	0%	
0200	62	0	—	0%	

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WEATHER DATA

Project No.: 115.02 Project Name: Potomac - Hudson
Date: 2-14-04 Biologists: Gilley, Leftwich
State: WV County: Greenbriar Site Name: Trans. Line

Comments: Canopy too thick to determine cloud cover

Moon Phase Quarter (see chart):

Time (2400 h)	Temp (°F)	Wind Speed (estimated – see chart)	Wind Direction: From ___ to ___	% Cloud Cover (estimated)	Comments (precip., humidity, etc)
2100	66	6	SW - NE		
2200	65	4	SW - NE		
2300	64	4	SW - NE		
2400	64	10	SW - NE		
0100	64	15	SW - NE		winds getting gusty
0200	64	10	SW - NE		

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1

ESI

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WEATHER DATA

Project No.: 115.02 Project Name: Potomac - Hudson
Date: 7-15-04 Biologists:
State: WV County: Greenbrier Site Name: Roanoke

Comments: Canopy too dense to determine cloud cover

Moon Phase Quarter (see chart):

Time (2400 h)	Temp (°F)	Wind Speed (estimated – see chart)	Wind Direction: From ___ to ___	% Cloud Cover (estimated)	Comments (precip., humidity, etc)
2100	60	0	—		
2200	58	0	—		
2300	56	3	W-E		
2400	54	5	W-E		
0100	54	3	—		
0200	54	3	—		

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ESI

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781 Neeb Road. Cincinnati, OH 45233 (Phone: 513-451-1777)

WEATHER DATA

Project No.: 115.02 Project Name: Potomac - Hudson
Date: 7-16-04 Biologists: Gilley, Lethwick
State: WV County: Greenbrier Site Name: Roanoke

Comments:

Moon Phase Quarter (see chart):

Time (2400 h)	Temp (°F)	Wind Speed (estimated – see chart)	Wind Direction: From ___ to ___	% Cloud Cover (estimated)	Comments (precip., humidity, etc)
2100	60	2	—		
2200	56	0	—		
2300	55	1	—		
2400	52	1	—		
0100	51	0	—		
0200	50	2	—		

Revised 6 September 2001

Appendix E

Appendix F

Study Plan submitted to USFWS

Environmental Solutions & Innovations, Inc.

Virgil Brack, Jr., Principal Scientist
781 Neeb Road
Cincinnati, OH 45233
Phone: (513) 451-1777; Fax: (513) 451-3321
E-mail: vbrack@EnvironmentalSI.com

Pesi115 13 July 2004

SENT VIA E-MAIL to barbara_Douglas@fws.gov

Ms. Barbara Douglas
Endangered Species Biologist
U.S. Fish and Wildlife Service
West Virginia Field Office
Elkins, WV 26241

RE: Survey 3 areas associated with a single project on Ranel Quadrangle, near Rainelle, West Virginia for the Indiana and Virginia big-eared bats (Site map attached)

1. **Transmission Line (<1 km) = 1 net site**
2. **Anjean: search abandoned buildings and cliff faces (netting completed only if hard evidence of bats is found in detailed search)**
3. **Rainelle: net 1 site at adjacent property that may be acquired (approx. 40 ac)**

Dear Ms Douglas:

This is a study plan from Environmental Solutions & Innovations, Inc. (ESI), to complete studies at the above referenced project areas. Taina Brack at ESI presented this information to you over the phone, when you gave preliminary approval based upon receipt of this information. ESI proposes to conduct these surveys based on that approval and approval of this plan.

Study Plan

Netting Survey

Netting will be in accordance with guidelines recommended by the Indiana Bat Recovery Team in the March 1999 Agency Draft Indiana Bat Recovery Plan. A summary of those guidelines follows.

NETTING GUIDELINES

1. Netting Season: 15 May to 15 August, when Indiana bats occupy summer habitat.
2. Equipment (Mist Nets): constructed of the finest, lowest visibility mesh commercially available – monofilament or black nylon – with the mesh size approximately 1½ inch (1¼ –1¾) (38 mm).
3. Net Placement: mist nets extend approximately from water or ground level to tree canopy and are bounded by foliage on the sides. Net width and height are adjusted for the fullest coverage of the flight corridor at each site. A "typical" net set consists of three (or more) nets "stacked" on top of one another; width may vary up to 60 feet (20 m).
4. Net Site Spacing:
   - Streams – one net site per 0.5 mile (1 km)
   - Land Tracts – two net sites per 250 acres (1 square km)
5. Minimum Level of Effort Per Net Site:
   - Two net locations (sets) per net site, with locations (sets) at least 100 feet (30 m) apart
   - Two (calendar) nights of netting
   - At least three net–nights (1 net–night = 1 net set deployed for 1 night); typically, two net sets are deployed at one site for two nights, resulting in four net-nights
   - Sample Period: begin at dusk and net for 5 hours (approximately 0200h)
   - Nets are monitored at approximately 20-minute intervals
   - No disturbance near the nets between checks
6. Weather Conditions: net only if the following weather conditions are met:
   - No precipitation
   - Temperature $\geq$ 10°C (50°F)
   - No strong winds
7. Moonlight: avoid net sets with direct exposure to a moon ½ -full or greater – typically by utilizing forest canopy cover

U.S. Fish and Wildlife Service, 1999 Agency Draft Recovery Plan

ESI will set mist nets to maximize coverage of flight paths used by bats along suitable travel corridors, foraging areas, and/or drinking areas. Riparian corridors are often used for travel or forage. However, upland corridors (e.g., trails or logging roads) also can provide suitable net sites. In upland areas, road ruts holding water have produced Indiana bats in many portions of the range. Site selection is based upon the extent of

canopy cover, presence of an open flyway, and forest conditions near the site. The actual location and orientation of each net is determined in the field.

Bats are live-caught in mist nets and released unharmed near the point of capture. When bats are captured, we identify species, sex, age class, and reproductive condition of each bat. We record weight and right forearm length of each individual. Age is determined by examining the ephiphyseal-diaphyseal fusion of long bones in the wing. Reproductive condition of female bats is recorded as pregnant (based on gentle abdominal palpation), lactating, post lactating, or non-reproductive. We also record time and location/net site of all bats captured. Processing is completed within 30 minutes of the time the bat is removed from the net.

Proposed Level of Effort

Area 1 is a corridor <1 km in length; we propose 1 net site.

Area 2 has essentially no suitable woodland habitat but does have some old buildings and rock cliffs that will be examined for bats. If evidence of bats (sightings or sign) is found, netting or trapping will be completed.

Area 3 has no suitable habitat and is comprised of shrubs and small black locust, however an adjacent block of land, about 40 ac in size, has suitable habitat. This tract could possible be acquired or "used" during project development or operation. We propose 1 net site.

Following netting guidelines, each site has 4 net nights. Each site has 2 net locations, at least 100 feet apart, run for two nights. Netting will be completed using "high" nets (20 to 30 feet). ESI uses pre-printed data sheets for recording bat captures, habitat evaluation, and weather. It will be the goal to place all net sites within project boundaries, however should adequate sites not exist within the project boundaries we will select sites no further than ½ km from the boundaries. ESI uses pre-printed data sheets for recording bat captures, habitat evaluation, and weather.

Habitat Survey

The Indiana bat seems most frequently to use woodlands with:

- Large trees (>16 inches dbh) for maternity roosts
- An open canopy, apparently important for warming roost sites
- An open, uncluttered understory, used for travel and forage

In addition, flight corridors and drinking water are often used by bats, and are the locations where netting is most frequently successful.

ESI will complete a habitat description of each study location. The emphasis of this description is habitat form: size and relative abundance of large trees and snags that potentially serve as roost trees, canopy closure, understory clutter/openness, water, and flight corridors. Habitat form is emphasized because the Indiana bat roosts in a great many species of trees. Tree species composition is included in the assessment. Species composition is important because it provides insight to edaphic conditions on site. For example, an oak-hickory stand references a different set of conditions than does a beech-maple stand.

ESI's habitat characterization does more than emphasize species of large trees near the net. It identifies components of the canopy and subcanopy layers. All trees reaching into the canopy are canopy trees, regardless of diameter/size. Dominant trees are the large trees in the canopy (>16" dbh) that have the greatest likelihood of being used by maternity colonies of Indiana bats. Smaller trees are often also found in the canopy, and the canopy can be entirely composed of smaller-diameter trees.

The subcanopy, or understory, vegetation layer is well defined in classical ecological literature. It is that portion of the forest structure between the ground vegetation (to approximately 2 feet (0.6 meters) and the canopy layers, usually beginning at about 25 feet (7.6 meters). Vegetation in the understory may come from:

- Lower branches of overstory trees
- Small trees that will grow into the overstory
- Small tress and shrubs that are confined to the understory

The amount of vegetation in the understory is termed clutter. Many species of bats, including the Indiana bat, tend to avoid areas of high clutter.

Each net site is documented with a sketch.

Thank you for your time and effort. If you have any questions, please call.

Sincerely,

Virgil Brack, Jr., Ph.D., Principal Scientist
Environmental Solutions & Innovations, Inc.

Appendix F
Stream Studies

Appendix F1 – Aquatic Biota and Habitat Survey of Two Streams in Rainelle, WV

Appendix F2 – Meander Study Report

Appendix F3 – Mussel Survey Report*

**** A mussel report has been added as Appendix F3 for the Final EIS.***

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Aquatic Biota and Habitat Survey of Two Streams in Rainelle, WV.

6-20-05

Submitted by:
Environmental Assessment Associates
PO Box 2274
Huntington, WV 25723

Prepared by:
Thomas G. Jones, PhD and Casey Swecker

Summary

A general aquatic survey was completed on Wolfpen and Sewell Creeks near Rainelle, WV. The surveys included water chemistry, physical characteristics, habitat assessment, benthic invertebrate sampling with WV SCI calculations, a fish community assessment and a superficial assessment of mussel habitat. Sewell Creek is larger than Wolfpen but both streams have similar physical and chemical water quality. An un-named tributary to Sewell Creek did show evidence of acid mine drainage impact. Both RAPID habitat quality scores (117 and 122) and WV SCI scores (73.68 and 73.64, ranked "good") were better in Wolfpen Creek than in Sewell Creek. Sewell Creek WV SCI scores were ranked "fair" to "grey zone". Fish communities in both streams were dominated by tolerant, pioneering species. No dead shells or living unionid mussels were observed at any of the sites. Small stream size for Wolfpen Creek and poor habitat/flow characteristics in Sewell Creek would make the presence of any federally listed mussel species extremely unlikely. Overall Wolfpen and Sewell Creeks have reasonable water quality but are both habitat and flow limited to support diverse aquatic communities. No rare or endangered aquatic species were located at the five sampling locations.

Introduction

A coal waste fired power plant is proposed for development in Rainelle, West Virginia (Figure 1). A component of the environmental assessment of the location includes detailed sampling of Sewell Creek and its tributary, Wolfpen Creek. This report includes data on habitat, water quality, presence of unionid mussels, assessment of fish populations, and benthic invertebrate populations. Water quality data were collected and analyzed by Acculab Inc., an EPA certified water quality laboratory. The data were collected at four locations (Figure 2, Tables 1- 4). Stream habitat and benthic samples were collected at five locations (Figure 3, Tables 5 – 7, Appendix 1). Fish population assessments were made along 100m transects at three locations (Figure 4, Table 8, and Appendix 2). General habitat assessment for unionid mussels and visual searches for live and or dead shells were made at both invertebrate and fish assessment locations.

Methodology:

Fishes

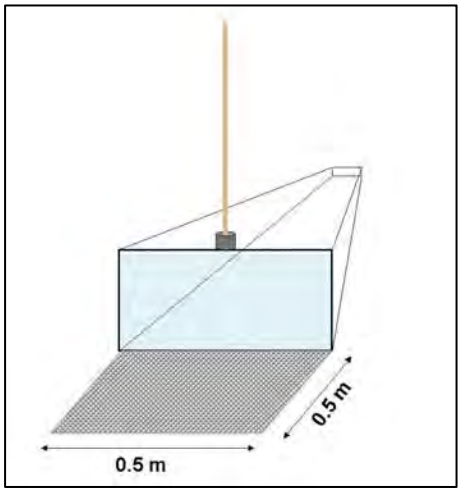
State agencies were notified of survey protocols, dates, and times. Area law enforcement agencies were notified to reduce concerns of the public. Three locations were sampled for fishes, two on Sewell Creek and one on Wolfpen Creek (Figure 4). Fish surveys were completed using a Smith Root backpack electro-fishing unit. Special care was taken not to disturb residences. Fishing began upstream and proceeded downstream as a series of zigzag bank encroachments. Blocking nets were not utilized since the stream segments had a series of well defined pools separated by very shallow water riffles. Stunned fishes were netted and placed into five gallon buckets. Shocking time and mean output were recorded at the end of each transect. Large fishes were identified, weighted, and measured for standard length. Small fishes were batch weighed. Images were collected for all species. Most fishes were released and no game fishes were retained. A series of

small specimens were retained as vouchers and for identification verification. All vouchers were placed in the Marshall University fish collection.

Benthic Macroinvertebrate Sampling

Five samples were collected, three on Sewell Creek and two on Wolfpen Creek (Figure 3, Table 5). Although the fish and benthic samples were collected in similar locations, specific habitat requirements did cause these sampling sites to differ slightly. Our protocols are directly quoted from the WV DEP's West Virginia Stream Index Protocol. The following are standard protocols (slightly modified) developed by the U.S. Environmental Protection Agency for conducting biological assessments of streams and rivers. A detailed description of the protocol is given in EPA 841-B-99-002 Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (RBP).

Benthic macroinvertebrates were collected using a 0.5 meter wide rectangular frame kick net with 600 µm mesh openings. The bottom substrate was examined to ensure that habitat was similar at each collection station. The net was positioned on the stream bottom in a riffle/run area so as to eliminate gaps under the frame. The surfaces of all large substrate particles (large gravel and larger) were cleaned using a dish scrub brush. The substrate particles were held in front of the net while brushing all surfaces so that dislodged organisms flowed into the net. Cleaned substrate particles were then set aside and the substrate was kicked vigorously for 20 seconds in an area approximating 0.25 square meters (one net width wide by one net width upstream of the net). This action dislodges bottom dwelling organisms and washes them into the net. Eight kick samples were collected at each site and composited into one sample that represented approximately 2 square meters of stream bottom substrate. The samples were preserved in 95% ethanol and returned for sorting. Sorting involved placing the entire benthic sample into a rectangular sieve and removing a 200 organism subsample. The organisms were identified to genus or the lowest level possible. A series of biological metrics (core metrics) were then calculated on each sample in order to determine the condition of the site:



Total taxa - measures the total number of macroinvertebrate taxa (diversity or different kinds) collected in the sample. Total taxa generally decreases with increasing stream degradation. In a 200 organism subsample, it is not uncommon for healthy streams to have 17 or more taxa at the family level of identification.

EPT Index - measures the total number of distinct taxa within the generally pollution sensitive groups Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). In general, this index increases with improving water quality. This index is widely used because it is very sensitive to changes in water quality. In a 200 organism

subsample, healthy streams commonly have 9 to 12 EPT taxa at the family level of identification.

Percent Contribution of 2 Dominant Taxa - measures the relative abundance of the 2 numerically dominant taxa to the total number of organisms in the sample. In healthy streams, there are generally several taxa, with the individuals being relatively evenly distributed among the different taxa. As stream water quality decreases, more individuals are concentrated in fewer, more tolerant taxa, and this metric increases. It is not uncommon for healthy streams to have as few as 40-60% of the total individuals in a sample in the 2 dominant taxa.

Percent EPT – measures the relative abundance of mayfly, stonefly, and caddisfly individuals to the total number of organisms in the sample. In general, this metric increases with improving water quality. It is common in healthy streams that at least 70 to 90% of the total organisms are in these sensitive orders.

Percent Chironomidae – measures the relative abundance of chironomid (midges) individuals to the total number of individuals in the sample. Chironomids are considered to be tolerant to many pollutant sources. This metric generally increases in value with decreasing water quality. In healthy streams, it is not uncommon that less than 10% of the organisms in a sample belong to the family Chironomidae.

HBI (Hilsenhoff's Biotic Index - modified) - summarizes tolerances of the benthic community to organic pollution. Tolerance values are assigned to each taxon on a scale of 0 to 10, with 0 identifying the organisms that are least tolerant (most sensitive), and 10 identifying the most tolerant (least sensitive) organisms. The HBI metric score can be thought of as an average organic pollution tolerance value for a sample, weighted by the abundance of organisms. As water quality of a stream decreases, the HBI increases. This is especially true where organic enrichment is present. Since many of the organic pollution tolerant organisms are also tolerant to other stressors, the HBI is often used as a general indicator of stress. It is not uncommon for healthy streams with good water quality to have HBI scores in the 3 to 4 range.

WVSCI SCORING CRITERIA
VERY GOOD **> 78.0 to 100.0**
GOOD **>68.0 to 78.0**
"GRAY ZONE" **>60.6 to 68.0**
FAIR **>45.0 to 60.6**
POOR **>22.0 to 45.0**
VERY POOR **0.0 to 22.0**

WVSCI (WV Stream Condition Index) - The six benthic community metrics were combined into a single multimetric index, the West Virginia Stream Condition Index (WVSCI). The WVSCI was developed by Tetra Tech Inc. (2000) using WVDEP data collected from riffle habitats in wadeable streams. In general terms, all metric values were converted to a standard 0 (worst) to 100 (best) point scale. The six standardized metric scores were then averaged for each benthic

sample site to come up with a final index score that ranges from 0.0 to 100.0. If a stream site received a WVSCI score greater than 78.0, it was considered in very good condition. A WVSCI score greater than 68.0, but equal to or less than 78.0 indicated good conditions. Initially, a site that received a WVSCI score equal to or less than 68.0 was considered impaired. However, because the final WVSCI score can be affected by a number of factors (collector, micro-habitat variables, subsampling, etc.), agency personnel sampled 26 sites in duplicate to determine the precision of the scoring. Following an analysis of the duplicate data, agency personnel determined the precision estimate to be 7.4 WVSCI points for a single sample. This value (7.4) was then subtracted from the impaired threshold score of 68.0 and generated what is termed the "gray zone" that ranges from 60.6 to 68.0. If a site had a WVSCI score within the gray zone, a single kick sample was considered insufficient for classifying it as impaired. If a site received a WVSCI score equal to or less than 60.6, the agency was highly confident that the site was truly biologically impaired based on a single benthic macroinvertebrate sample. In accordance, scores greater than 45.0 and equal to 60.6 indicated fair conditions. Scores between 22.0 to 45.0 indicated poor conditions, and between 0.0 to 22.0 indicated very poor conditions.

Habitat Evaluation

A habitat evaluation was conducted utilizing a modified version of the Rapid Bioassessment technique. The approach focuses on integrating information from specific parameters on the structure of the physical habitat that are important to the survival and maintenance of benthic macroinvertebrate populations. Ten parameters were evaluated and given a score on a scale of 0 to 20. The scoring is broken down into four categories: 1) 0 to 5 = Poor, 2) 6 to 10 = Marginal, 3) 11 to 15 = Suboptimal, and 4) 16 to 20 = Optimal. The ten scores were summed to provide a total habitat score for each station (maximum score = 200).

Water Quality Sampling

A field technician from Acculab, Inc. completed field testing and laboratory testing of water chemistry. This is an EPA certified laboratory. All standard QA/QC procedures were followed. Water samples were collected from four locations (Figure 2).

Qualitative Mussel Habitat Surveys

While completing the above work qualified graduate students assessed the available suitable habitat for mussels. Specifically habitat for federal listed species was assessed. Students also searched the sampling areas for dead shells or other signs of a viable mussel population. No dead shells or live specimens, if present, were handled.

Results:

Water Quality

Water quality data was independently collected and analyzed by Acculab, LLC. This facility is EPA approved and regularly samples water in southern West Virginia. Table 1 lists the UTM coordinates for zone 16 for each sampling site. Figure 2 shows the approximate locations of the sampling sites on a topographical map layer. Sites one and three were in Sewell Creek, site two was from Wolfpen Creek, and Site 4 was from an unnamed tributary to Sewell Creek. The number of fecal coliform colonies per 100ml sample was calculated for all four sites with a single duplicate at Site 3 (Table 2). Results of the fecal coliform count indicated the numbers of colonies per 100 ml ranged from 56 colonies for site 4 to 243 colonies for Site 3. Fecal coliform numbers were generally low with a small spike at Site 3. This site was a shallow pool with very little flow. Therefore it is not unexpected that it would show elevated fecal coliform levels. The Wolfpen Creek runs through a golf course; surveyors noted footprints, feathers, etc., suggesting ducks, geese, and several mammals living along the creeks. Applied fertilizers and mega fauna are sources of fecal colonies.

Selected water quality criteria was collected from from the four stations is summarized in Table 3. Sites one, three, and duplicate sample three had stream flows that ranged from 13 to 15 cubic feet persecond (cfs), and exhibit strong correlations of flow, conductivity, pH, and temperature measurements. Data collected from the sites show conductivity values ranged from 33.3 to 109.5 umhos, pH values were generally neutral and ranged from 6.9 to 7.3 su, and temperature for the four sites ranhed from 16.4 ℃ for sites 1 and 3 to 17.9 ℃. These sites are all within expected values for a stream of this size and location in West Virginia. The Wolfpen Creek site (Site 2) is much smaller; a flow of 2 cfs compared to a mean of 14 cfs for Sewell Creek, and has a slightly elevated conductivity (109.5 umhos). Site four is on an unnamed tributary of Sewell Creek and has a tenth of the flow of Wolfpen Creek (0.219 cfs).

Additional chemical tests from sites one, two, three, and duplicate three exhibit very similar conditions with little evidence of acid mine drainage impact. The water quality data indicates the concentration of dissolved organic and inorganic minerals range from 0.081miligrams per liter (mg/l) for aluminum, to 19 mg/l for sulfate.The concentration for suspended solids varies from less than 1mg/l to 3 mg/l. The concentration for acidity is typically less than 1 mg/l and alkalinity ranges from 26 mg/l (sites 1 and 3) 44 mg/l (site 2)(see Table 4). However site four does exhibit reduced alkalinity (8 mg/l), increased acidity (6 mg/l), and slightly elevated manganese and total aluminum levels (0.1 mg/l and 0.115 mg/l respectively). All these are chemical signatures of acid mine drainage. Based on size and similarity of physical and chemical measurements the water quality of upstream Sewell Creek would dictate the conditions near the proposed power plant.

Benthic Macroinvertebrates

Five benthic invertebrate samples were collected from Wolfpen and Sewell Creeks near Rainelle, WV (Figure 3, Table 5, and Appendix 2). Stream habitat data were collected from all five sites. Five sites were chosen to assess some measure of in stream variability. The EPA's RAPID protocol habitat score sheets, which were modified by the WVDEP, was used to measure the gradient score. The high gradient score sheet was used since Wolfpen Creek best fits this scoring procedure and therefore direct comparisons could be made between sites. Sewell Creek was judged borderline between high and low gradient. If low gradient scores were utilized, then the mean habitat scores would increase slightly. The high gradient scoring procedure is the most commonly utilized scoring procedure in WV. The RAPID protocol includes ten metrics calculated for each site with a possible maximum of 20 pts per metric (Table 6). Three of the ten metrics, bank stability, vegetative protection, and riparian vegetative zone width are measured along both banks and their cumulative, right and left bank scores can total a maximum 20 pts. Wolfpen Creek sites 1a and 1b scored 117 and 122, respectively. The total possible score is 200. These represent below average stream habitats. The site images found in Appendix 1 shows high gradient rocky bottom locations. These images represent the best benthic habitat in along the stream segment. Benthic samples are collected from a series of riffles within a 100 meter reach. Habitat scores are based on the cumulative habitat across the entire reach. The three sites on Sewell Creek were scored even lower at 94, 88, and 85. All three scores suggest degraded stream habitats.

Table 7 lists the West Virginia Stream Condition Index (WVSCI) scores and metrics for the five locations. The raw sample data is located in appendix 2. The Wolfpen Creek sites scored the highest WVSCI values of 73.68 and 73.64. These sites habitat also scored 20 or more points above the Sewell Creek sites. Habitat scores and WVSCI almost always show a positive correlation. Lack of agreement would suggest anthropomorphic impacts. These site scores would rank in the "Good" criteria zone. Sites 3 and 2b scored 66.3 and 60.92. These values are in the "Grey Zone" criteria zone. This area was defined as an area of overlap between "Good" sites and "Fair" sites. The WV DEP reserves judgment as to the exact classification of this zone. The final benthic site 2a had a score of 56.32 a "Fair" zone classification. All sites show an intermediate level of impairment. The Hilsenhoff Biotic Index (HBI) ranges from 4.32 for site 1A to 5.11 for site 2B, which would characterize water quality as average. No benthic invertebrates of special interest were found within the samples collected.

Fishes

Three electrofishing transects were sampled, site 1a from Wolfpen Creek, sites 2a and 3 from Sewell Creek. (Figure 4, Table 8, Appendix 3). Fish communities at all sites were numerically dominated by creek chubs, stone rollers, blunt nose minnows, and rock bass (Appendix 3). These species are found in small streams that are regularly impacted by low water conditions. They are considered pioneer species. The greatest number of fish species occurred at site 1A (11 species) and site 3 contained the least number of species (1). No fishes of special interest were located during this study. Table 8 lists the

commonly used fish metrics for assessment. West Virginia does not have a regionally modified assessment protocol for fishes. Many more individuals were collected from Wolfpen Creek (site 1a) than the other two sites. Wolfpen was much smaller, had more graveled substrates, and had more fish barriers (riffles) than the Sewell Creek. Sewell Creek was larger and consisted of a series of poorly defined pools with sections of water deeper than wadeable. These sites also had significant deposits of fine sediments and very low current velocities. Capture efficiency was near 90% in Wolfpen Creek but was estimated at 35% (site 2a) and 50% (site 3). Both streams have a limited number of fish species (Table 8). In small habitat restricted streams this is not uncommon. No trout were collected at any site. Green sunfish, an invasive species, was collected from all sites in low numbers. No diseased or hybrid individuals were collected from any site. Rock bass and green sunfish were used as the top carnivore since they were collected from all sites. Numerically creek chub dominated the system but they were not collected from site 2a. The northern hog sucker was the only catostomid collected. These values suggest a tolerant community that may be exposed to regularly very low water levels.

Mussel Habitat

Qualified graduate students made observational notes on current mussel populations and potential habitat. General observations were made during an initial walk through of the sites. Wolfpen Creek is small, sand and gravel dominated stream (Appendix 1). During extreme dry years it would mostly consist of a series of isolated pools with little to no current. Invertebrate sampling sites, those imaged, would represent the best benthic habitat available and they should not be considered typical of this stream. Both banks of the stream show extreme evidence of instability and regular sloughing. Sewell Creek is larger but is more base flow in nature (Appendix 1). It is a series of sand dominated shallow pools. Bank height is up to three meters with both sides highly unstable. Figure 3 shows the characteristic meandering of a low gradient stream. The water would be more consistent in this stream. Both streams exhibited signs of enrichment, sheens and bubbles on the water surface and filamentous algae. All sites had very low habitat scores from 85 to 122 out of a possible 200 points (Table 6). Overall, neither site had potential habitat suitable for any federally listed species except the rabbit's foot, *Quadrula cylinderia*. This species is known from sandy, depositional habitats. However, there is no historical record for this species within a 50 mile radius.
While sampling fish, habitat, and benthos additional observations were made noting existing mussel populations and the potential habitat. No evidence of an extant mussel population was found except for the invasive Asiatic clam *Corbicula flumieria.* No live unionids or dead shell material were observed.

Conclusions
A general survey of water quality found the Wolfpen and Sewell Creek sites similar in both physical and chemical characteristics. Sewell Creek is the larger stream. Due to large flow differences upstream Sewell Creek will determine water quality in the area. An unnamed tributary of Sewell Creek exhibits characteristics of limited acid mine drainage input. It is not so heavily contaminated or it's flow large enough to affect Sewell Creek. Wolfpen Creek was found to have higher quality stream habitat and

benthic invertebrate communities. Both sites ranked "good" with the WV SCI. The three Sewell Creek sites had a mean habitat score of 89 out of 200. Their benthic index scores ranked from "fair" to "grey zone". This suggests an intermediate level of impact. Fish communities in both streams were dominated by tolerant, pioneering species. Metric values all suggested either a fish community highly impacted in the recent past and recovering or a system with repeated impacts such as periodic very low flows. No dead shells or living unionid mussels were observed at any of the sites. Small stream size for Wolfpen Creek and poor habitat/flow characteristics in Sewell Creek would make the presence of any federally listed mussel species extremely unlikely. Overall Wolfpen and Sewell Creeks have reasonable water quality but are both habitat and flow limited to support diverse aquatic communities. No rare or endangered aquatic species were located at the five sampling locations.

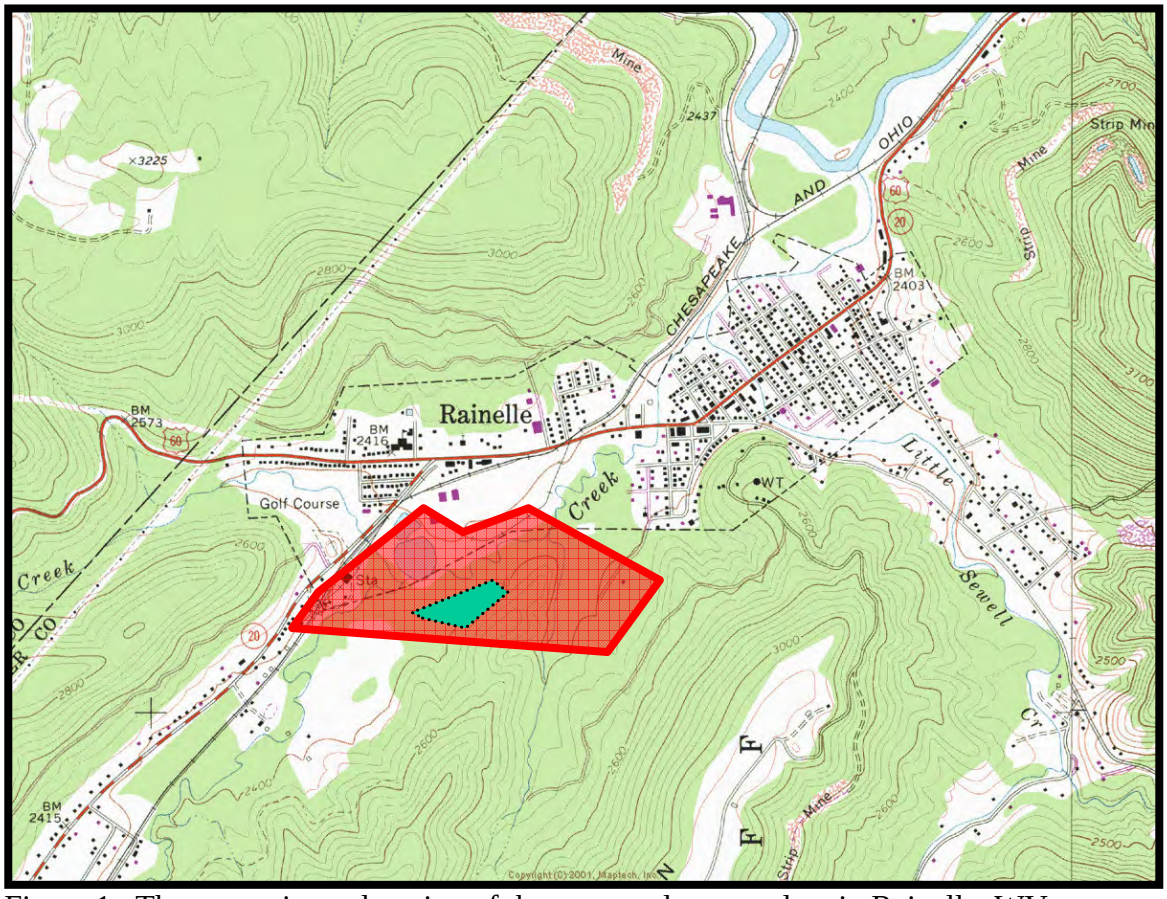


Figure 1. The approximate location of the proposed power plant in Rainelle, WV.

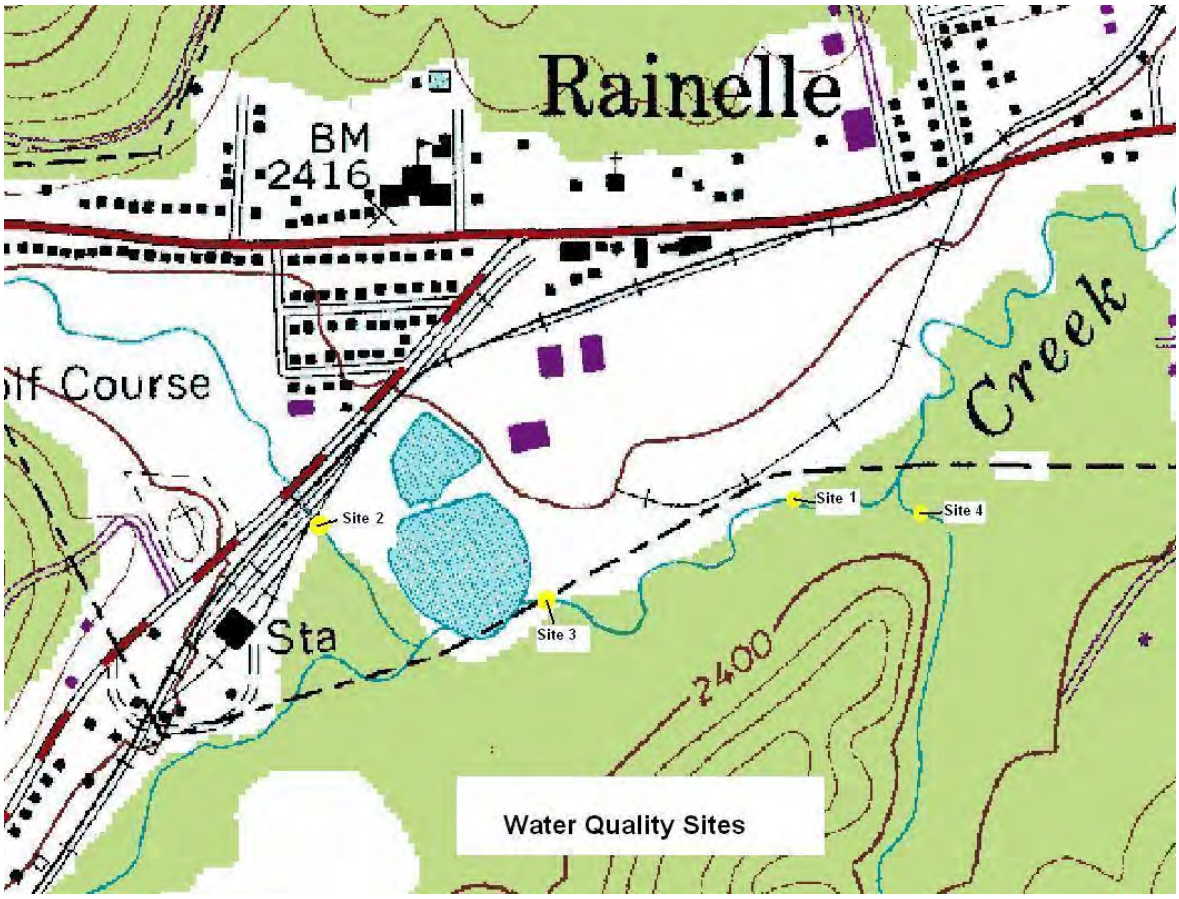


Figure 2. Locations of water quality sampling sites.

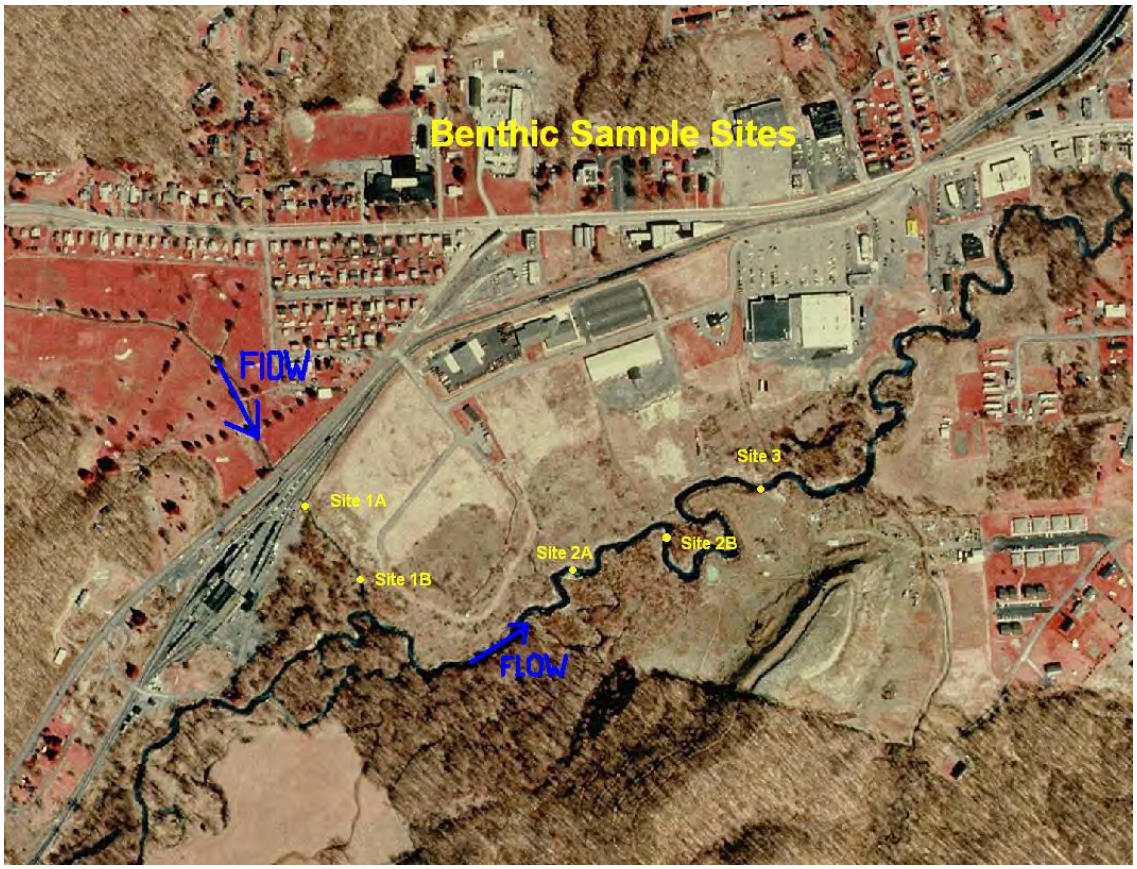


Figure 3. Benthic invertebrate sampling sites on Wolfpen (site 1a & 1b) and Sewell Creeks (sites 2a, 2b, and 3) near Rainelle, WV.

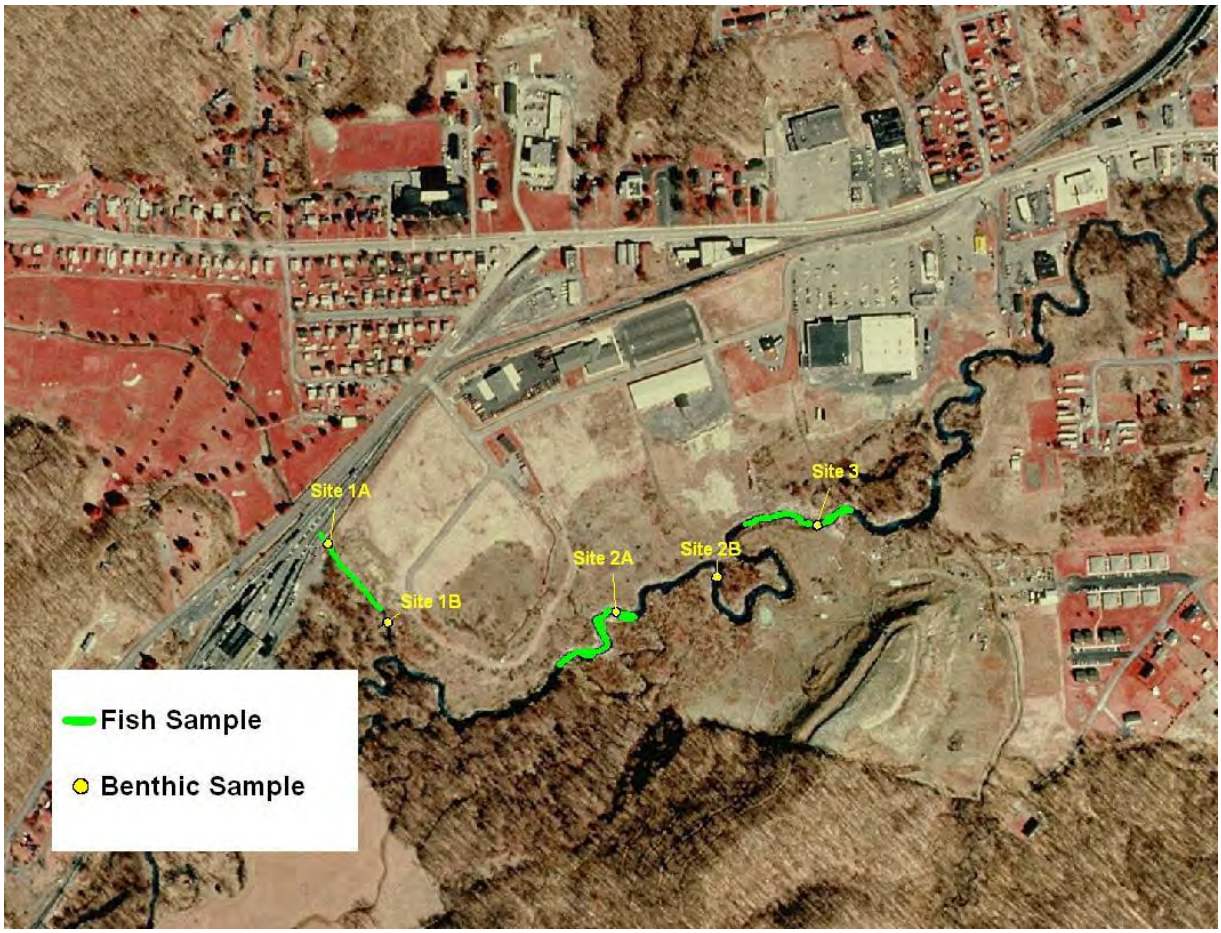


Figure 4. Fish sampling transects on Wolfpen and Sewell Creeks near Rainelle, WV.

Table 1. UTM data on four water quality locations in Rainelle, WV.

Site	Northing	Easting
1	4201919	519763
2	4201894	519190
3	4201798	519473
4	4201902	519926

Table 2. Data on Fecal coliform counts at four locations in Rainelle, WV. (Numbers of colonies per 100ml)

SITE	FECAL COLIFORM
1	124
2	65
3	243
3 DUP	241
4	56

Table 3. Selected water quality data collected from four locations in Rainelle, WV.

PARAMETER	SITE 1	SITE 2	SITE 3	SITE 3 DUP	SITE 4	UNITS
FLOW	13.0	2.0	15.0	15.0	0.219	cfs
CONDUCTIVITY	90.7	109.5	90.7	90.7	33.3	umhos
pH	6.9	7.4	7.3	7.3	7.0	su
TEMPERATURE	16.4	16.8	16.4	16.4	17.9	℃

Table 4. Water quality data collected from four locations in Rainelle, WV.

PARAMETER	SITE 1	SITE 2	SITE 3	SITE3 DUP	SITE 4	UNITS
Total Suspended Solids	<1	2	3	1	4	mg/l
Alkalinity	26	44	26	34	8	mg/l
Acidity	<1	<1	<1	<1	6	mg/l
Hot Acidity	<1	<1	<1	<1	<1	mg/l
Sulfate	17	3	18	19	4	mg/l
Turbidity	4	4	5	4	7	mg/l
Iron	0.43	0.17	0.39	0.48	0.4	mg/l
Manganese	0.08	0.05	0.07	0.08	0.1	mg/l
Aluminum	0.087	0.036	0.156	0.081	0.115	mg/l
Selenium	<2	<2	<2	<2	<2	ug/l
Zinc	<10	<10	<10	<10	<10	ug/l
Dissolved Iron	0.23	0.1	0.17	0.24	0.2	mg/l
Dissolved Aluminum	<0.02	<0.02	<0.02	<0.02	<0.02	mg/l
Dissolved Copper	2	2	2	1	1	ug/l
Dissolved Zinc	<10	<10	<10	<10	<10	ug/l
Nitrite/Nitrate	2.64	1.76	2.2	1.76	1.76	mg/l
Phosphate	<0.05	<0.05	<0.05	<0.05	<0.05	mg/l
Total KJELDAHL Nitrogen	<0.14	<0.14	<0.14	<0.14	<0.14	mg/l

Table 5. Locations of fish and benthic collection sites in Rainelle, WV

Site Name	UTME	UTMN
Lower Sewell Creek Site 3	519772	4201916
Upper Sewell Creek 2A	519532	4201806
Middle Sewell Creek 2B	519643	4201849
Wolfpen Creek Site 1A Upstream Sample	519178	4201877
Wolfpen Creek Site 1B Downstream Sample	519258	4201794

Table 6. Rapid bioassessment habitat data collected from five locations in Rainelle, WV.

Habitat Metrics	Lower Sewell Creek Site 3	Upper Sewell Creek 2A	Middle Sewell Creek 2B	Wolfpen Creek Site 1A Upstream Sample	Wolfpen Creek Site 1B Downstream Sample
Epifaunal Substrate	5	11	12	12	14
Embeddedness	5	2	3	14	14
Velocity/Depth Regime	4	5	5	13	15
Sediment Deposition	5	2	1	12	14
Channel Flow Status	12	9	8	10	9
Channel Alteration	18	18	17	13	14
Frequency of Riffles	2	2	1	15	16
Bank Stability (LB+RB)	8	5	6	4	3
Vegetative Protection (LB+RB)	15	16	15	8	9
Riparian Vegetative Zone Width (LB+RB)	20	18	17	16	14
Total	**94**	**88**	**85**	**117**	**122**

Table 7. West Virginia stream condition index data from five locations in Rainelle, WV.

Site Name	TOTAL TAXA	EPT TAXA	EPT%	CHIRO %	DOM2 %	HBI SCORE	WVSCI
Site 3 Lower Sewell Creek	13	6	44.82759	39.41	64.04	5.03	66.33
Site 1A Wolfpen Creek Upstream	16	8	56.29921	32.68	63.78	4.32	73.68
Site 1B Wolfpen Creek Downstream	15	9	54.31034	26.29	62.93	4.39	73.64
Site 2A Upstream Sewell Creek	15	7	25.70093	66.82	73.64	5.08	56.32
Site 2B Middle Sewell Creek	16	9	33.63636	57.73	77.1	5.11	60.92

Table 8. Fish metrics data collected in Rainelle, WV.

Fish IBI Metrics	Site 1A	Site 2A	Site 3
Total Number of Species	11	8	9
Number of Darter Species	0	1	0
Number of Sunfish Species	2	2	2
Number of Sucker Species (Catostomids)	0	0	1
Number of Intolerant Species (Trout)	0	0	0
% Green Sunfish	0.016	0.034	0.1
% Omnivores (Golden Shiner)	0.008	0	0
% Insectivorous (Cyprinids)	0.94	0.72	0.74
% Top Carnivores (*rupestrus & cyanellus*)	0.044	0.206	0.24
Number of Individuals (or catch per effort)	247	29	50
% Hybrids	0	0	0
% Diseased Individuals (deformities, lesions, and tumors)	0	0	0

Western Greenbrier Co-Generation (WGC) Power Plant

Meander Study Report

Boyd F. Edwards
Department of Physics
West Virginia University

June 20, 2005

1. Conclusion

The meandering study indicates that the construction of the WGC plant might not affect the migration of Sewell Creek for the next 50 years as long as the piers for the permanent bridge over Sewell Creek are located judiciously.

2. Predictions

Figure 1 shows future locations of Sewell Creek (colored traces, by calendar year) predicted by the river meandering model (see Section 4, below). Figure 2 shows the same predictions as Figure 1; however, it is set against the background of a 2004 aerial photograph. In Figure 1, Sewell Creek flows from lower left (southwest) to upper right (northeast). The proposed bridge is planned to be located in quadrant F10. According to the the predictions, Sewell Creek will migrate southeast where it passes under the bridge. This migration is consistent with general features of meander bends, which typically migrate downstream and bulge laterally away from the center of the river valley, until cutoff occurs and an oxbow lake is created.

The locations of the bridge piers is not known at this time. According to correspondence with Potesta & Associates, the bridge will likely consist of three 100' spans, with two intermediate concrete piers, which are 4' wide perpendicular to stream flow and separated by 100'. The bridge design allows for some flexibility in where the bridge piers would be placed; however, placing them at equal distances from the creek center would most likely be the default design.

Two black rectangles superposed on the proposed bridge in quadrant F10 of the image in Figure 1 give one possible location of the bridge piers, separated by 100'. This location would not interfere with the predicted river migration. If instead the bridge were divided into three equal-length spans, then the southeast pier would be standing in the present location of Sewell Creek. Hence, some adjustment in the pier locations must be made from this simple arrangement.

Another place where the migration of Sewell Creek might potentially be affected by the construction is in quadrant F7, where the river is predicted to contact the fill area from the WGC plant, but not until the year 2060.

The large meander loop in quadrant F8 will likely cut off by the year 2060, since the neck is predicted to become smaller and smaller in each successive year. The exact date of the cutoff depends on the extent of flooding each spring, during which most migration

occurs. This meander loop will likely cutoff eventually whether or not the plant is constructed.

Barriers to migration turned out to be irrelevant, since the WGC construction is not predicted to present any barriers to migration unless the bridge piers are located injudiciously. It is difficult to include the effects of barriers presented by bridge piers in the analysis because the locations of these piers is not yet known.

3. Past

In order to calibrate the model, the past behavior of Sewell Creek was examined by using the following photography:

Exposure Date	Project Code	Roll	Frame(s)	Type
Nov. 19, 1940	USDA DZC-3R-71	CMS 15	**19**, 20	aerial b/w photograph
April 8, 1970	GS-VCEJ	3	289, **290**	aerial b/w photograph
April 3, 1996	NAPP	9444	**23**, 24	aerial infrared photograph
April 6, 2004				ortho-corrected color image

The first task in examining the past behavior of Sewell Creek was to reorient and rescale the 1940, 1970, 1996 and 2004 aerials and to superimpose these images in order to examine the migration of Sewell Creek.

The file 2004 image includes reference points A, B, C, and D that was used to scale and orient the aerial photos. Only the 2004 photo is ortho-corrected. Accordingly, small orthographic misalignments occur in the 1940, 1970, and 1996 photos. However, since the reference points were chosen to be along Sewell Creek, misalignments in the scaled, reoriented photos should be small (of order 15 feet or less) along the creek.

4. Model

The future positions of Sewell Creek were estimated using a 2400-line FORTRAN code called MEANDER. This code employs the level set numerical method of Sethian (Ref. 1) to implement the mathematical model (Refs. 2 and 3). The 2004 shape of the Sewell Creek centerline is used as the initial condition, and the simulation predicts subsequent river shapes.

One input for the simulation is the scale factor for the images, the pixel width p in meters. This scale factor is easily determined from the digitized form of the WGC topographic map, which has 140 pixels between adjacent longitude lines. According to the scale on the bottom right side of this topographic map, adjacent longitude lines are separated by 250 feet = 76 meters. Thus, p = 76 m / 140 pixels = 0.54 m / pixel.

Three other parameters, though needed for the simulations, are not known directly, and must be tuned using the past behavior of Sewell Creek as a guide, thereby calibrating the model to the specific characteristics of Sewell Creek. The decay length D gives the

distance required for cross-stream shear to recover downstream of meander bends. The time scale T gives the basic time scale for lateral migration. A dimensionless parameter P, the Parker number, governs the rate of migration of sharp bends relative to the migration at slower bends. For further details about the mathematical model, see Refs. 2 and 3.

To calibrate the model, the values of D, T, and P were tuned until the 8-year migration of Sewell Creek between 2004 and 2012 approximately matched its 8-year migration between 1996 and 2004. This process involves predicting the migration of several meander bends with different values of D, T, and P, all independent parameters, until an optimal match is obtained. The final values were D = 4.5 m, T = 3.5 years, and P = 1.0.

After imaging Sewell's path based on these values, the MEANDER program rotates the river so that the starting and ending points both lie on the x axis. A 400 x 100 lattice was employed to investigate the meandering. The level set method (Ref. 1) describes the river shape in the x, y plane, defines a function f(x,y,t) whose value is zero on the river, is positive to the right of the river, and is negative to the left. The level set method then relegates the propagation of the river to the time evolution of the function f(x,y,t). Once the values of this function are found in each time step, it is a simple matter to locate the river, by looking for zeros of this function along gridlines. The program uses an adaptive time step which does not allow the river to propagate more than a tenth of a grid spacing per time step.

5. References

1. J. A. Sethian, Level Set Methods and Fast Marching Methods, Cambridge University Press, New York, (1999).

2. B. F. Edwards and D. H. Smith, Critical wavelength for river meandering, Physical Review E **63**, 045304 (2001).

3. B. F. Edwards and D. H. Smith, River meandering dynamics, Physical Review E **65**, 046303 (2002).

6. Disclaimer

This meandering study provides useful information about the past migration of Sewell Creek, and attempts to predict the future migration of this Creek. However, predicting the behavior of rivers far into the future is a notoriously difficult business, involving variability of soil, ground cover, topography, floods, and spring runoff. For rivers, small changes in the initial conditions can grow exponentially and lead to large changes in the future. Accordingly, the predictions described above are not to be used for design purposes.

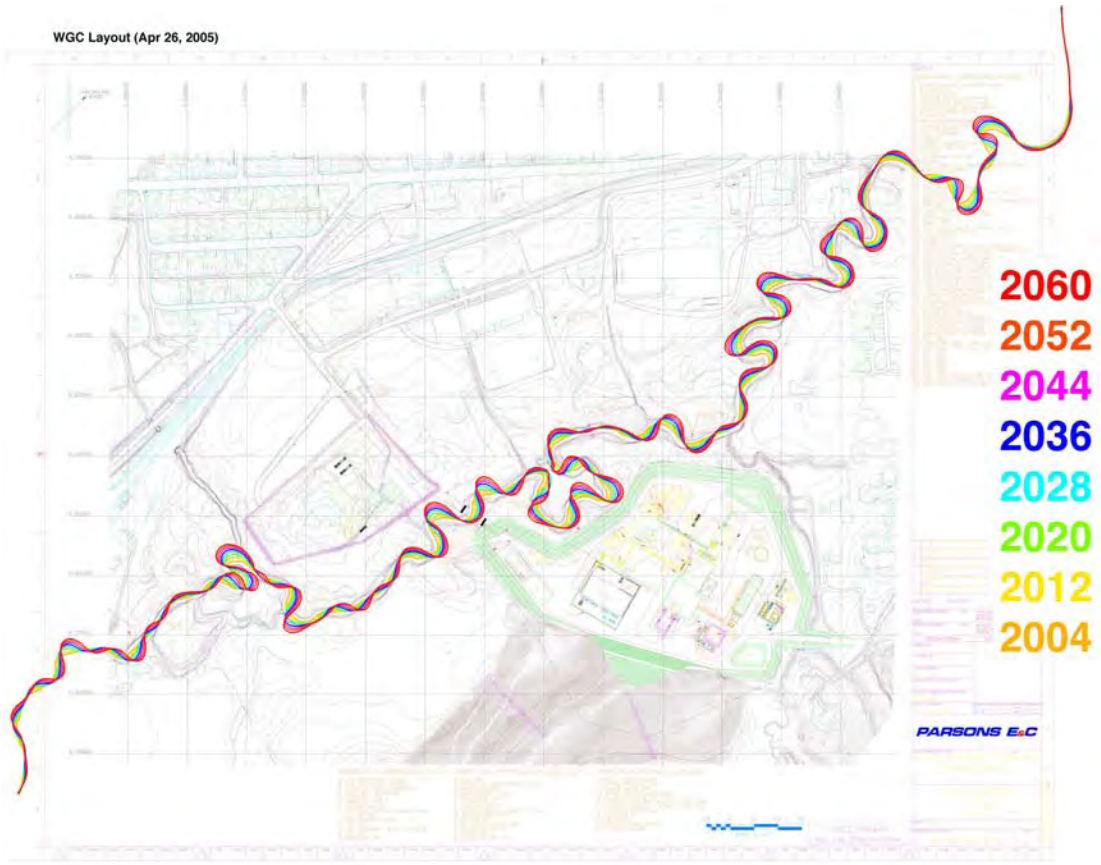


Figure 1. Future Locations of Sewell Creek (topographic survey)

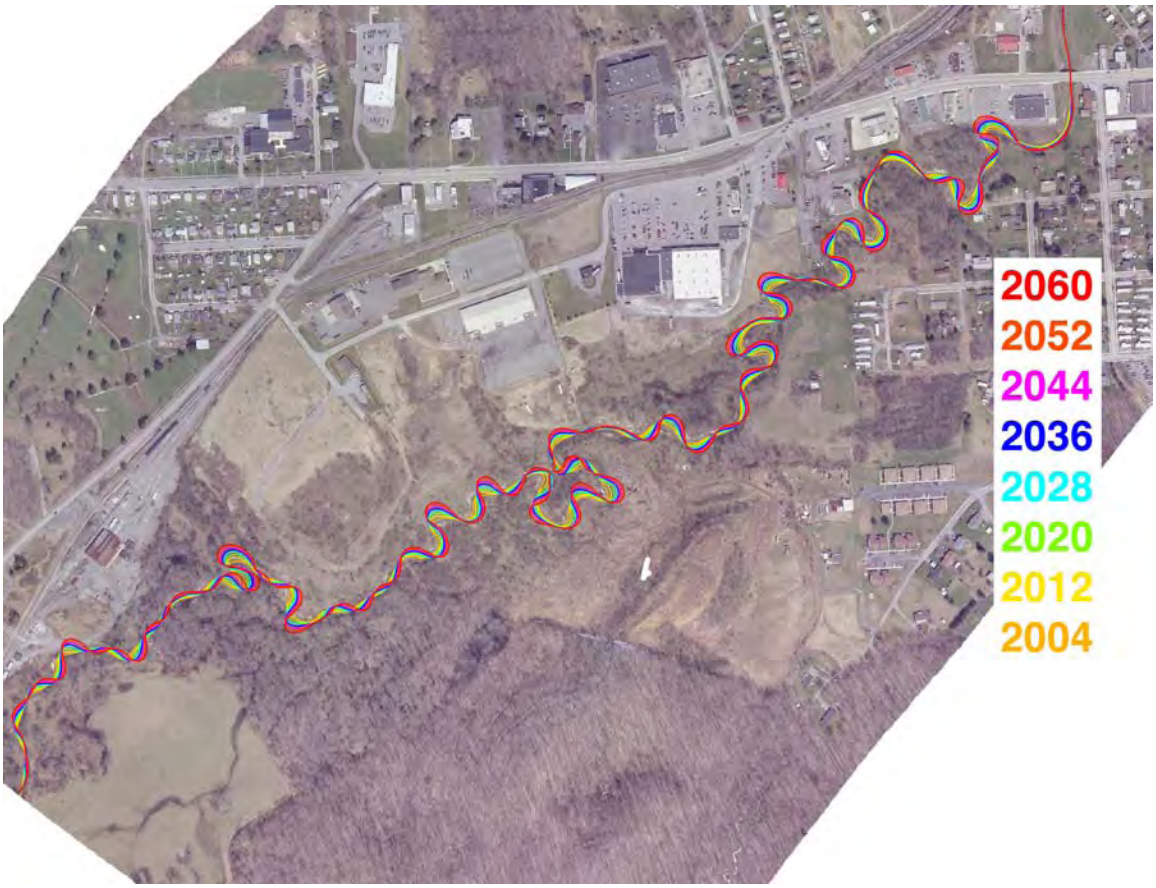


Figure 2. Future Locations of Sewell Creek (2004 aerial)

Mr. Wayne Brown
Western Greenbrier Co-Generation LLC
1 John Raine Dr.
P.O. Bax 766
Rainelle WV 25962

August 22, 2006

Mr. Brown,

Here is the final report of our activities at the potential construction site near the confluence of Sewell Creek and Meadow River near Rainelle WV.

On August 1, 2006 I and two divers carried out a stream survey of the portion of the Meadow River that might be impacted by a planned construction of a water intake structure upstream of Sewell Creek. The purpose of the survey was to determine if freshwater mussels inhabited the area.

The River above Sewell Creek was surveyed by putting in bank – to – bank transects (ropes) and having a diver on each side of the rope search for mussels. The divers were attached to the transect by a one meter rope. They then extended to search from finger tip to finger tip thus covering an area of approximately 2 Meters. Ten of these transect ropes were placed at 10 meter intervals. We therefore covered one hundred meters of river above Sewell Creek. The river is approximately 25 meters wide here so we effectively searched 1,000 sq meters. The transect lines are represented on the accompanying map by red lines.

The area covered by green parallel lines represents the area searched without SCUBA gear. This searched area included Sewell Creek up to the current treated outfall and approximately 60 meters below Sewell Creek. The substrate of Meadow River

below the creek is almost completely solid rock with a few large rocks (1 foot diameter or less) scattered about. Water was clear on this date and visibility was excellent during all searches. Water on this lower portion of the survey area was less than one foot depth. Approximately 2 man hours were spent searching this area.

Sewell Creek had a similar substrate with more large cobble. One and a half man hours were spent searching the creek.

The results of the survey were negative at all sites. No mollusks of any kind were found in Sewell Creek or below the entrance of the creek in Meadow River. In the area where transects were laid, two specimens of the snail *Helisoma anceps* and one Sphaeriacean Finger-nail clam , *Sphaerium striatinum,* were found. Good numbers of the Asian Clam *Corbicula fluminea* were found on a small sand bar 20 meters below Sewell Creek on the left descending bank.

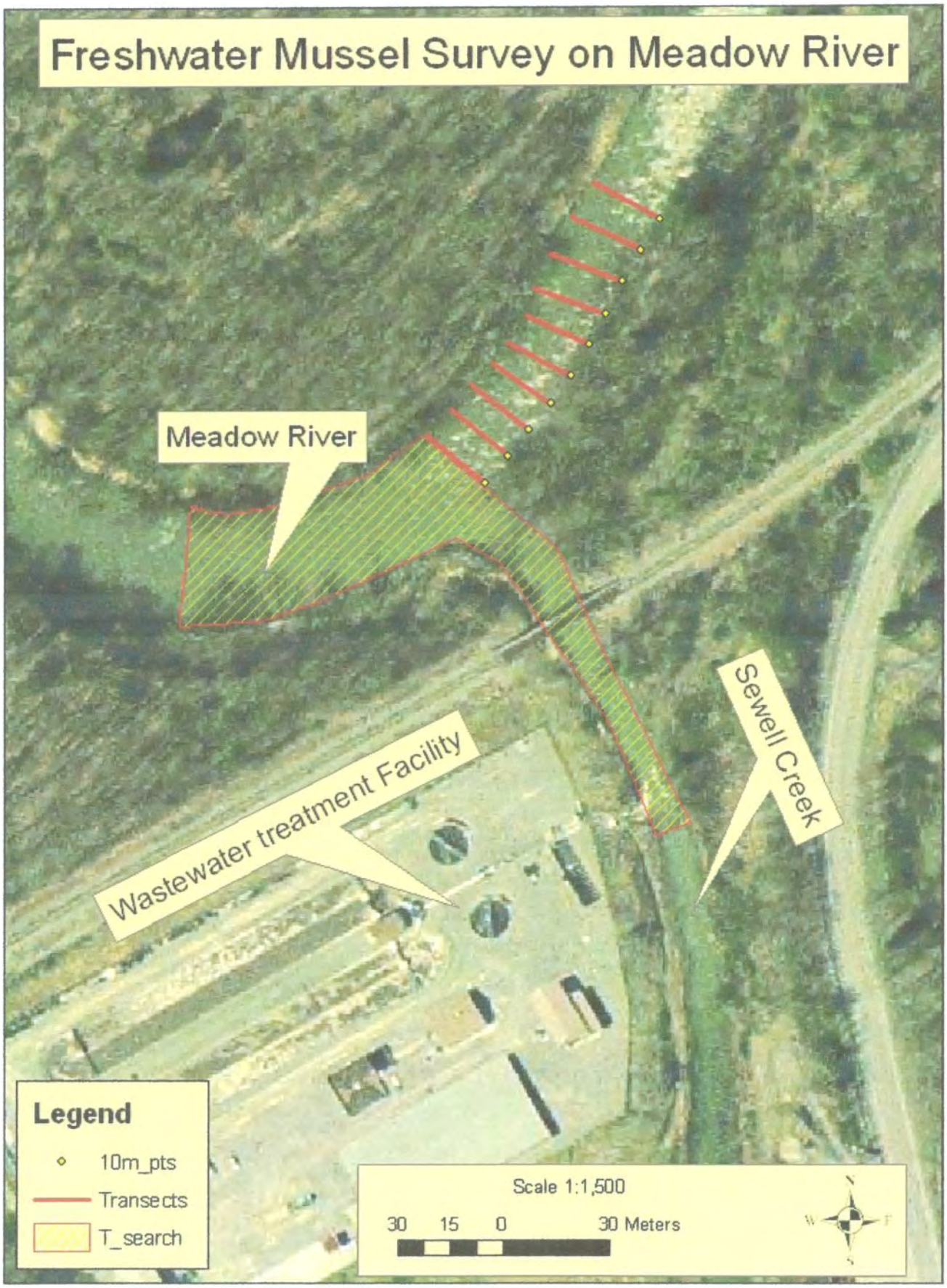
This work was completed under an addendum to my WV collecting permit NO. 2006-217

A copy of this report has been sent to Ms. Janet Clayton of the WV DNR.

Respectfully submitted,

Ralph W. Taylor

Ralph W. Taylor, Ph.D
Environmental Assessment Associates
~~2 Francis Circle~~
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Huntington, WV 25723


Freshwater Mussel Survey on Meadow River
Meadow River
Wastewater treatment Facility
Sewell Creek
Legend
10m_pts
Transects
T_search
Scale 1:1,500
30 15 0 30 Meters

Appendix G
Cultural Resources Reports

Appendix G1 – Historic Resources Determination of Eligibility and Assessment Effects

Appendix G2 – Phase I Archaeological and Geomorphological Investigations

Appendix G3 – Phase I Archaeological Survey of the Proposed Transmission Line Corridor – Western Greenbrier Co-Production Project Greenbrier & Nicholas Counties, West Virginia*

A Phase I report has been added as Appendix G3 for the Final EIS.

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HISTORIC RESOURCES DETERMINATION OF ELIGIBILITY AND ASSESSMENT OF EFFECTS

WEST GREENBRIER CO-PRODUCTION DEMONSTRATION PROJECT

GREENBRIER COUNTY
WEST VIRGINIA



April 2005

Prepared for:
U.S. Department of Energy
National Energy Technology Laboratory
Morgantown, West Virginia

Prepared by:
Potomac-Hudson Engineering, Inc.
Bethesda, Maryland

Appendix G1

Appendix G1

ABSTRACT

This Historic Resources Determination of Eligibility and Assessment of Effects report has been prepared for the Western Greenbrier Co-Production Demonstration Project, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Gen, LLC (WGC), with the U.S. Department of Energy (DOE) providing financial support through a 5-year cooperative agreement with WGC under the DOE's Clean Coal Power Initiative (CCPI) Program. The facility would be designed for long-term commercial operation (at least 20 years) following completion of the cooperative agreement. Because DOE is considering providing financial support for the co-production facility, the project is subject to both the National Environmental Policy Act (NEPA) and Section 106 of the National Historic Preservation Act (NHPA).

This report has been prepared to support the EIS which is being prepared by DOE under the requirements of NEPA and to support the Section 106 consultation process. As part of this effort, field reconnaissance and archival research was conducted to determine whether any historic properties exist within the Area of Potential Effects (APE) of the proposed undertaking and to assess effects to any such properties by the proposed undertaking.

The project area for the WGC co-production facility is located on and adjacent to the former location of the Meadow River Lumber Company in Rainelle. The Meadow River Lumber Company began operations to harvest hardwoods from the area in 1906. Rainelle was established as the Meadow River Lumber Company town in 1910, when the Meadow River Lumber Company mill opened. Over the 60-year history of operations, the Meadow River Lumber Company harvested timber from 125,000 acres around Rainelle. From its inception, this company was one of the largest hardwood lumber operations in the United States and by the 1930s was the largest hardwood mill in the world. It maintained this position through the 1960s. The Meadow River Lumber Company ceased operations in 1970, and the entire mill and lumber yards were razed by 1975.

This report concludes that there is one historic property within the APE that is eligible for the National Register of Historic Places (NRHP). This property is the City of Rainelle Historic District. This study finds that the proposed West Greenbrier Co-Production Demonstration Project will have a no effect on the National Register Eligibility of resources and that the undertaking should not alter the existing setting or characteristics of the City of Rainelle Historic District. Impacts to the historic district would be limited to view shed changes related to the height of the facility and its approximately 300-foot high exhaust stack. These changes would be largely limited to those historic buildings and structures located in the western half of the city. Given the existing setting, however, it cannot be said that the proposed project would alter, directly or indirectly, any of the characteristics of these historic properties that individually or collectively qualify them for inclusion in the National Register. Nor can it be fairly said that the proposed project will alter the existing setting, feeling or association of these historic properties. It is the recommendation of this report that the DOE consult with the SHPO regarding these conclusions drawn by the DOE about the potential impacts of the proposed project.

Appendix G1

Appendix G1

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HISTORIC RESOURCES DETERMINATION OF ELIGIBILITY
AND ASSESSMENT OF EFFECTS

SECTION I. INTRODUCTION

This Historic Resources Determination of Eligibility and Assessment of Effects report has been prepared for the Western Greenbrier Co-Production Demonstration Project, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Gen, LLC (WGC), with the U.S. Department of Energy (DOE) providing financial support through a 5-year cooperative agreement with WGC under the DOE's Clean Coal Power Initiative (CCPI) Program. The facility would be designed for long-term commercial operation (at least 20 years) following completion of the cooperative agreement. Because DOE is considering providing financial support for the co-production facility, the project is subject to both the National Environmental Policy Act (NEPA) and Section 106 of the National Historic Preservation Act (NHPA).

WGC is proposing to design, construct, and operate a 90 megawatt net electric output (MWe) atmospheric circulating fluidized bed power plant that would generate electricity and steam by burning approximately 2,700 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site (the ENR property) immediately on the east side of Sewell Creek and immediately south of the city limits of Rainelle in the extreme western corner of Greenbrier County (see Figure 1 and conceptual drawings presented in Appendix A). The confluence of Sewell Creek and the Meadow River is roughly 1.5 miles northeast of the proposed plant site. A coal-fired rotary kiln associated with the power plant would combine coal ash and limestone into a cement-like material for use with wood wastes to manufacture structural building blocks (Woodbrik™). Currently, it is anticipated that the Woodbrik™ manufacturing plant would be located on the northwest side of Sewell Creek adjacent to the Eco Park. The power plant is being designed to serve as the anchor for future tenants at the Eco Park by providing a source of steam and hot water supply for building heating and other industrial activities.

Waste coal would initially be obtained from abandoned waste coal piles located in the vicinity of Anjean (see figures Appendix B). Excess combustion ash not needed for Woodbrik™ manufacture would be used to remediate acid drainage from the source waste coal piles. WGC is in the process of determining additional waste coal pile sites for obtaining fuel source once the Anjean piles are depleted (currently estimated at 6 to 7 years). Generally, future waste coal pile sites that would be used would be within 20 to 30 miles of the power plant site. The Green Valley waste coal pile site, located on Route 20 north of Quinwood, is the most probable candidate for use as a secondary fuel source. Both rail and truck were initially considered as transportation options for the waste coal fuel, raw materials (e.g., limestone), and waste removal. However, considerations for rail were abandoned due to economic factors and the associated feedback received from the local community.

Potomac-Hudson Engineering, Inc. (PHE) conducted a survey and evaluation of historic structures in the vicinity of the proposed project. This effort included a historic structures survey of the town of Rainelle, WV, and its environs (Figure 1), as well as an architectural survey of the Anjean coal waste site (Figure 2). No structures are in the vicinity of the Green Valley waste coal pile site. The survey was conducted to identify all National Register-eligible historic structures within the Area of Potential Effects (APE) of the proposed project. The APE was in large part defined by the expected visibility of the proposed facility in the surrounding community as determined by completing a balloon test. The balloon test consisted of elevating two 5-foot diameter balloons at the expected location of the facility stack to a height of approximately 350 feet (an elevation of approximately 2,750 feet above MSL). Background research and field investigations were conducted in December of 2004. David C. Berg served as Principal Investigator in the field and author of this report.

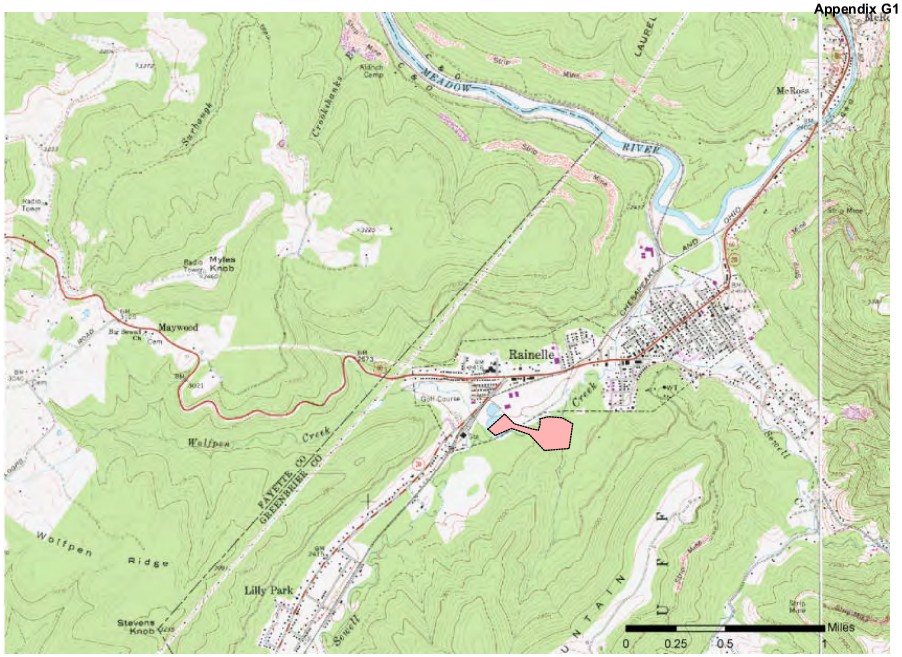


Figure 1. Co-Production Facility Location

Sources: U.S.G.S. Rainelle, WV 7.5 Minute Series (Topographic)

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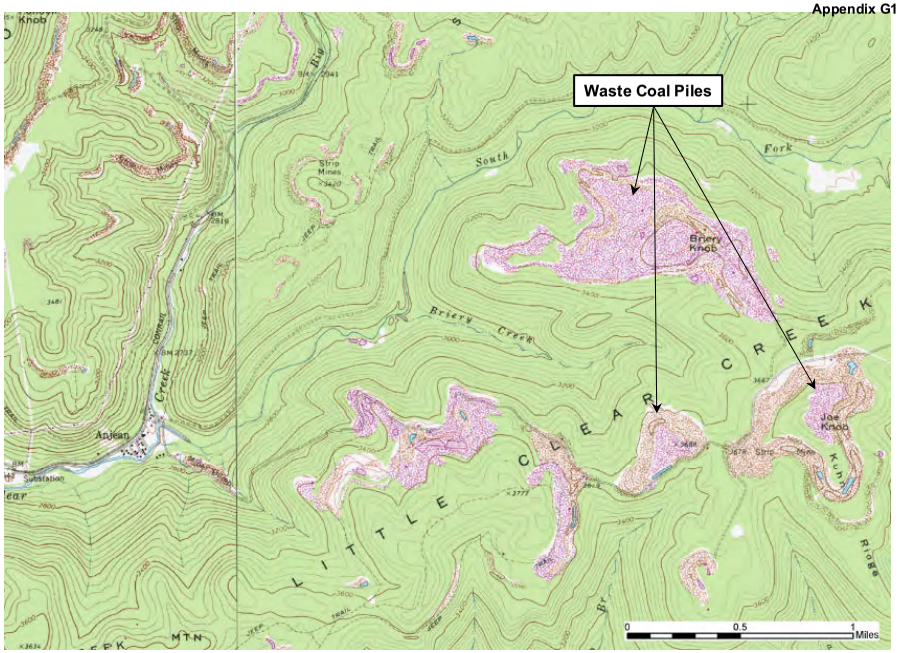


Figure 2. Anjean Waste Coal Pile Location
Sources: USGS Duo/Quinwood, WV 7.5 Minute Series (Topographic)

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SECTION II. METHODS

Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended, requires the evaluation of impacts of Federal actions on historic properties eligible for the National Register of Historic Places. More specifically, section 106 requires a formal identification/evaluation/consultation process subject to review by the State Historic Preservation Office (SHPO) and, if there are effects on historic properties, by the Advisory Council on Historic Preservation.

The "cultural environment" includes "historic properties," which are defined by Title 36 of the Code of Federal Regulations (CFR), section 800, as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places." This phrase includes artifacts, records, and the remains that are related to and located within such properties. The term "eligible for inclusion in the National Register" includes both properties formally determined eligible and all other properties that meet National Register listing criteria. Taken in its broadest sense, the "cultural environment" also includes the intangible expressive traditions of cultural groups bound by ethnicity, region, occupation, or other common ties.

The significance of historic properties is generally judged against a property's ability to meet the four criteria for inclusion on the National Register of Historic Places (36 CFR 60). Properties may be eligible for the National Register for contributions at the national, state, or local level. Ordinarily, properties achieving significance within the last 50 years are not considered eligible unless they are integral parts of historic districts or unless they are of exceptional importance; the most common types of properties less than 50 years old listed on the National Register are works of modern architecture or scientific facilities.

Objectives

The objectives of this survey and evaluation of historic structures include the inventory of all historic properties within the project APE. This inventory is not intended to be a complete recordation of such properties, but a reconnaissance survey sufficient to evaluate their National Register eligibility. Further objectives include the assessment of the effects of the proposed undertaking on historic properties, and the evaluation of potential minimization and mitigation measures to reduce or make up for effects to historic properties.

Research Methods

Background research for this investigation was conducted at the West Virginia Division of Culture and History in Charleston, the Rainelle Public Library in Rainelle, WV, the Greenbrier Historical Society in Lewisburg, WV, and the Greenbrier County Court House in Lewisburg, WV. Maps and information available on the Library of Congress web site were also consulted. Background research focused on examination of site files and technical reports of previous investigations of archaeological and historic resources in the vicinity to assist in developing the historic context of the region.

Field Methods

USGS Quadrangle topographic maps of *Rainelle, Duo, and Quinwood,* WV, high-resolution aerial photographs, and county tax maps were used to identify any standing structures within the project area. A field reconnaissance was then conducted to determine if any structures 50 years of age or

older, exist within the APE. Previously documented historic structures were identified through consultation with state and local agencies, including the West Virginia Division of Culture and History and the Greenbrier Historical Society.

The field survey consisted of a reconnaissance of the entire APE, during which all properties appearing to be 50 years old or older were described, photographed, and mapped (see photographs Appendix C). In addition, a balloon test was conducted to visually evaluate the effects of the stack for the proposed location of the power plant from various vantage points in Rainelle. As part of this test, two red, 5-foot diameter balloons were filled with helium gas, tethered together, and allowed to rise to a height of 350 feet above grade at the expected location of the facility stack. The elevation at ground surface where the balloon test was conducted was approximately 2,395 feet resulting in a final elevation of the balloons of approximately 2,745 feet above MSL. The cultural resource analyst then took pictures of the balloons from various locations around Rainelle. The photos were used to produce renderings of the stack from various locations, including possible historic districts, in order to determine potential effects (see renderings in Appendix D).

SECTION III. RESULTS OF ARCHIVAL AND BACKGROUND RESEARCH

Historic Context

Greenbrier County

Greenbrier County was created by an act of the Virginia General Assembly in October 1777 from parts of Montgomery and Botetourt counties of Virginia. It was named in honor of the principal river that drains through the county. From its original territory, eleven additional counties were created either in whole or in part. These include: Boone, Cabell, Jackson, Kanawha, Mason, Monroe, Nicholas, Putnam, Roane, Wayne and Webster Counties (Lewis, 375).

During the early 1700s, central West Virginia, including present-day Greenbrier County, was used as a hunting ground by the Mingo, the Delaware, and by other members of the Iroquois Confederacy, especially the Seneca, one of the largest and most powerful members of the Iroquois Confederacy. The Seneca and the other members of the Iroquois Confederacy claimed all of present-day West Virginia as their own, using it primarily as a hunting ground. The Cherokee, headquartered in western North Carolina and eastern Tennessee, also claimed part of southern West Virginia. In 1744, Virginia officials purchased the Iroquois title of ownership to West Virginia in the Treaty of Lancaster. The treaty reduced the presence of the Iroquois Confederacy in the state.

Despite their defeat in the French and Indian War, many Indians continued to fight the British. The Shawnee chief Keigh-tugh-qua, or Cornstalk, led similar attacks on western Virginia settlements in present-day Greenbrier County. By the end of July 1763, Indians had captured all British forts west of the Alleghenies except Detroit, Fort Pitt, and Fort Niagara. Then, on August 6, 1763, British forces under the command of Colonel Henry Bouquet retaliated and destroyed Delaware and Shawnee forces at Bushy Run in western Pennsylvania. Hostilities were renewed in 1772-1773, when Shawnee Chief Cornstalk, who had led numerous raids against western Virginia settlers in the past, began to organize the Indians in a concerted effort to drive the whites from their territory after depredations they had suffered against the white settlers. Virginia Governor John Murray, Earl of Dunmore, formed two armies, one marching from the North, consisting of 1,700 men led by him and the other marching from the South, comprised of 800 troops led by western Virginia resident and land speculator, Captain Andrew Lewis. Cornstalk, along with approximately 1,200 Shawnee, Delaware, Mingo, Wyandotte and Cayuga warriors, attacked the southern regiment before they had a chance to unite with Lord Dunmore's forces. On October 10, 1774, the Indians attacked Lewis' forces near the confluence of the Kanawha and Ohio Rivers, at present-day Point Pleasant in present-day Mason County, West Virginia.. Although both sides suffered significant losses, the Indians finally retreated back to their settlements in Ohio's Scioto Valley. Cornstalk's defeat at Point Pleasant was the beginning of the end of the Indian presence in western Virginia (Comstock, 1973, West Virginia Heritage Encyclopedia, Volume 9, pgs. 2001 – 2002).

The first organized religion came to Greenbrier County in the 1780's. In 1787, the Reverend John Alderson Jr. organized a congregation to meet at the Old Greenbrier Baptist Church at Alderson. Also around this same time, Rev. John McCue and Reverend Benjamin Brigsby organized Presbyterians in Lewisburg, Union, and Spring Creek. In 1796, after a fire had destroyed the rudimentary Presbyterian Church in Lewisburg, a much larger and permanent structure was built to replace it. Known as the Old Stone Church, the place of worship has the distinction as the oldest, unrestored church still in continuous use west of the Alleghenies.

Lewisburg, the county seat, was originally called The Savannah, then Fort Savannah, and, in 1774, Camp Union. The town then became known as Lewisburg, in honor of General Andrew Lewis (1720-1781). The town's name was officially recognized as Lewisburg when the town was incorporated by the Virginia Generally Assembly in 1782. In 1808, the Presbyterian minister John McElhenny and his wife Rebecca Walkup opened the first school in Lewisburg. Classes were initially held in their living room. In 1812, the community finished the construction of a two-story, brick schoolhouse.

Project Area History

Although there were some white settlers in the Rainelle area in the early 1800s, little is known of these people other than a few scattered headstones. In this early period, there was a tavern known as Thompson's Tavern in what is now the western edge of Rainelle. Aiding settlement of the land was the James River and Kanawha Turnpike Company, which built a road (present-day Route 60) that had reached the Kanawha Falls by 1824. Around 1790, James Coggin built a grist mill in the Meadow Bluff District, and in 1848, William McFarland constructed a sawmill here (Whitman, 1952:7).

The Covington and Ohio Railroad, which had begun before the Civil War, was completed through Greenbrier County after the war by the Chesapeake and Ohio Railroad Company, which was formed by Collis P. Huntington in 1868. (Whitman, 1952:9) The railroad was completed to Huntington on the Ohio River by 1873 (Ibid.).

The Rainelle area was still a remote region when the first purchases of land were made by the Meadow River Lumber Company. Rainelle was established as the Meadow River Lumber Company town in 1910 when the Meadow River Lumber Company mill opened. The company was incorporated in 1913. The company was started by Thomas W. Raine and his brother John Raine. Timber and coal lands began to be purchased, and a mill was constructed on the Sewell Creek, a branch of the Meadow River. The Raines also constructed the Sewell Valley Railroad from Meadow Creek station on the C&O Railroad to the plant, a distance of about 20 miles. Over their 62-year history, the Meadow River Lumber Company harvested timber from 125,000 acres around Rainelle. From its inception, this company was one of the largest hardwood lumber operations in the United States. (Whitman, 1952:10-14). Thomas Raine operated the Sewell Valley Railroad until 1927, when the C&O and the New York Central Railroad took over the operations and it was later known as the Nicholas, Fayette and Greenbrier Railroad (Whitman, 1952:33).

In addition to the lumber business, the Raines formed the Meadow River Coal and Land Company in 1908 in order to obtain coal to fire the plant and manage the timber land. In 1911, the company also formed the Bank of Rainelle (Whitman, 1952:29)

To help create a company town, the Meadow River Lumber Company built houses for workers in two major building campaigns, with the first being along the Kanawha Turnpike (Route 60), Walnut Street, West Greenbrier, and Fayette Avenues during 1909-1910. These houses followed two basic plans of single-family houses: a front-gable, two-story style, and a side-gable, two-story style. The first houses were constructed along the turnpike, and later houses were constructed behind them.

Additional houses were built along Kanawha later. In 1921, when the Sewell Valley Railroad was split off from the Meadow River Lumber Company, additional company houses were built along Chestnut, Locust, Poplar and Cherry Streets for railroad workers and their families. These houses mostly followed a front-gable, two-story form (Whitman, 1952: 38-43). These houses were above

average for company housing, and had plastered walls, running water, bathrooms, and electricity. Each house had enough space for a garden plot (Rice, 1986:353).

Larger houses were built for company management, including the Raine house, demolished by 1973 and now the site of the Rainelle Medical Center, and the John Raine house, which still stands on Chestnut Street. The first private house not owned by the company was constructed by Dr. Ira Wall in 1921 on land purchased from the company. The Meadow River Lumber Company and the Raines also provided in other ways for the town of Rainelle. The first school was built and in its early years was financially supported by the company. The Meadow River Lumber Company also built a company store, bank, hotel, and the Rainelle Methodist Church for the town in 1913-1914. In 1923, a more substantial brick school was erected by the town by bond issue on land donated by the company (Whitman, 1952: 38-43).

The original lumber mill burned to the ground on August 28, 1924; and in its place, a new mill was built and put into operation on March 9, 1925. When begun, the company employed about 150 to 200 workers, but by the 1950s, nearly 500 workers were needed for full production (Whitman, 1952:21). The mill cut the timber, rough cut the logs, kiln-dried the wood, and also made the wood into various products including flooring for such opulent structures as the Waldorf-Astoria in New York. The operations also included a planning mill for all types of interior trim and, in 1932, a shoe heel plant for turning out heels for women's shoes. At one time, the company operated a furniture department, a coffin manufacture, and other production lines such as stair treads, doors, and bowling alley wood. During World War II, the company also produced specialty parts for airplanes and the Navy (Whitman, 1952:25-28).

East Rainelle began as "Levelton" by the Levelton Land and Improvement Company, but due to the mill slabwood used to side the original houses, the early residents called the area "Slab Town". From the first lot sale in 1910 until its incorporation as East Rainelle in 1921, only a few businesses and houses were constructed. Growth accelerated following the opening of the low volatile, or "smokeless", coal region around the Meadow River Valley made possible by the opening of the Greenbrier and Eastern Railroad in 1921 (Whitman, 1952:46-49). Churches were much more plentiful in East Rainelle, with a Baptist Church, the Church of God, Christ's Church, and a Catholic Church, as well as lodges such as the Odd Fellows, Masonic Lodge, and Moose Lodge. East Rainelle grew quickly into a commercial center that served the Rainelle area, and many commercial buildings were constructed along Main Street (Route 60) (Whitman, 1952:49-50).

The towns of Rainelle and East Rainelle merged on July 1, 1969, creating the largest city in the Meadow Bluff District of Greenbrier County (Greenbrier County, 1997:212). The Meadow Valley Lumber Company outlived most of its competition, but could not survive the changing economy of the mid-twentieth century, finally selling to Georgia-Pacific, Inc., in 1970 (GC Deed, 260:36). The new owner began to transform the company town into a privately owned community by selling land and houses at bargain prices to the former tenants. Additionally, the company began to sell land to developers and private home-seekers on the outskirts of town. The lumber plant buildings were demolished in 1975, and Georgia-Pacific continued to operate a nearby hardwood sawmill on a smaller scale while maintaining a 30,000-acre tract of woodlands (Maddocks, ed., 1978:7-8).

The site of the lumber company is now a proposed Industrial Park and also contains the 811th Ordnance Company, Army Reserve. This site is proposed for the Western Greenbrier Co-production Demonstration Project.

Anjean

The town of Anjean and the Anjean coal mine were founded by the Leckie Smokeless Coal Company in 1926 (Odor, 1977). The Leckie Smokeless Coal Company was founded by William S. Leckie and his brother Andrew F. Leckie, sons of Colonel William Leckie, who moved from Scotland to West Virginia in 1870. Anjean was named after Colonel Leckie's wife Anna, and Andrew Leckie's daughter, Jean. The Leckie Smokeless Coal Company operated mines in West Virginia and Kentucky for 30-40 years, including the Anjean mine that operated from 1926 until its closing in 1954 (Odor, 1977). The company provided low volatile coal for the Meadow River Lumber Company (Whitman, 1952: 52).

During the height of the mining period, Anjean contained 100 houses and supported a mixed population of Euro-Americans (ca. 67%) and Afro-Americans (33%) (Odor, 1977). Company houses were mostly built along Anjean Road, but none remain at this location today. Three houses, probably built as company houses, remain near the entrance to the Anjean site.

SECTION IV. SURVEY RESULTS

Area of Potential Effects

There are necessarily two separate APEs for this project. In order to determine the APEs of the project, PHE conducted a site reconnaissance that included a walkover of the entire parcel in late autumn when leaves had already fallen. The APEs were determined based upon sight distances and potential audible effects that could result from the undertaking. Factors influencing the APE included viewsheds, topographical features, proposed use of the property, and existing road network, as well as potential audible effects. Both the APE and potential for effects to historic properties for the plant site were determined with the aid of a balloon test in which a 5-foot-wide helium balloon was raised to a height equivalent to the stack of the proposed plant (estimated elevation of 2,720 feet above msl). PHE then drove through town taking photographs and notes at various places to determine the visibility of the proposed stack within the greater project area. Maps and photographs produced during this balloon test accompany this report (see Appendix A).

The Anjean site has a much more limited APE, as activities will be limited to the loading and transportation of waste coal and return of ash using trucks. Initially, rail was considered for this project, which would have entailed the construction of rail loading facilities and a rail spur at the entrance to Anjean. However, WGC is no longer considering this option, and all loading and unloading would occur on top of the mountain at or near the waste coal pile sites. The Anjean site is in a mountainous region, which substantially limits the APE. All buildings visible from the sites of planned project activities, including the entrance to the mountain, were considered within the APE at Anjean.

Due to the height of the stack, the APE in Rainelle for the Co-Production Plant site extends a radius of approximately ¾ mile from the exhaust stack location. This is an approximation, as the mountainous terrain, especially to the west and north, limits the APE to a certain extent (Figure 3). In addition, there are a number of visual barriers (e.g.; buildings, tree lines, etc.) that limit the viewscape toward the proposed site that are within the ¾ mile radius. The APE for the Anjean site is limited to about ¼ mile from the center of Anjean, near the entrance to the mountain (Figure 4).

City of Rainelle

A field reconnaissance confirmed that there are numerous historic structures within the project APE, consisting largely of worker housing found principally in Rainelle, in addition to churches and commercial buildings, which are mostly located in East Rainelle. Few of these structures have the architectural or historical qualities necessary for individual listing on the National Register, but the entire city of Rainelle has clusters of original structures that are well preserved and these clusters represent a distinguishable entity due to their concentration. There are essentially three clusters of structures within the original city of Rainelle, and a fourth area that encompasses the original outlines of the city of East Rainelle. While the following descriptions are not intended to be a definitive survey of the City of Rainelle, the four areas have only a few basic building types. These types, as well as significant individual resources are described below.

Appendix G1

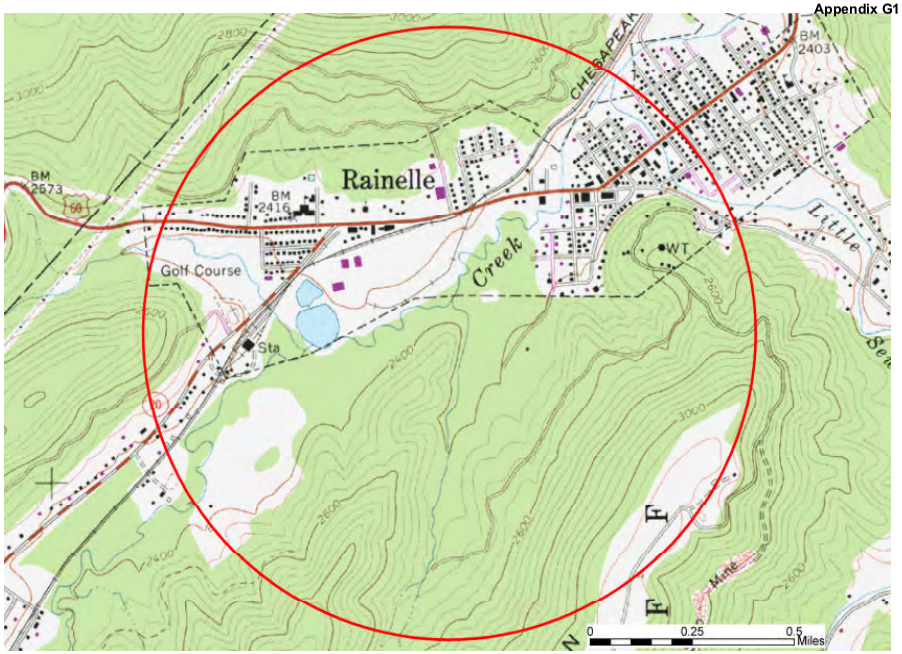


Figure 3.
Area of Potential Effect, Rainelle.
Sources: USGS Rainelle, WV 7.5 Minute Series (Topographic)

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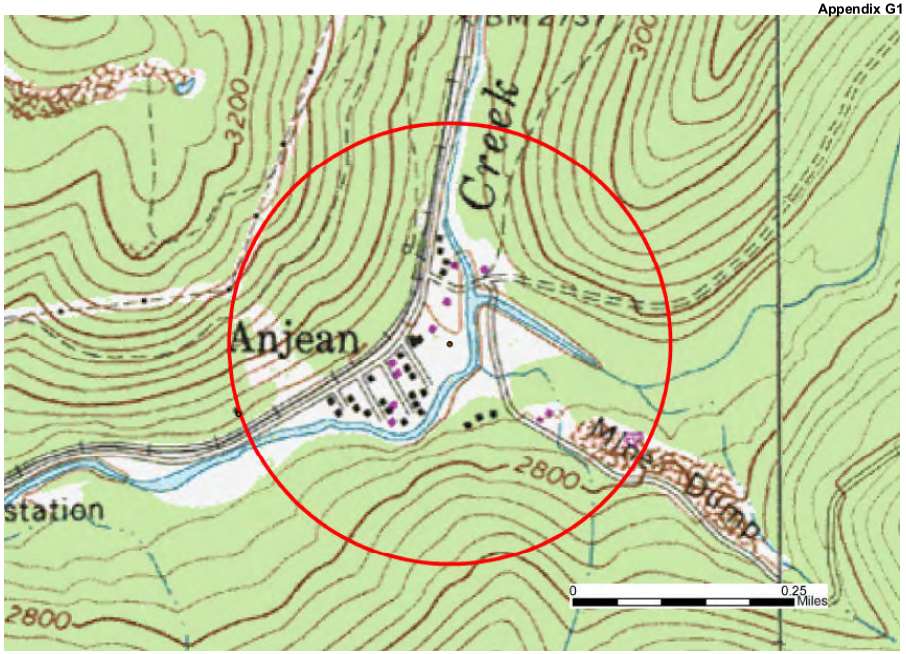


Figure 4.
Area of Potential Effect, Anjean
Sources: USGS Duo/Quinwood, WV 7.5 Minute Series (Topographic)

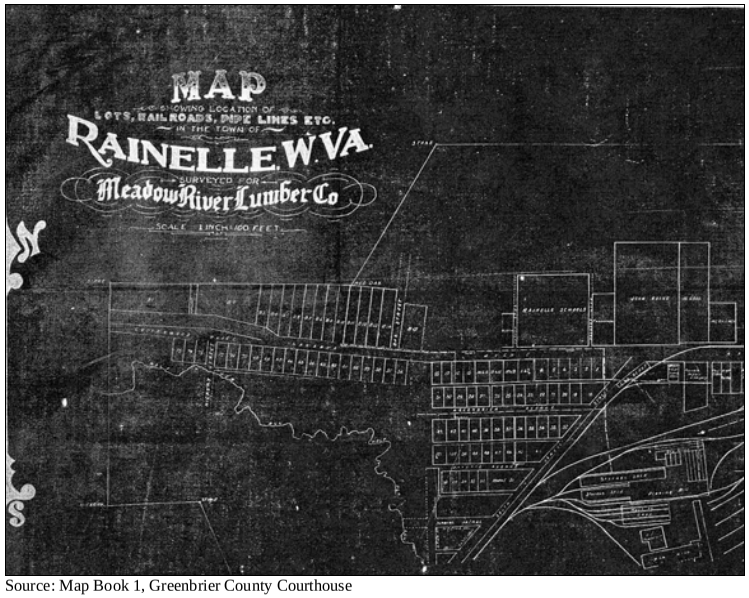
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Initial Phase of Construction (1909-1910)

Virtually all buildings and structures within the original Meadow Valley Lumber Company grounds were demolished in 1975, however, one building that originally served as a Fire Pump House is now used by Greenbrier County as an office for the Public Services District #2. Although the original mill buildings and objects have been demolished, the majority of the other structures in Rainelle have been spared. The initial phase of housing construction took place on the western side of the present City of Rainelle. The streets included Kanawha (Route 60), Walnut Street, Fayette Avenue, and Greenbrier Avenue (Figure 5).



Source: Map Book 1, Greenbrier County Courthouse

Figure 5: Survey of Rainelle in 1928 Showing First Phase of Construction. (Not to Scale)

The initial phase of construction consisted of two basic housing types. The first was a two-story, front-gabled frame style. Photo 1 shows a typical example of this style. The houses had red sandstone foundations. These houses were two bays wide and two deep, with narrow 3-inch reveal clapboard siding. Both one-over-one and two-over-two double-hung windows are present, and most houses currently have asphalt roof shingles, while others are clad with seamed or corrugated metal. The majority of these houses also have a first story front porch with a simple shed roof held in place

with two square wood posts, one at each corner. The majority of these front porches are now enclosed. Many of these houses have a single-story rear porch as well, and most of these are currently enclosed. Single brick chimneys are found centered within the main structure.

PHOTO 1: TYPICAL FRONT GABLED COMPANY HOUSE, FRONT FAÇADE, LOOKING SOUTH



The second style constructed in this period consists of a two-story, side-gabled frame house with a single-story front porch (Photos 2 and 3). The first story front façade of these structures have three bays consisting of a central entrance door flanked by two double-hung windows. Chimneys are either double interior gable-end brick, or central brick. The second story of this type typically has two one-over-one double-hung sashes. Roofs are generally clad with asphalt shingles. The majority of the front porches on this type remain open. Rear enclosures appear less frequently with this style. Many of the lots in this area now have small single-story garages that were constructed later. Nearly all of the houses constructed during the 1909-1910 period can be considered contributing resources to the Rainelle Historic District.

PHOTO 2: SIDE GABLED COMPANY HOUSES, KANAWHA TURNPIKE, LOOKING WEST

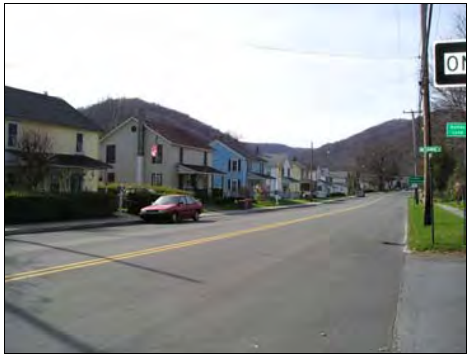


PHOTO 3: TYPICAL SIDE GABLED COMPANY HOUSE, FRONT AND SIDE FAÇADES, LOOKING SOUTHEAST



Individual structures constructed around the same time include the Sewell Valley Railroad Depot, later known as the N.F. & G Railroad Depot. This structure was originally constructed in 1910 as a two-story depot with side-gabled roof and two brick interior chimneys. There were three bays on the gable ends, and four on the sides. The building was clad with clapboard siding, and the side facing the railroad tracks had a pent roof that protected the ticket window and entrance to trains. The original appearance of the depot can be seen in a C&O Historical Society photograph taken in 1916 (Photo 4). Today, this building has been added to, notably by the extension of the two-story building on the west gable end, as well as the addition of a long one-story addition on the same side. The building still possesses its original siding, but has been neglected, and the railroad tracks no longer service the structure (Photo 5). The depot possesses ample integrity of design, materials, and workmanship to be considered a primary contributing resource to the historic district.

PHOTO 4: SEWELL VALLEY RAILROAD DEPOT, CIRCA 1916
(Source: Greenbrier Historical Society)



PHOTO 5: CURRENT VIEW OF SEWELL VALLEY RAILROAD DEPOT , LOOKING SOUTH



The Rainelle United Methodist Church was constructed in 1914, soon after the houses in western Rainelle were completed (Photo 6). It was supposedly constructed entirely of American Chestnut. Additional rooms were added over the years, including assembly rooms, classrooms, a kitchen, and a nursery. The church was dedicated on June 28, 1914 by Bishop David H. Moore, D.D. from Indianapolis, Indiana (Whitman 1952:41). The church possesses ample integrity of design, materials, and workmanship to be considered a contributing resource to the historic district.

PHOTO 6: RAINELLE UNITED METHODIST CHURCH, LOOKING NORTHWEST



The John Raine House is located on Chestnut Street and can be considered a primary contributing resource to the historic district, as well as an individually-eligible for the National Register. This large Colonial Revival Style dwelling was home to one of the founding brothers of the City of

Rainelle, and may be eligible for the National Register under Criterion A, B, and C (Photo 7). Historic photographs on file at the Greenbrier Historical Society suggest that the house has been altered from its appearance in the late-1920s (GCHC, File Photo # 26). The house originally had three dormers evenly space on the front roof slope where now there are two larger hipped roof bays that project from the second story. The basic plan of the house, however, appears to be unchanged. Further research would be needed to make a formal determination on this resource.

PHOTO 7: JOHN RAINE HOUSE ON CHESTNUT STREET, LOOKING NORTHWEST



Constructed in 1911 by the Lumber Company, the Rainelle Bank now serves as home to the regional office of the Appalachian Power Company (Photo 8). This building is a two-story, brick building with a rear slanting "flat roof" with Terra-Cotta capped parapet. The building is five bays wide and has one-over-one double-hung windows with stone lintels and sills. This building should be considered a primary contributing resource to the historic district. It possesses a high degree of integrity of materials, design, and workmanship and may be individually eligible for the National Register of Historic Places.

PHOTO 8: FORMER BANK OF RAINELLE, LOOKING SOUTH



Second Phase of Construction (1921-1928)

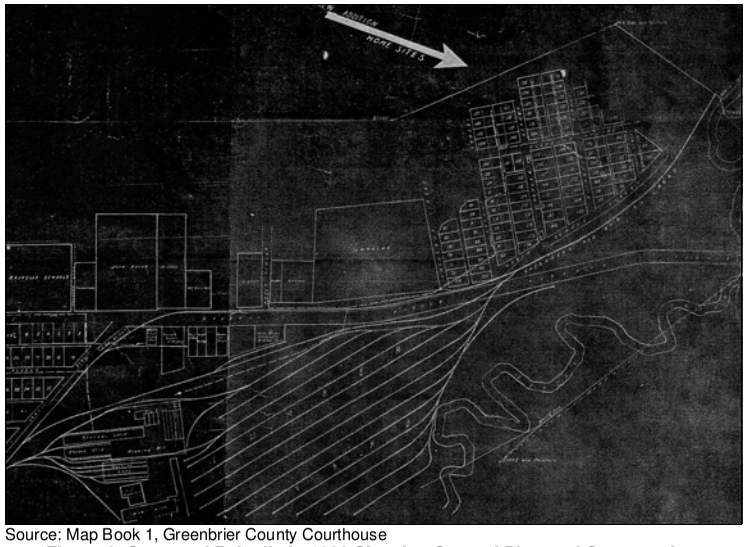
A second phase of construction began in 1921, when the Sewell Valley Railroad was split off from the Meadow River Lumber Company. Company houses were built along Chestnut, Locust, Poplar and Cherry Streets for railroad workers and their families (Figure 6). These houses mostly followed a front-gable, two story form that is identical to those constructed during the first phase of house construction (Photos 9 and 10). Although some of these houses have been vinyl sided and altered, many still possess the majority of their integrity of materials, design, and workmanship necessary to be considered contributing resources to the historic district.

PHOTO 9: SIDE VIEW OF TYPICAL HOUSE ON LOCUST STREET, LOOKING NORTH



PHOTO 10: FRONT FAÇADE OF TYPICAL HOUSE ON LOCUST STREET , LOOKING EAST





Source: Map Book 1, Greenbrier County Courthouse

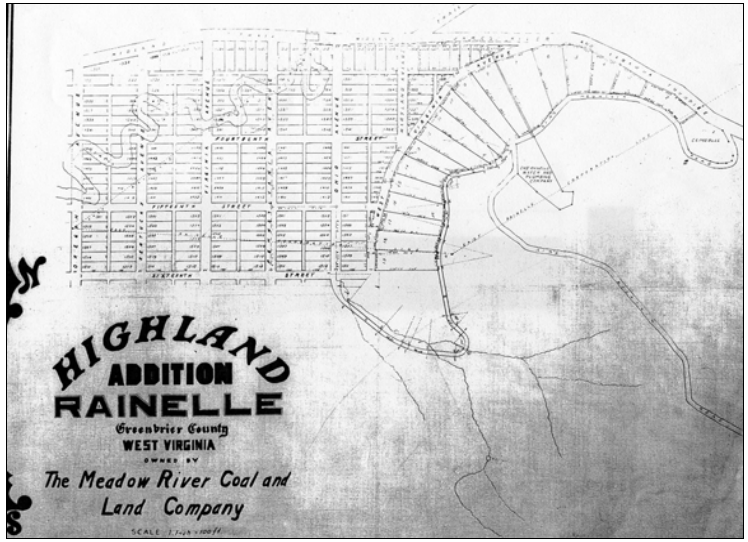
Figure 6: Survey of Rainelle in 1928 Showing Second Phase of Construction. (Not to Scale)

Other Additions to Rainelle

Another plat filed by the Meadow River Coal and Land Company in 1928 showed the "Highland Addition" to Rainelle (Figure 7). This addition was located south of the James River and Kanawha Turnpike, southeast of the second phase of company house construction. Much of this section was platted over the meandering bed of the Sewell Creek and was never constructed upon. The earliest houses in this area were constructed farthest away from the creek. Those lying east of Pennsylvania Avenue date from the 1930s and 1940s, while those west of Pennsylvania Avenue tend to date from the latter half of the twentieth century; and many appear to be structures constructed as late as 1970 and 1980. Houses that contribute to the historic district are the older structures east of Pennsylvania Avenue. These are generally one story and one-and-a-half story, side gabled dwellings (Photo 11).

PHOTO 11: VIEW SHOWING TYPICAL HOUSES IN THE HIGHLAND ADDITION TO RAINELLE, LOOKING SOUTH





Source: Map Book 1, Greenbrier County Courthouse

Figure 7: Survey Showing Highland Addition to Rainelle, circa 1928. (Not to Scale)

East Rainelle

The original portion of East Rainelle, originally called Levelton, was platted out east of the James River and Kanawha Turnpike in the area south of Main Street and Greenbrier Avenue around 1910. Until its incorporation as East Rainelle in 1921, only a few businesses and houses were constructed.

Growth accelerated following the opening of the low volatile, or "smokeless", coal region around the Meadow River Valley made possible by the opening of the Greenbrier and Eastern Railroad in 1921 (Whitman, 1952:46-49).

In the years after 1921, several additions appeared in the plat books illustrating the growth of the town. These included the "L.L. Graybeale Addition" (Maps 2:128), the "W.S, Surbaugh Addition" (Maps 1:117), the "McClung Addition" (Maps 1:87), and the "Hughart Addition" (Maps 1:77). These additions range in date from 1928 to 1949.

Main Street in East Rainelle is dominated by one- and two-story frame and masonry commercial buildings that date from the first decade of the twentieth century through the late 1940s. Although some alterations are evident, most of the building stock possesses a high degree of integrity (Photo 12).

PHOTO 12: VIEW SHOWING COMMERCIAL BUILDINGS ON MAIN STREET, EAST RAINELLE, LOOKING EAST



One important structure constructed at this time was the King Coal Hotel. This building is currently vacant and considered by the City of Rainelle to be unsafe. The hotel is a three-story, brick building with limestone cornice capped with a brick parapet. The building is eight bays wide and three bays deep, consisting of a central five-bay section and two double bay wings. Originally known as the Maple Oaks Hotel, the building was constructed in 1928. The original owners had to sell the hotel as a result of the Great Depression, and it passed to Coleman Gore, who renamed it the King Coal Hotel around 1935 (WV Daily News, 4/13/04). The most recent owner, Virgil McMillion, has proposed renovating the building for use as either a hotel or apartments (WV Daily News: 4/13/04), but the building is currently vacant, having most of its windows either boarded up or missing (Photo 13). The building was recently been gutted but at this point its future is uncertain due to lack of funds for the proposed renovations. Due to its current condition, the building would not be individually eligible for the National Register, but would still be considered a contributing resource to the historic district.

PHOTO 13: VIEW SHOWING KING COAL HOTEL IN DISTANCE, LOOKING WEST



The earliest houses in East Rainelle were similar to the company houses in Rainelle, being one- and two-story, front-gabled dwellings (Photo 14), but later houses are more varied, having Cape Cod, Bungalow, Queen Anne, and other stylistic influences (Photo 15). These later styles are evident mostly north of Main Street and along the Kanawha Turnpike.

PHOTO 14: VIEW SHOWING TYPICAL EARLY HOUSES IN EAST RAINELLE, LOOKING WEST

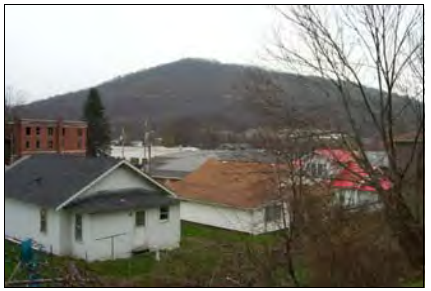


PHOTO 15: VIEW SHOWING LATER PERIOD HOUSES IN EAST RAINELLE, LOOKING EAST



Other significant buildings include the East Rainelle Grade School, which stands at the eastern edge of East Rainelle (Photo 16) as well as a number of churches within this area, including the First Baptist Church at Seventh Street and Surbaugh Avenue, (constructed in 1950, Photo 17) and the Sacred Heart Catholic Church at Thirteenth Street and Greenbrier Avenue (Photo 18).

PHOTO 16: EAST RAINELLE GRADE SCHOOL, LOOKING SOUTH



PHOTO 17: EAST RAINELLE FIRST BAPTIST CHURCH, LOOKING NORTHEAST



PHOTO 18: SACRED HEART CATHOLIC CHURCH, LOOKING EAST



Anjean

All that remains of the structures that comprised the company buildings at Anjean are three concrete block dwellings with minimal Colonial Revival/Cape-Cod styling. These are all virtually identical four by two bay structures. The buildings are one-and-a-half story, side-gabled dwellings with two dormers on the front roof slopes and single large central roof dormers on the rear slopes. The roofs have gable-end exterior chimneys. They have six-over-six, double-hung windows and enclosed side porch wings. The roofs are shingled with asphalt. The main buildings are concrete block painted green, and the dormers are clad with 8-inch aluminum siding (Photo 19 and 20).

PHOTO 19: EAST AND NORTH (FRONT) FAÇADE OF ANJEAN SITE DWELLING, LOOKING WEST



PHOTO 20: SOUTH (REAR) AND WEST FAÇADES OF ANJEAN SITE DWELLINGS, LOOKING NORTHEAST



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HISTORIC RESOURCES DETERMINATION OF ELIGIBILITY
AND ASSESSMENT OF EFFECTS

SECTION V. DETERMINATIONS OF NATIONAL REGISTER ELIGIBILITY

Determinations of eligibility are guided by the publication: *National Register Bulletin 15,* "How to Apply the National Register Criteria for Evaluation" (Department of Interior, 1991). Each surveyed property over 50 years of age within the APE of the project area is measured against these Criteria to determine if they are eligible for the National Register of Historic Places.

The criteria are as follows:

Criterion A: Properties associated with events that have made a significant contribution to the broad patterns of our history.

Criterion B: Properties associated with the lives of persons significant in our past.

Criterion C: Properties that embody the distinctive characteristics of a type, period, or method of construction or that represent a significant and distinguishable entity whose components may lack individual distinction.

Criterion D: Properties that have yielded, or may be likely to yield, information important in prehistory or history.

Ordinarily, cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

A. A religious property deriving primary significance from architectural or artistic distinction or historical importance; or

B. A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or

C. A birthplace or grave of a historical figure of outstanding importance if there is no other appropriate site or building directly associated with his or her productive life; or

D. A cemetery which derives its primary significance from graves of persons of transcendent importance, from distinctive design features, or from association with historic events; or

E. A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

F. A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historical significance; or

G. A property achieving significance within the past 50 years if it is of exceptional importance.

City of Rainelle (Rainelle and East Rainelle)

While there are very few buildings or structures within the current City of Rainelle (consisting of both the historic Rainelle and East Rainelle addition) that appear to be individually eligible for the National Register, the majority of the buildings and structures within the city possess a great deal of integrity of materials, workmanship, design, feeling, and association with the history of the Meadow River Lumber Company and the subsequent general history of Rainelle. Some areas of the city have experienced enough alteration to be excluded from consideration as part of a historic district, such as the area directly north of the Lumber Mill site on the north side of the Kanawha Turnpike, which has seen the destruction of the Raine House and other structures to make room for such structures as the Rainelle Medical Center. The core areas of company housing from both the first, second, and later construction periods have remained remarkably intact. The strength of these historic areas comes not from an individual building, but from the sheer number and uniformity of original company houses lined up in rows within these areas. The latter periods of construction in the eastern sections or Rainelle offer a glimpse of the changes that occurred in the city as it grew with the expansion of the lumber and coal industries. The original corporate limits of East Rainelle contain a great diversity of structures including later domestic buildings and a great variety of early-twentieth century commercial buildings and churches that are equally important to the history of the twin company towns that are now combined in the City of Rainelle.

The majority of the City of Rainelle is eligible for the National Register of Historic Places under Criterion A for its history and Criterion C as it represents a significant and distinguishable entity whose components may lack individual distinction. Boundaries for the historic district include the entire areas of all periods of construction, but exclude areas that lack historic integrity, such as the land south of the Kanawha Turnpike at the former site of the Meadow River Lumber Company, whose buildings were nearly all demolished in the 1970s. The modern buildings to the north of the mill site are also excluded for the same reason. The area known as the "Highland Addition" to Rainelle also contributes to the historic district except the buildings west of Pennsylvania that date from the latter half of the twentieth century. Nearly all of the East Rainelle section contributes to the district. Anchor structures within this historic district include the John Raine House, the Rainelle Depot, the Rainelle Methodist Church and other churches in East Rainelle, and the Bank of Rainelle. Suggested boundaries of the City of Rainelle Historic District are shown in Figure 8: City of Rainelle Historic District Boundaries. These boundaries represent a discontinuous historic district that roughly corresponds to the different chronological periods of development of the City of Rainelle from west to east. Further research is needed to ascertain the exact boundaries and contributing resources to this district.

Anjean

The three company dwellings at the Anjean Site are not notable examples of the Colonial Revival/Cape Cod architectural style, nor are they associated with historically significant persons or events. The majority of buildings and structures that were associated with the coal mining operations

at Anjean are no longer extant, and these dwellings do not possess the integrity or significance to be either individually or collectively eligible for the National Register of Historic Places.



Figure 8. Rainelle Historic District

Sources: U.S.G.S. Rainelle NE, WV 7.5 Minute Series (Aerial)

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(see above)

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SECTION VI. ASSESSMENT OF EFFECTS

According to the regulations governing Section 106 of the National Historic Preservation Act, when historic properties are found that the undertaking may affect, the Agency official shall assess the effects in accordance with Section 800.5. One property has been found to be eligible for the National Register as a result of this survey. Section 800.5 requires that the agency official shall apply the criteria of adverse effect to National Register eligible historic properties within the area of potential effects. This section states in part:

(1) Criteria of adverse effect. An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.

(2) Examples of adverse effects. Adverse effects on historic properties include, but are not limited to: (i) Physical destruction of or damage to all or part of the property; (ii) Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary's standards for the treatment of historic properties (36 CFR part 68) and applicable guidelines; (iii) Removal of the property from its historic location; (iv) Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; (v) Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features; (vi) Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and (vii) Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

Application of Criteria of Adverse Effect

City of Rainelle (Rainelle and East Rainelle)

The view shed of City of Rainelle, including the historic confines of both Rainelle and East Rainelle, will be changed by the construction of the proposed facility principally through the visual intrusion of the tallest co-generation facility buildings and the facility stack that will be placed at the proposed site. The proposed stack is expected to reach a an elevation of approximately 2,720 feet above msl, compared to the base elevation of approximately 2,400 feet above msl in downtown Rainelle. While many areas are well distanced and screened from the proposed facility and associated stack by the terrain, the stack will be readily visible from many locations, including the historic district as a whole.

Renderings that depict the predicted visibility of the proposed facility at various locations within the APE are presented in Appendix C. Although it may be argued that the change is adverse, the fact that the City of Rainelle was developed around a lumber industry that historically included a number of

very visible, smoke billowing stacks minimizes the actual practical impact of the changes (see Photo 21). More importantly, the existing alterations and modifications to the historic district and its perimeter areas (through the demolition of historic buildings and the development of modern convenience stores, a shopping plaza, and numerous businesses of various types) have altered the historic qualities of the setting in ways that overwhelm the impacts from the more distant proposed power plant or the power plants operations (see Photos 22, 23, and Panoramic Photo in Appendix E). Additionally, between the proposed power plant site and the historic district areas, the City of Rainelle has established and has been attempting to develop an industrial park. Efforts by the local community to establish the industrial park will proceed even if the proposed power plant project fails to develop.



PHOTO 21: PHOTO OF FORMER MEADOW RIVER LUMBER COMPANY, LOOKING WEST.

Potentially eligible buildings most affected will be the Railroad Depot and company housing closest to the proposed facility, as well as the Rainelle Bank building and the John Raine House. Given the existing setting, however, it cannot be said that the proposed project would alter, directly or indirectly, any of the characteristics of these historic properties that individually or collectively qualify them for inclusion in the National Register. Nor can it be fairly said that the proposed project

will alter the existing setting, feeling or association of these historic properties. Those buildings in the East Rainelle section will not be affected.

PHOTO 22: VIEW OF ROUTE 60 AND LOCUST STREET INTERSECTION LOOKING SOUTH AND WEST

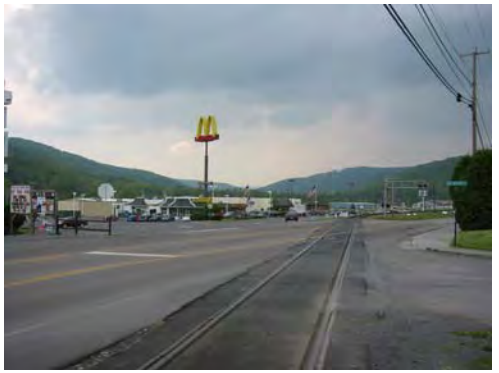
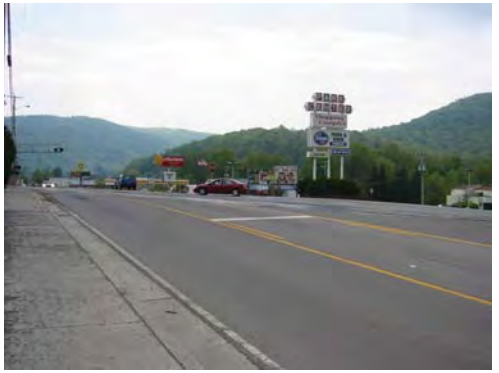


PHOTO 23: VIEW FROM ROUTE 60 AND LOCUST STREET INTERSECTION LOOKING EAST



Anjean

Since there are no buildings or structures eligible for the National Register within the APE of this part of the project, there will be no effect to any historic structures as a result of activities at the Anjean Site.

SECTION VII. RECOMMENDATIONS

This study finds that the proposed West Greenbrier Co-Production Demonstration Project will not have an adverse effect on either individually eligible resources or on the City of Rainelle Historic District. Effects to the historic district would be limited to view shed changes related to the construction of the facility and its approximately 300 feet high stack. Changes in the view shed would be largely limited to those buildings and structures located in the western half of the city. It is the recommendation of this report that the DOE consult with the SHPO regarding these conclusions drawn by the DOE about the potential impacts of the proposed project.

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1995 *Duo, WV,* 7.5-Minute Quad .

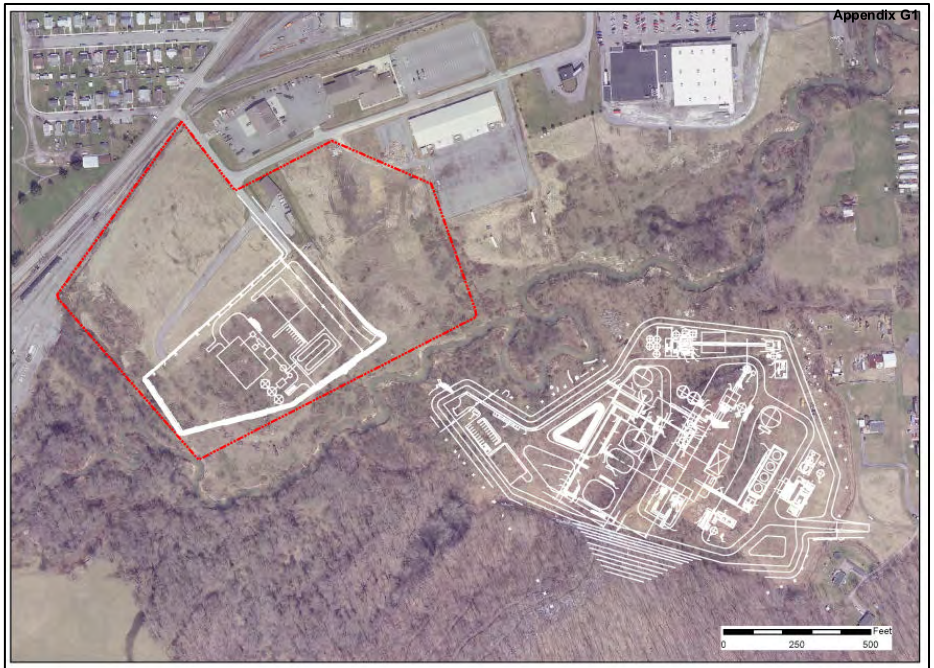
1995 *Quinwood, WV,* 7.5-Minute Quad.

Whitman, Lucy Lee
1952 "The History of The Meadow River Lumber Company and The Surrounding Area", Original unpublished manuscript available at the Greenbrier Historical Society, Lewisburg, WV.

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Appendix A – Proposed Project Conceptual Drawing



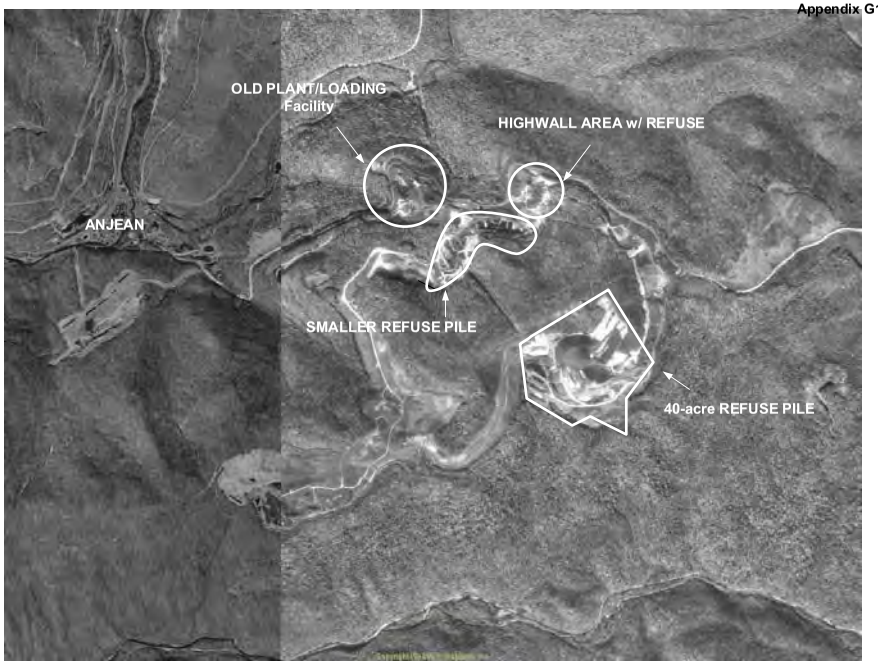
Proposed Project Layout
Conceptual Drawings
Sources: Parsons DWG WGC1-1-SK-111-002-001-F and WGC1-1-SK-111-002-007-B

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Appendix B – Anjean Figure



Anjean

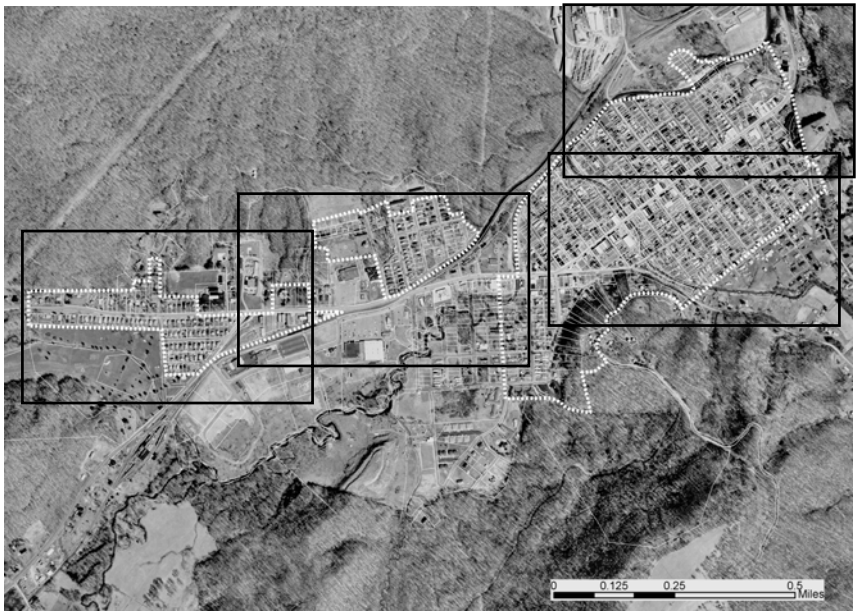
Sources:U.S.G.S Duo 7.5 Minute Series (Aerial) NE Greenbrier County

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Appendix C – APE Photos



Rainelle Historic District
Photo Key Maps
Sources: U.S.G.S. Rainelle NE, WV 7.5 Minute Series (Aerial)

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Rainelle Historic District
Photo Key - 12, 17
Sources: U.S.G.S. Rainelle NE, WV 7.5 Minute Series (Aerial)

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Rainelle Historic District
Photo Key - 6, 7 8, 9, 11
Sources: U.S.G.S. Rainelle NE, WV 7.5 Minute Series (Aerial)

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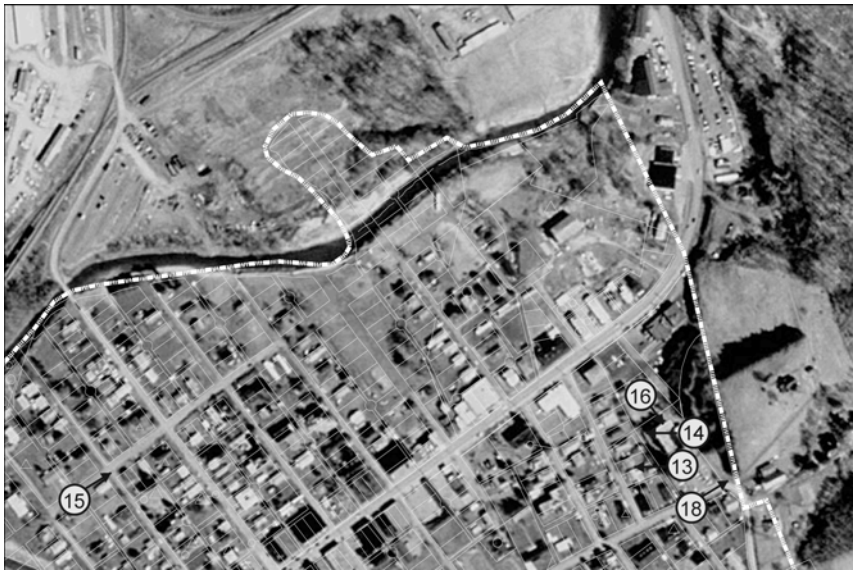
Rainelle Historic District
Photo Key - 1,2, 3, 4, 5, 10
Sources: U.S.G.S. Rainelle NE, WV 7.5 Minute Series (Aerial)

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Rainelle Historic District
Photo Key - 13, 14, 16, 18
Sources: U.S.G.S. Rainelle NE, WV 7.5 Minute Series (Aerial)

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Appendix D – Visual Renderings



Expected View of Stack from Second Street and Route 60 Looking West



Expected View of Stack from Locust Street and kanawha Parkway Looking South



Expected View of Stack from the United Methodist Church Looking South

Appendix E – Panoramic Photo



Panoramic View of Route 60 from the United Methodist Church Looking South

Appendix G1

Appendix G1

Phase I Archeological and Geomorphological Investigations
of the
Proposed Western Greenbrier Co-Production Plant
Rainelle, Greenbrier County, West Virginia



prepared for
Potomac-Hudson Engineering, Inc.
Bethesda, Maryland

and
U.S Department of Energy
National Energy Technology Laboratory
Morgantown, West Virginia

prepared by
John Milner Associates, Inc.
Louisville, Kentucky

April 2005

Appendix G2

Appendix G2

PHASE I ARCHEOLOGICAL AND GEOMORPHOLOGICAL INVESTIGATIONS OF THE PROPOSED WESTERN GREENBRIER CO-PRODUCTION PLANT RAINELLE, GREENBRIER COUNTY, WEST VIRGINIA

Prepared for

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Prepared by

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April 2005

ABSTRACT

John Milner Associates, Inc. (JMA) was retained by Potomac-Hudson Engineering, Inc. (PHE) of Bethesda, Maryland to conduct Phase I archeological and geomorphological investigations and to contribute to an Environmental Impact Statement (EIS) for the Western Greenbrier Co-Production Demonstration Project. Specifically, the U.S. Department of Energy (DOE) and PHE are preparing an EIS for the referenced Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The DOE, PHE, and JMA, in consultation with the West Virginia State Historic Preservation Office (WV SHPO), followed a staged approach to the field investigations in order to comply with Section 106 and NEPA requirements.

The project area for the WGC plant site is located on and adjacent to the former location of the Meadow River Lumber Company in Rainelle. The Meadow River Lumber Company began operations to harvest hardwoods from the area in 1906. Rainelle was established as the Meadow River Lumber Company town in 1910, when the Meadow River Lumber Company mill opened. Over the 60-year history of operations, the Meadow River Lumber Company harvested timber from 125,000 acres around Rainelle. From its inception, this company was one of the largest hardwood lumber operations in the United States, and by the 1930s was the largest hardwood mill in the world. It maintained this position through the 1960s. The Meadow River Lumber Company ceased operations in 1970, and the entire mill and lumber yards were razed by 1975.

Field investigations were conducted in two stages: Stage 1 was in April, 2004 and Stage 2 was in November, 2004. The purpose of the Stage 1 investigations was to identify obvious cultural resources and assess the potential for subsurface archeological sites. At the time of the Stage 1 survey, design plans for the plant site and related infrastructure (e.g., steam pipeline corridor, transmission line corridor, etc.) were not finalized. Areas investigated during the walkover survey included (1) the proposed 26-acre plant site south of Rainelle, (2) the proposed location of the transmission corridor between the plant site and the existing power line to the west, (3) the proposed steam and water line corridor that parallels the existing railroad bed north of the plant site, (4) the proposed location of the loading facilities in Anjean, and (5) selected refuse piles on Little Clear Creek Mountain east of Anjean. During the Stage 1 investigations, JMA identified areas that have the potential to contain prehistoric or historic archeological deposits. JMA also identified several areas within the project area that were heavily disturbed and had little or no potential to contain archeological deposits. The latter areas included the truncated ridgetop at the plant site, areas on either side of the ridge that contained a minimum of 3-6 feet of fill, and the former mill pond, lumber mill, and lumber yard. A meeting was held with the WV SHPO, PHE, and the DOE on May 12th, 2004, to discuss the results and recommendations of the Stage 1 walkover survey.

Stage 2 of the Phase I investigations included the excavation of STPs, soil probes, and backhoe trenches. More specifically, the following areas were surveyed: (1) an intensive Phase I survey and deep testing of alluvial terraces between Sewell Creek and the toeslope of the truncated ridge that have a high probability for containing archeological deposits; (2) Phase I archeological survey and excavation of judgmental STPs on the benches in the Plum Creek tract south of the property fenceline; (3) walkover survey and judgmental soil probes of the steam/water pipeline corridor and preparation of archeological sensitivity map; (4) walkover survey of the 17-acre exchange property and preparation of archeological sensitivity map.

JMA excavated 8 backhoe trenches and 32 STPs in high probability areas in the construction footprint for the plant site. Field observations revealed that the floodplain is dissected by numerous paleochannels, and four different interfluve surfaces were identified in the proposed plant site. The various interfluves and paleochannels indicate this surface is very active. Backhoe trenches in the alluvial terraces exhibited different soil profiles depending on landscape position. Trenches in the floodplain demonstrated the presence of both fluvial and alluvial soils. Collectively, the trench profiles indicated that (1) the proposed plant site location has very little potential to contain buried soils, and (2) Sewell Creek as a whole has little, if any, potential for buried soils, given the very active nature of this stream course. The geomorphic evaluation demonstrated that if archeological sites are present within this part of the project area, then evidence of the sites would necessarily be limited to the upper 30-35 cms.

The backhoe trenches on the colluvial slopes demonstrated that the fill in these areas is 6 ft or more, but because water seepage caused the side walls of the trenches to collapse, the exact depth of the fill could not be determined. Based on the results of the pedestrian survey and the information gleaned from the backhoe trenches, the STPs were located on various alluvial terraces (interfluves) within the plant site location. Despite the excavation of 32 STPs and eight backhoe trenches, no archeological materials were recovered in the proposed plant site during the Phase I survey.

JMA also excavated 11 STPs on the three small benches south of the fenceline in the Plum Creek tract. The STPs resulted in the recovery of a single flake fragment of gray chert on the third or smallest bench. Two additional STPs were excavated on the bench, but no other artifacts were recovered. The bench, which measures less than 8 x 10 m, has been disturbed by logging activities as well as two former logging roads. The eight STPs on the two larger benches produced negative results. These benches have also been disturbed by erosion and logging activities and logging roads in the past. No further archeological work is recommended. Based on the results of the background research, Stage 1 and 2 (Phase I) archeological investigations, and the excavation of several backhoe trenches, it is JMA's recommendation that the proposed plant site and the benches in the Plum Creek tract have no potential to contain significant archeological deposits. JMA recommends that these areas should be considered cleared for purposes of Section 106 compliance and no further consideration of archeological resources is warranted in these areas.

The pedestrian survey and subsequent placement of 11 soil probes within the pipeline corridor was successful in that it was possible to differentiate disturbed areas from those relatively undisturbed. Soil probes #4-6 are located in the only portion of the pipeline corridor that has the potential to contain archeological sites in an undisturbed context. JMA recommends that an intensive subsurface investigation of the area between soil probes #4-6 should be undertaken prior to the disturbance of these areas. JMA conducted a walkover survey of the 17-acre land exchange property. The land exchange area is steep, extremely rocky in parts, and heavily disturbed by former logging roads. Erosion of exposed soils on these steep slopes has reduced the surface horizon to only a few cms. No archeological sites and no high probability areas were identified in the land exchange property as a result of the pedestrian survey. No further consideration of archeological resources is recommended for the land exchange tract.

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

John Milner Associates, Inc. (JMA) was retained by Potomac-Hudson Engineering, Inc. (PHE) of Bethesda, Maryland to conduct Phase I archeological and geomorphological investigations (as directed by PHE) and to contribute to an Environmental Impact Statement (EIS) for the Western Greenbrier Co-Production Demonstration Project. Specifically, the U.S. Department of Energy (DOE) and PHE are preparing an EIS (and appropriate technical support documentation) for the referenced Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Gen, LLC (WGC), with DOE providing financial support through a 5-year cooperative agreement with WGC under the DOE Clean Coal Power Initiative (CCPI) Program. The facility would be designed for long-term commercial operation (at least 20 years) following completion of the cooperative agreement. DOE's support would amount to 50% of the development cost for the proposed facility.

DOE's sponsorship of the cultural resources investigations is required under several federal regulations, including, but not limited to, the National Environmental Policy Act (NEPA) of 1969, as amended; the National Historic Preservation Act (NHPA) of 1966, as amended, and its implementing regulations 36 CFR 800; and the Native American Graves Protection and Repatriation Act (NAGPRA). The DOE, PHE, and JMA, in consultation with the West Virginia State Historic Preservation Office (WV SHPO), followed a staged approach to the field investigations in order to comply with Section 106 and NEPA requirements. Detailed discussions of the work tasks associated with each stage are discussed below as well as Section 106 requirements that will be conducted as mitigation measures of the Final EIS. As part of the Section 106 and NAGPRA process, consultation letters were sent by the DOE to various tribal leaders and/or Tribal Historic Preservation Officers (THPOs) on July 28, 2004, requesting their comments and participation throughout the duration of the project. As January, 2005, no tribes have responded or otherwise indicated that they have any concerns regarding the project.

WGC is proposing to design, construct, and operate a 90 megawatt net electric output (MWe) atmospheric circulating fluidized bed power plant that would generate electricity and steam by burning approximately 2,700 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on ca. 26-acre site immediately on the east side of Sewell Creek and immediately south of the city limits of Rainelle in the extreme western corner of Greenbrier County. The confluence of Sewell Creek and the Meadow River is roughly 1.5 miles northeast of the proposed plant site. A coal-fired rotary kiln associated with the power plant would combine coal ash and limestone into a cement-like material for use with wood wastes to manufacture structural building blocks (Woodbrik™). Currently, it is anticipated that the Woodbrik™ manufacturing plant would be located on the north side of Sewell Creek adjacent to the Eco Park. The power plant would likely serve as the anchor for future tenants at the Eco Park by providing a source of steam and hot water supply for building heating and other industrial activities.

Waste coal would initially be obtained from abandoned waste coal piles located in the vicinity of Anjean (see attached figures). Excess combustion ash not needed for Woodbrik™ manufacture would be used to remediate acid drainage from the source waste coal piles. WGC is in the process of determining additional waste coal pile sites for obtaining fuel source once the Anjean piles are depleted (currently estimated at 6 to 7 years). Generally, future waste coal pile sites that would be

used would be within 20 to 30 miles of the power plant site. As of the writing of this report, the most likely candidate to be used as a second source of fuel by WGC is the Green Valley site, located north of Quinwood on Route 20. The Green Valley site is adjacent to an active coal mine, and the proposed fuel site is highly disturbed from mining activities. In its current condition, the site consists of waste-coal piles that were placed on steep ridges, contoured, and covered with planted pines. Both rail and truck were initially considered as transportation options for the waste coal fuel, raw materials (e.g., limestone), and waste removal. However, considerations for rail by WGC were abandoned due to economic consideration and the associated feedback received from the local community.

Additional components of the proposed project included the construction of power lines and the construction of steam lines and water supply lines from the Rainelle sewage treatment plant to the plant site (Figure 1). A combination of groundwater and reclaimed wastewater would be used for supplying water to the plant. An additional component of the project, added for the November investigations, was the ca. 17 acre land exchange with the City of Rainelle in order for the DOE to construct the power lines across land for which the town of Rainelle holds a recreational easement.

1.2 AREA OF POTENTIAL EFFECT AND PROJECT HISTORY

The project area for the WGC plant site is located on and adjacent to the former location of the Meadow River Lumber Company in Rainelle. The Meadow River Lumber Company and their land-holding entity, the Meadow River Coal and Land Company, began operations to harvest hardwoods from the area in 1906, initially building the Sewell Valley Railroad spur to provide access to the Chesapeake and Ohio (C&O) Railroad. Rainelle was established as the Meadow River Lumber Company town in 1910, when the Meadow River Lumber Company mill opened; the town was incorporated in 1913. Over the 60-year history of operations, the Meadow River Lumber Company harvested timber from 125,000 acres around Rainelle (Whitman 1977). From its inception, this company was one of the largest hardwood lumber operations in the United States, and by the 1930s was the largest hardwood mill in the world. It maintained this position through the 1960s (HAER 1984). The Meadow River Lumber Company ceased operations in 1970, and the entire mill and lumber yards were razed by 1975. The former Fire Pump House, currently the Greenbrier County Public Service District #2 building, is the only extant building within the project area. As will be discussed in depth in subsequent chapters, the support buildings for the proposed Co-Generation plant are located on fill of the former Log Pond and the former railroad tracks at the entrance to the lumber company.

The Area of Potential Effect (APE) for prehistoric and historic archeological sites is limited to areas of proposed ground disturbance, provided that these areas have not been too disturbed by previous land-use practices. Areas of proposed ground disturbance include the 26-acre plant site on the east side of Sewell Creek, the proposed site for the support facilities on the west side of Sewell Creek, steam and water pipeline corridors that will parallel Sewell Creek from the wastewater treatment facility to the plant site, the power line corridor, and possible staging areas and access roads both at the plant facility as well as the coal refuse piles near Anjean, West Virginia.

Figure 1 depicts the archeological APE for the plant site and supporting infrastructure in the Rainelle area as of April, 2004, and Figure 2 depicts the archeological APE for the waste coal piles and infrastructure in the area near Anjean as of April 2004. As will be discussed in depth

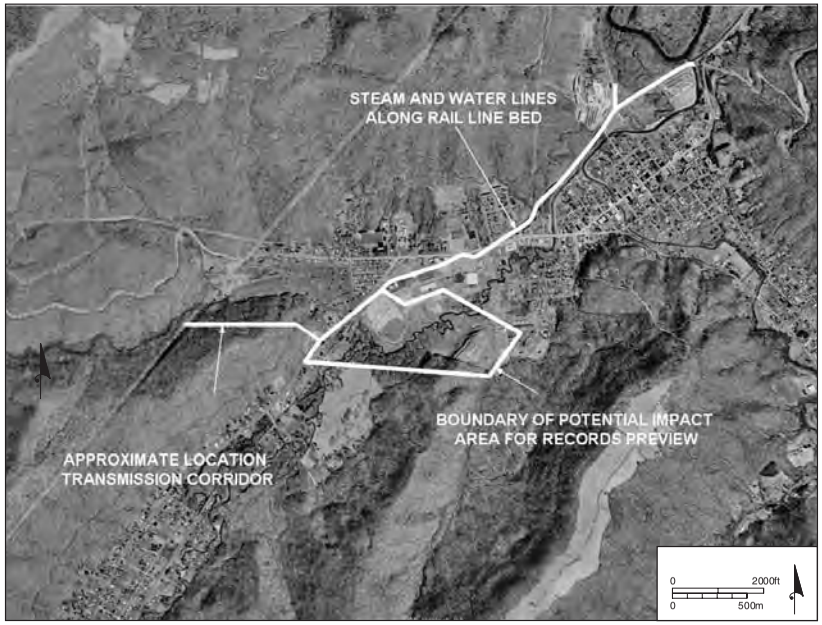


Figure 1. Detail of *Rainelle 7.5 Minute Aerial Quad,* showing Rainelle Study Area.

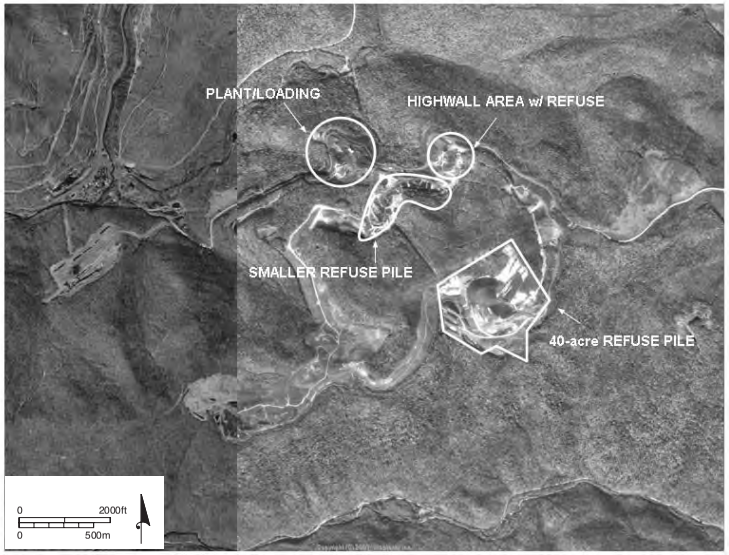


Figure 2. Detail of *Duo and Quinwood 7.5 Minute Aerial Quads,* showing Anjean Study Area.

below, the degree of previous ground disturbance within the APE is highly variable, depending on past land-use history. For example, some portions of the proposed plant site on the east side of Sewell Creek as well as the proposed land exchange area are relatively undisturbed and have the potential to contain archeological sites. Conversely, other portions of the plant site as well as the proposed location of the support facilities either consist of several feet of man-made land or fill deposits overlying a truncated alluvial terrace surface. The pipeline corridor for the steam and water lines traverses both heavily disturbed and relatively undisturbed land.

Field investigations were conducted in two stages: Stage 1 in April, 2004 and Stage 2 in November, 2004. Stage 1 investigations, conducted from April 5-8, 2004, consisted of a walkover survey of the impact areas near Anjean (Figure 2), and a walkover survey of the proposed plant site and support facilities (i.e., on both sides of Sewell Creek) as well as the truncated ridge overlooking the plant site. Additional field investigations included the placement of 10 judgmental soil probes within the proposed plant site and undisturbed portions of the adjacent ridge. JMA also conducted a pedestrian survey of the proposed transmission line and steam pipeline corridors. At the time of the April field investigations, the proposed location for the pipeline corridor paralleled the railroad tracks and Sewell Creek from the plant site to the wastewater treatment facility, near the confluence of Sewell Creek and Meadow River. The results of these investigations, including the identification of archeologically sensitive areas are depicted in Figure 3.

Following the Stage 1 field investigations, a meeting was held on May 12, 2004 among the DOE, PHE, JMA and the WV SHPO. The purpose of the meeting was to present the results of the background research and Stage 1 field investigations and to discuss what, if any, additional field investigations were necessary for inclusion in the Draft EIS (DEIS) and to discuss activities that were required for Section 106 compliance. Stage 2 investigations, conducted from November 8-12, 2004, consisted of the excavation of backhoe trenches along Sewell Creek at the plant site location, the excavation of shovel test pits (STPs) in high probability areas at the plant site location, a walkover survey of the land exchange area, and the pedestrian survey (and soil probes) of the revised steam pipeline corridor. Because of the extensive ground disturbance and soil truncation that has occurred at the proposed waste coal piles, no further work was recommended at the Anjean locations (Plates 1and 2).

1.3 TEAM ORGANIZATION AND REPORT FORMAT

Stage 1 investigations were conducted by Mr. J. Sanderson Stevens (Principal Investigator and Senior Author) and Mrs. Sarah Traum. Stage 2 investigations were also conducted by Mr. Stevens, with the assistance of JMA geomorphologist, Dr. William Chadwick. Dr. Chadwick served as junior author of the report, and he also assisted in the preparation of GIS graphics. Ms. Sarah Ruch prepared the final report graphics and plates, and Ms. Margy Schoettle prepared the final report manuscript.

Following the report introduction, Chapter 2 presents an overview of the environmental setting, Chapter 3 discusses the results of the background research, and Chapter 4 summarizes the prehistoric and historic context. Chapter 5 outlines the various survey methodologies used during the Stage 1 and Stage 2 investigations, and Chapter 6 presents the survey results and interpretations. Chapter 7 provides the report conclusions and management recommendations, and Chapter 8 presents the References Cited. Appendices, tables, figures, and plates conclude the report.

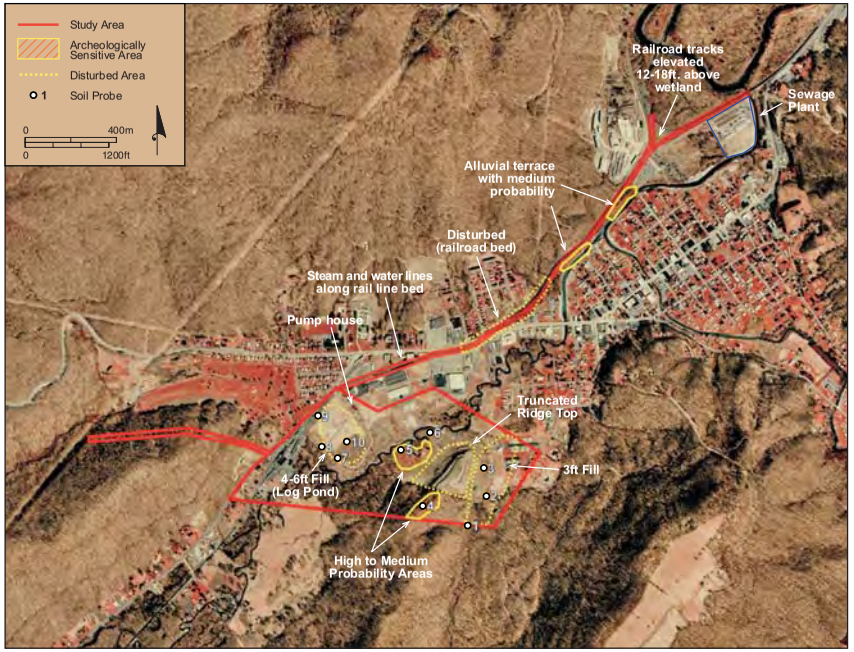


Figure 3. Stage 1 survey results and archeogically sensitive areas in Rainelle Study Area.



Plate 1. View of 40-acre strip mine and coal waste piles, facing north.



Plate 2. View of high wall area and coal waste piles, facing southeast.

2.0 ENVIRONMENTAL SETTING

2.1 PHYSIOGRAPHIC PROVINCES

Greenbrier County, located in southeastern West Virginia, is situated near the eastern margin of the Appalachian Plateau Physiographic Province. The Appalachian Plateau, which dominates the western two-thirds of the state, consists of a heavily dissected, western-tilting plateau that is underlain by sedimentary rocks of the Mississippian, Pennsylvanian, and Permian periods (WVGES 1969). Rock formations in the Appalachian Plateau Province typically consist of relatively flat-lying rocks that frequently contain easily mined coal deposits. The eastern margin of the Appalachian Plateau contains the Allegheny Front subprovince, a prominent geological feature that runs from northeast to southwest across the state. Immediately east of the Allegheny Front are the folded mountains and valleys of the Valley and Ridge Physiographic Province. Coal is limited to the western one-third of the county and is more or less defined by the extent of the Appalachian Plateau.

The eastern third of the state is dominated by the Valley and Ridge Physiographic Province, which is more widespread in Pennsylvania, Virginia, and North Carolina. Within Greenbrier County, the Valley and Ridge Province generally lies east of the Greenbrier River and consists of series of parallel mountain ridges and narrow valleys. The structural geology of the Valley and Ridge Province is complex and includes extensive thrust faults and folds. Valley formations are generally underlain by less-resistant shale and siltstone, while Ridge formations are generally underlain by more resistant rock such as sandstone and limestone. Rock formations are oldest in the eastern part of the state and become progressively younger in the western part of the state, likewise rock formations in the northern part of the plateau are younger (Permian) than those in the southern part of the plateau (Mississippian). Elevation ranges from about 2,000 feet or less in the valley bottoms in the eastern part of the county to over 4,400 feet in the mountain ranges in the northwest corner of the county.

2.2 GEOLOGY

The Greenbrier Formation, which underlies the central and western portions of Greenbrier County, dates to the Mississippian Period (323–354 million years ago [Ma]). The Greenbrier Formation predominantly consists of limestone with red beds of shale and sandstone. This formation, which depicts a time when the inland seas were expanding, represents the last significant marine deposits in the state (2004 www.wvgs.wvnet.edu/www/geology/geolhist.htm). Low-grade coal seams occur within this formation, but for the most part the more prominent and higher grade coal deposits are associated with the Pennsylvania formations that occur in the western two-thirds of the Appalachian Plateau.

Pennsylvanian Period rocks (290–323 Ma) consist of various sequences of limestone, coal, shale, clay and sandstone. During the early Pennsylvanian Period, the land dropped to near sea level, and land continued to sink for the next 50 million years at about the same rate that deposition was taking place (2004 www.wvgs.wvnet.edu/www/geology/geolhist.htm). Thus, swamp conditions prevailed throughout the period, resulting in the thousands of feet of non-marine deposits of sandstone, shale, and coal. During the subsequent Permian Period (290 – 248 Ma), the Appalachian Orogeny began and West Virginia and other portions of eastern North America were uplifted. Permian-aged formations in West Virginia are confined to the northwestern one-third of

the state and mainly consist of sandstone, shale, and limestone. Coal beds occur within Permian formations in the northwestern part of the state. As mountain building continued, erosion of existing sediments increased, the inland seas disappeared, and marine deposition ceased. The Appalachian Orogeny resulted in major folding and thrust faulting events, which eventually lead to the development of the Appalachian Mountains (WVGES 1969). It is during this period that the Mississippian and Pennsylvanian sediments were uplifted and subsequently dissected to form the Appalachian Plateau (2004 www.wvgs.wvnet.edu/www/geology/geolhist.htm).

Mesozoic Era (248–65 Ma) rocks do not occur in West Virginia, and with the exception of Quaternary Period (1.8 Ma – present) alluvial sediments in low-lying areas, Cenozoic Era (65 Ma – present) rocks are also absent in both Greenbrier County as well as the remainder of the state (WVGES 1969). During the Pleistocene Epoch (1.8 Ma-10,000 yrs BP) large continental glaciers covered much of North America. Although glacial ice did not advance into West Virginia, the proximity of the ice front influenced paleoclimatic and paleoenvironmental conditions throughout the state. Drainage patterns were completely altered during the Pleistocene. For example, the Monongahela River, which formerly drained northward into the St. Lawrence River, was diverted westward and drained into the Ohio River system, which at the beginning of this time period followed the ancient Teays River channel across central Ohio, Indiana, and Illinois. The lower third of the Illinois River is the only surviving active channel segment of the ancient Teays River system.

2.3 GEOMORPHOLOGY

The geomorphology within Greenbrier County is in part a reflection of the orientation of the underlying rock formations as they relate to the respective physiographic provinces. The landscape reflects millions of years of mountain building, seasonal cycles of weather, and the results of weathering and stream erosion for thousands of years. For example, eastern Greenbrier County, which lies in the Valley and Ridge province, is dominated by inclined rock formations and broad linear valleys which have resulted in a dendritic drainage pattern. The central and western part of the county are made up by the Allegheny Front and Appalachian Plateau which have nearly horizontal rock formations that result in a dendritic drainage pattern being dominant. The present study area is located within the Appalachian Plateau Physiographic Province, and thus the area is dominated by a dendritic drainage pattern dictated by nearly horizontal bedrock. Within the project area, there are four basic geomorphic landforms represented. These landforms are as follows: (1) Sewell Creek and its associated features; (2) the floodplains of Sewell Creek; (3) the toe slope of the truncated ridge; and (4) the truncated ridge.

Sewell Creek drains approximately 44 square miles of area within Fayette and Greenbrier counties. The creek flows northeast until it enters the Meadow River north of the Rainelle water treatment plant. The Sewell Creek stream channel meanders and is dominated by high cut banks, bank scours, and point bars. The channel itself has smaller sand bars and a thalweg of course sand. The stream banks are typically over steepened and have little riparian vegetation to prevent further erosion and migration of the stream channel.

The floodplain to the east is highly dissected by paleochannels and crevasse splays of Sewell Creek. The paleochannels still have prominent cut banks and points bars features although they sit approximately 2 meters above the present creek water level. Many of the paleochannels have wetland vegetation and are slightly damp and may have been oxbow ponds in the past. The floodplain to the west of Sewell Creek sits approximately 3 meters above Sewell Creek and is not dissected by paleochannels or crevasse splays. This lack of dissection is likely the result of its

higher position above the creek decreasing the frequency of flooding as opposed to the floodplain east of Sewell creek.

The toe slope of the truncated ridge has been denuded of vegetation in much of the study area. At the surface, the soil of the toe slope is reddish brown (5YR 4/3) clay loam with many fragments of sandstone megascopically similar to the bedrock of the truncated ridge. The fence line on the toes slope of the ridge at the southern edge of the proposed plant location sits approximately 5 meters higher than the toe slope surface within the plant footprint. This difference in elevation would be an indication that the toe slope within the footprint of the proposed plant has been mechanically modified.

The prominent ridge within the study area trends northeast and has its northern terminus within the footprint of the proposed plant. This ridge has been denuded of vegetation and mechanically truncated. The bedrock of this ridge lay nearly horizontal and is made of alternating beds of red sandstone and shale.

2.4 SOILS

Soils within Greenbrier County in part reflect the lithology of the underlying rock formations and the respective physiographic provinces. For example, eastern Greenbrier County, which lies in the Valley and Ridge province, consists of moderately deep to shallow soils that formed in material that weathered from shale (Gorman et al. 1972:1). The central part of the county (Allegheny Front) consists of deep, moderately fertile to fertile soils derived from limestone (Gorman et al. 1972:1). Finally, the western third of the county, which is part of the Appalachian Plateau, contains deep, easily eroded soils that formed in material weathered from shale (Gorman et al. 1072:1). Within the project area, three major soil associations are represented. They are as follows: (1) Atkins-Teas-Monongahela association along Sewell Creek and other lowlands in the area; (2) Teas-Calvin-Gilpin-Litz association in the upland ridges east of Sewell Creek and south of US 60; and (3) Dekalb-Gilpin-Laidig-Cookport association in the upland areas west of Route 20 and south of US 60. The waste coal piles near Anjean represent a fourth soil type (Strip Mine Spoil), which will also be discussed at the end of this subsection.

(1) *Atkins-Teas-Monongahela association.* Soils along Wolfpen Creek and Sewell Creek belong to three soil series: the Atkins silt loam series, the Monongahela silt loam series (2 to 8 % slope), and Alluvial land. The latter is limited to the mouth of Sewell Creek and adjacent low-lying areas along Meadow River. The soil descriptions are derived from Gorman et al. (1972:9-10). Atkins silt loam soils consist of deep, poorly drained, nearly level soils that formed in alluvium derived from upland soils (Gorman et al. 1972:10). These soils are extensive along Meadow River and its tributaries, such as Sewell Creek and Little Sewell Creek (Plate 3). A typical profile of Atkins silt loam soil is an Ap horizon, consisting of a dark grayish brown (10YR4/2) silt loam from 0 to 8 inches with an abrupt wavy boundary. The subsoil, which is nearly 30 inches in thickness, is a gray (10YR5/1) heavy silt loam to silty clay loam (with depth) mottled with a strong brown (7.5YR5.8). The soil structure consists of a weak, medium subangular blocky structure with a gradual wavy boundary. The C horizon or parent material is a gray (10YR5/1) silty clay loam with stratified lens of sand and silt.



Plate 3. View of Atkins soils along stream bank of Sewell Creek, facing north.



Plate 4. View of benches below truncated ridge showing Calvin-Gilpin soils, facing northwest.

Soils described as Alluvial land are subject to frequent flooding and range in texture from sand and silt to gravel. The alluvial soils at the mouth of Sewell Creek consist of fine-grained sediments that are frequently flooded. Vegetation is restricted to moisture-tolerant species. Because of the high water table and the frequency of flooding, both the Atkins soils and the alluvial land have limited use for agricultural crops, but can be used for pasture. Monongahela silt loam soils are also found in alluvial settings, in this case along the lower reaches of Sewell Creek. This series consists of deep, moderately well drained, silty soils on gently sloping terraces. The soils are formed in old alluvium, washed from upland settings that are underlain by sandstone and shale (Gorman et al. 1972:25-26). Water-worn stones and pebbles may occur at a depth of three feet or more, and a fragipan is common in the B horizon at a depth of 2.5 to 3 feet. Soil permeability and drainage are moderate above the fragipan, but they are slow within the fragipan (Gorman et al. 1972:25-26).

(2) *Teas-Calvin-Gilpin-Litz association.* Soils of the Teas-Calvin-Gilpin-Litz association occur on the truncated upland ridge (and its benches) that lies between Sewell Creek (on the east) and Little Sewell Creek (on the east) and south of US 60 (Plate 4). Mr. Shaun Allen of WGC indicated that as much as 20 to 40 feet of the ridge was removed by the land owner many years ago (Plate 5). These soils were deposited on the toeslope on both sides of the ridge. The soils in this portion of the project area are mapped as the Calvin-Gilpin very stony soils (25 to 40 percent slopes). The depth and extent of the fill that was deposited on the toeslopes of the truncated ridge is not know with certainty, but estimates are at least 4 or more feet of fill was deposited on top of the Calvin-Gilpin very stony soils.

(3) *Dekalb-Gilpin-Laidig-Cookport.* These soils are confined to two parts of the project area. They occur along the transmission line corridor (which extends west from the proposed plant site for approximately .5 mile) as well as within the 17-acre land exchange (which is west of Rainelle, between Wolfpen Creek on the south and US 60 on the north). Gorman et al. (1972: Map Sheet #29 and #37) have mapped these soils as part of the DeKalb-Gilpin very stony complex 40-65 percent slope. However, based on field observations of the authors and comparison of the observed soils with the soil descriptions for 20 to 40 percent soils and 40 to 65 percent soils, the soils in the two project areas are more accurately described as the DeKalb-Gilpin very stony complex 20-40 percent slope. These soils occur on the upper portion of slopes and benches in the mountainous parts of western Greenbrier County. Because of the slope and excessive amount and size of the stones throughout the profile, these soils are limited in use to woodlands, wildlife, and recreation (Gorman et al. 1972:17). Large boulders and cobbles cover a large portion of the 17-acre exchange property, and that part of the land exchange not covered by large boulders is very steep and crisscrossed by numerous old lumber roads.

(4) *Strip Mine Spoil.* The waste coal piles in the Anjean project area are mapped as Strip Mine Spoil (ST) by Gorman et al. (1972:30 and Map Sheet 29). These soils, which consist of a mixture of soil, shale, sandstone, and coal, frequently occur on level or nearly level areas that have been modified as a result of strip mining. This type of mining frequently follows contours around the mountain slopes, thereby reducing a portion of the stripped area by as much as 20 to 50 feet (Plate 6). The refuse piles are generally pushed to the middle of the leveled areas while the contoured margins usually have very steep slopes. Revegetation of these areas is difficult due to the stony nature of the soil residual, the extremely low Ph values, excessive erosion, and low available soil moisture capacity (Gorman et al. 1972). As depicted in Plates 1 and 2, the waste coal piles in the Anjean area are typical of the Strip Mine Spoil described by Gorman et al. (1972). Note that there is virtually no vegetation in the vicinity of these waste piles.



Plate 5. View of truncated ridge showing exposed soils of Calvin-Gilpin series, facing southeast.



Plate 6. View of contour strip mine, facing south.

2.5 CLIMATE

Greenbrier County has a humid continental climate, characterized by strong seasonal changes (Gorman et al. 1972:84). Climate within Greenbrier County is variable depending on both location and elevation. The Allegheny Mountains in the northwestern part of the county are some of the highest peaks in the state. Precipitation on the windward (west) side of the mountains is much higher than precipitation amounts on the leeward side (east) side of the mountains (Gorman et al. 1972:91). Additionally there are sharp differences in rainfall amounts between the valley bottoms and the mountain or ridgetops. Average precipitation in Rainelle over a 30 year period was 51 inches, compared to White Sulphur Springs in the southeast portion of the county with an average of 38 inches (Gorman et al. 1972:91). The northwest part of the county includes about 80 inches of snow, whereas the central and eastern portions of the county average about 20 inches of snow. Both snowfall and thunderstorms are more numerous at elevations above 3,000 feet. Average daily maximum and minimum temperatures for the 30-year period in Rainelle (1931-1960) ranged from 62 to 38 degrees, with January (40 and 18 degrees) the coldest month and July and August (80 and 56 degrees) the warmest months. Rainfall in the Rainelle area and northwestern Greenbrier County averages about 25 inches during the growing season (the last week in May through September) compared to 18 inches of rain in the southeastern part of the county where the growing season is three weeks longer (Gorman et al. 1972:84).

2.6 VEGETATION

Braun (1950:40) characterizes the modern flora of the Appalachian Plateau as a mixed mesophytic forest. This type of forest is characterized by a diversity of floral species, but there is no dominant species. Edaphic conditions, including slope, soil, elevation, available moisture, and aspect encourage the proliferation of different floral communities. At the time of initial European contact (and continuing into the early twentieth century when the Rain brothers settled in the area), common tree species of the mixed mesophytic forest included: various oak, chestnut, hickory, tulip poplar, beech, basswood, maple, and hemlock. Braun (1950) and Shelford (1963) note that different plant communities dominate at different elevations. True mixed mesophytic forests are found between 1,500 to 2,000 feet; oak-chestnut communities occur between 2,000 and 2,700 feet although maple-beech-basswood communities may occur between 2,500 and 3,500 feet. Birch-hemlock-spruce communities are more dominant between 3,500 and 4,200 feet, and spruce communities are dominant above 4,200 feet. Today, various oak species have replaced the chestnut. The secondary forests that typify the region today are markedly different than the true virgin forests encountered by the Rain brothers. The impact of deforestation, principally for timber harvesting and agricultural land clearing, decimated the mixed mesophytic forest, the associated open-forest understory, and the upland hardwoods. Today the forests in the region are characterized by xerophytic species (oak-hickory-beech) and a dense understory of thickets, vines, and greenbrier (Hubbard 1971).

Within the project area, vegetation is extremely diverse and ranges from a variety of landscapes on man-made soils to oak-hickory and oak-beech forests on relatively undisturbed ridge slopes and alluvial terraces. As note above, the soils at the waste coal piles are not conducive to revegetation and as a result very few plants grow in these areas. Within the project area for the plant site, three types of man-made land exist, each with a different type of vegetation. Areas with man-made land include (1) the truncated ridge crest, (2) the modified ridge slopes and colluvial fans, and (3) the former location of the Meadow River Lumber Company and the log (mill) pond. (1) A comparison of historic maps to the current project map suggests that at least 20 to 30 feet of

soil and bedrock have been removed from an area measuring some 400 ft x 60 ft. Thus, at least 60,000 cubic feet of soil and bedrock have been stripped from the ridge (Plate 7).

As a result the crest of the truncated ridge is relatively level and virtually void of vegetation (Plates 5 and 7), save for a few tree saplings and occasional tuffs of grass. (2) The spoil removed from the ridge was placed along the toeslope of the ridge and the adjacent colluvial apron. Although vegetation is very sparse in this area, some oak, beech, and holly saplings along with an understory of mixed grasses and thorny shrubs are beginning to spread across the toeslopes that are capped by the materials removed from the adjacent ridge (Plate 8). Because of the low Ph value of the fill, the excessive amount of clay and boulders in the fill, and the low available moisture capacity of the fill, vegetation on the modified toeslopes will necessarily be limited to plant species that prosper in disturbed soils with low nutrient values. (3) The former log or mill pond area and adjacent portions of the Meadow River Lumber Company were drained and filled more than twenty years ago. Today this area supports a nearly level grassy field adjacent to the former Fire Pump House and the Army Reserve buildings (Plate 9).

Upland vegetation in the relatively undisturbed portions of the project area (e.g., the benches below the truncated ridge, the transmission line corridor that traverses the northeast trending ridge west of Route 20 (opposite the plant site), and the 17-acre land exchange property west of the golf course on the north side of Wolfpen Creek) consists of oak-hickory and oak-beech forests. Because the trees in these areas have been harvested on more than one occasion over the last 100 years, a majority of the oak, hickory, and beech trees are still relatively small. Many oak saplings occur in these forested areas, and the understory supports ferns, sassafras, holly, greenbrier, and short grasses. Mountain laurel and pine trees are also common along the transmission line corridor on the northeast facing side of the ridge and at higher elevations. Oak-beech and pine are the dominant species in the land exchange property (Plate 10), and mountain laurel and holly are the dominant species in the understory, with mountain laurel especially plentiful along Wolfpen Creek, elsewhere the soil is too stony to support a significant understory (Plate 10). Vegetation in the eastern half of the land exchange property is less dense because the majority of this area consists of a steep talus slope covered with large boulders and cobbles. The western half of the land exchange property is very steep and supports a secondary growth forest (predominately oak, beech, and pine). Old logging roads are common in this part of the tract (Plate 11).

Vegetation in the lowland areas adjacent to Sewell Creek is somewhat variable depending on soil drainage, the degree of recent disturbance, and the duration since the most recent disturbance. For example, the higher terraces with moderately well drained soils and minor disturbances are dominated by oak-beech forests with an understory of saplings and some shrubs (Plate 12). As the degree of land disturbance increases, or soil drainage deteriorates, vegetation is characterized by a marked increase sweet gum and holly as well as a concomitant increase in the height and density of greenbrier, hawthorn, and other thorny vines. Some low-lying areas that have been spared extensive disturbance exhibit various types of wetland vegetation. Poison ivy and poison oak are pervasive in all low-lying settings.

Appendix G2



Plate 7. View of truncated ridge crest, facing north.



Plate 8. View of disturbed colluvial slope below ridge, facing west.

Appendix G2



Plate 9. View of former Log Pond showing grassy field. Note Army Reserve in background, facing north.



Plate 10. View of vegetation within the land exchange property, facing north.



Plate 11. View of land exchange property showing old road cut, facing south.



Plate 12. View of vegetation on alluvial terraces along Sewell Creek in the Plant Site, facing north.

3.0 PREVIOUS INVESTIGATIONS

3.1 BACKGROUND RESEARCH

The purpose of the background research conducted by JMA was to determine if previously recorded archeological and historic architectural resources occur within the APE and to collect information on the history of settlement and development of Rainelle and the Meadow River Lumber Company. Background research was conducted in March, April and May. Initial background research included review of the state archeological sites files and records at the WV SHPO, review of published and unpublished archeological reports at the WV SHPO, and review of the state historic architectural files and records at the WV SHPO. An extensive collection of historic photographs, maps, newspaper and journal articles, reports, and other types of information was examined and/or Xeroxed at the West Virginia State Archives. Topics researched at the State Archives included, but were not limited to, information on Greenbrier County, the town of Rainelle, the Rain brothers, the Meadow River Lumber Company, the Meadow River Coal and Land Company, and Shays engines. Records and files of the Greenbrier Historical Society in Lewisburg were also researched for information on the early history of the county and specifically on the town of Rainelle and the Meadow River Lumber Company.

In addition, various websites were researched that had information on the Meadow River Lumber Company, the history of the lumber and coal industries in West Virginia, and the Shays railroad. The West Virginia State Archives also maintains a website that contains more than 600 historic photographs of Rainelle and the Meadow River Lumber Company. In addition to research at the above repositories, information on Rainelle and the history of land use within the project area was obtained from Dr. George Collins of Tusculum College. Dr. Collins, whose father worked at the Meadow River Lumber Company for more than 40 years, is a professor of history at the university. Not only has Dr. Collins published several books and articles on Rainelle, Shays locomotive engines, and the Meadow River Lumber Company, but he also donated his father's collection of 600+ photographs to the West Virginia State Archives and made them available to all researchers via the West Virginia State Archives website.

An archeological site file and records search was conducted at the West Virginia Division of Culture and History in Charleston on April 5, 2004. The proposed co-production plant site is located on the Rainelle 7.5' quad, and the proposed coal waste areas and loading facility near Anjean are located on the Duo and Quinwood quads. Review of the site files and 7.5' USGS maps (Rainelle, Duo, and Quinwood) indicated no archeological sites have been recorded on these quad maps let alone within a 1.5 mile radius of the project areas. A few coal related surveys have been reported several miles east of the project area on the Duo quad, and a few abandoned mine surveys and proposed drill locations have been surveyed several miles west of Anjean on the Quinwood quad. A few multi-purpose surveys and coal-related surveys have been documented on the Rainelle quad, but again the survey areas were several miles distant from the proposed project area. Archeological project reports in the general vicinity were reviewed for relevant information on cultural context and environmental setting.

Research was also conducted at the West Virginia Archives and the Greenbrier County Historical Society in Lewisburg. Research at the latter facility was conducted on April 8, 2004. Research at the West Virginia Archives and the Greenbrier Historical Society focused on historic maps of the areas and county and regional histories, in particular the Meadow River Lumber Company in Rainelle and the Leckie "Smokeless" Coal mines near Anjean. Numerous historic maps of the

area were Xeroxed for use in the report. Historic maps included the 1821 Wood map, early 20th century USGS, soils, and geology maps, and maps and photographs of the Meadow River Lumber Company. Numerous documents and photographs regarding the Meadow River Lumber Company, the Meadow River Coal and Land Company, and the Sewell Valley Railroad were reviewed at the West Virginia Archives.

3.2 RESULTS OF HISTORIC MAP RESEARCH

The earliest map of the project vicinity is John Wood's 1821 "Map of Greenbrier County, Virginia." In the vicinity of Rainelle, the map shows very little detail, save for the Meadow River and some unnamed tributary streams, one of which could be Sewell Creek. In the vicinity of Anjean, the map shows Big Clear Creek and Little Clear Creek and an unnamed ridge or mountain between them. Presumably, the unnamed ridge is Pollock Mountain. The first detailed map of the study area is the Harrison and Handley's 1887 "Map of Greenbrier County, WV (Figure 4). In the vicinity of Rainelle, Figure 4 identifies the Meadow River, Sewell Creek, the James River and Kanawha Pike (US 60), a W.A. Stuart residence, which is either along Wolfpen Creek or the confluence Sewell Creek and the Meadow River. The town of Rupert and a railroad are also depicted. The railroad follows the northern bank of Meadow River from east of Rupert, west to the county line. Little detail is provided for the Anjean area except for Big and Little Clear Creek

Figure 5 (USGS 1912) presents a detail of the *Meadow Creek 15 Minute Quad*. The town of Rainelle is depicted on the map as is the Meadow River Lumber Company. The town of East Rainelle is labeled as Sewell Valley. With the exception of a small part of the Meadow River Lumber Company, no historic buildings are depicted within the study area. Figure 6 (USGS 1923 and 1939) presents a detail of the *Clintonville and Richwood 15 Minute Quad*. This figure illustrates the town of Anjean and includes geographic place names for the many creeks and ridges in the area. No historic buildings are depicted within the Anjean study area. Figure 7 (Price and Heck 1937), which also uses the same base map and the 1937 County Soil Map, shows the Rainelle and Anjean study areas. The level of detail is similar to the earlier USGS maps, illustrated in Figures 5 and 6, respectively. The next maps that provide any level of detail are the 1969 *Rainelle 7.5 Minute Quad* (photorevised 1976) and the 1972 *Soil Survey of Greenbrier County* (Gorman et al. 1972: Map Sheets 37 (Rainelle) and 29 (Anjean). These maps do not depict any buildings in the proposed project areas. Figure 8 is a modern aerial photo of the proposed plant site (April, 2004) overlain by a layout of the Meadow River Lumber Company and Log Pond circa 1930s. As noted previously, the entire Meadow Lumber Company and the associated railroad tracks were razed in 1975. As depicted in Figure 8, the only extant building within the proposed plant site is the former Fire Pump House, which is currently used as an extension building for the Greenbrier County Public Service District #2 (Plate 13). Two extant buildings related to the Meadow River Lumber Company lie outside, but adjacent to, the project area. The old train depot (Plate 14) and the former bank building (currently the regional office for Appalachian Power Company) (Plate 15) are located at the intersection of Route 20 and US 60. These buildings lie outside the area of proposed ground disturbance and therefore grounds around these buildings were not investigated for archeological deposits (Figure 8). Other extant buildings that date to the early beginnings of Rainelle include the First (United) Methodist Church, built in 1914 with lumber and interior finish materials (wormy Chestnut) furnished by the company (Plate 16); the John Raine House, one of the founders of the company and the town of Rainelle (Plate 17); and the King Coal Hotel, built in East Rainelle in the 1920s (Plate 18).

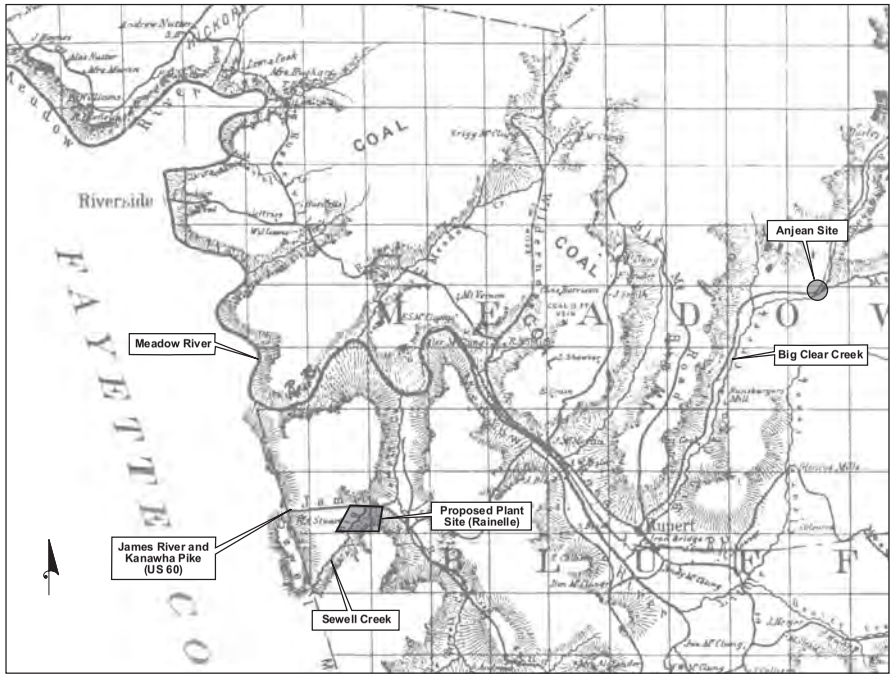


Figure 4. Detail of *Map of Greenbrier County, WV* (Harrison and Handley 1887), showing proposed project vicinity for Rainelle and Anjean Study Area.

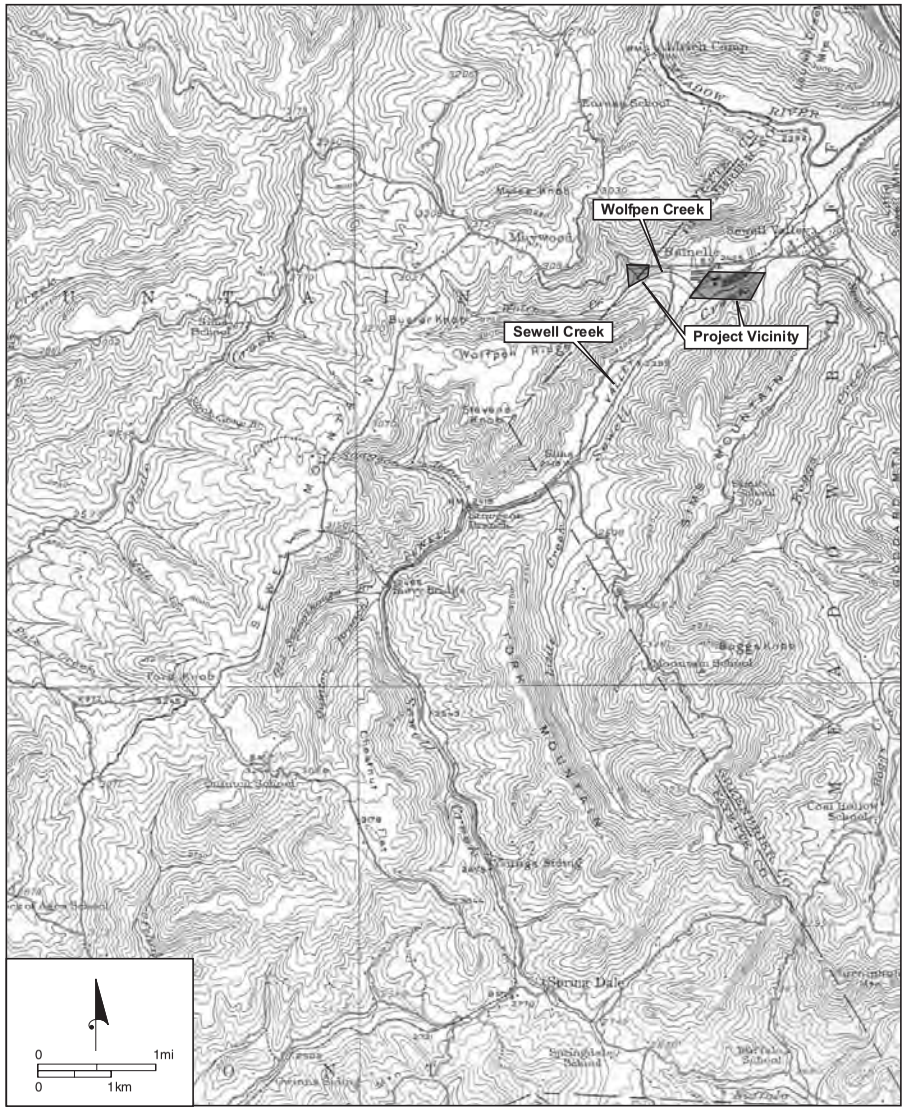


Figure 5. Detail of *Meadow Creek 15 Minute Quad* (USGS 1912), showing proposed project vicinity for Rainelle Study Area.



Figure 6. Detail of *Richwood 15 Minute Quad* (USGS 1939) and *Clintonville 15 Minute Quad* (USGS 1923), showing proposed project vicinity for Anjean Study Area.

Appendix G2

Appendix G2



Figure 8. Overlay of Meadow River Lumber Company (ca. 1930's) with plant site location.



Plate 13. View of former Fire Pump House adjacent to old Log Pond, facing north.



Plate 14. View of former Railroad Depot, facing west.



Plate 15. View of former Bank Building, facing east.



Plate 16. View of the United Methodist Church (1914), facing northwest.



Plate 17. View of the John Raine House, facing northwest.



Plate 18. View of the King Coal Hotel, facing southeast.

4.0 CULTURAL AND HISTORIC CONTEXT

4.1 PREHISTORIC CONTEXT

The prehistory of West Virginia reflects the developmental patterns established for eastern North America. It shares similar cultural manifestations and demonstrates affinities with the general Appalachian region, but cultural relationships are most similar to those that characterize the Middle and Upper Ohio River zone (Eddins 1980). While several generalized cultural sequences for the Upper Ohio Valley have been proposed (e.g. Griffin 1967), the earlier work of Mayer-Oakes (1955) provides a more localized chronology for the region. This sequence remains viable in the region, although more recent investigations and radiocarbon dates have refined temporal ranges in the years since Myer-Oakes first published his findings (Johnson n.d.).

4.1.1 THE PALEO-INDIAN PERIOD (10,000 TO 8,000 B.C.)

Although the temporal range of the Paleo-Indian period is the subject of much debate throughout North America, the available evidence suggests a range of approximately 10,000 to 8,000 B.C. for Paleo-Indian occupations in West Virginia. Of the excavated Paleo-Indian sites in the region, the Thunderbird Site Complex, located approximately 70 miles east of Seneca Rocks in the Shenandoah Valley of Virginia, has contributed extensively to our understanding of the Paleo-Indian period in the region.

Research to date indicates that the Central Appalachian Uplands were not extensively occupied by these early prehistoric peoples. This assertion rests on the paucity of fluted points reported for the uplands (Wilkins 1977). Two fluted points have been reported from a site on the Upper North Fork, within the Monongahela National Forest (Brashler et al. 1987). Another find, described as the basal section of a possible fluted point, was reported from an excavation 18 miles northwest of White Sulphur Springs (Brashler 1984). In the absence e of deliberate investigations that focus on higher probability areas like rock shelters or buried sediments, it is unlikely that Paleo-Indian sites amounting to much more than random surface finds will be identified.

Although evidence of Paleo-Indian occupations in other areas of West Virginia (e.g., along the Kanawha and Ohio rivers) and surrounding states is more extensive, Broyles (1967) reported several surface finds of fluted points in areas neighboring the Monongahela National Forest, and Anslinger reported surface finds of Paleo-Indian artifacts from Boone and Nicholas counties. Large numbers of fluted points have been reported from the Ohio River Valley and its tributaries in western West Virginia, including the Tygart and Monongahela drainages (Wilkins 1977; Wall 1981), and Dalton-like projectile points have been recorded in Braxton County (Fitzgibbons et al. 1980:194). Regardless of the actual number of Paleo-Indian points, the evidence indicates human occupation within the Appalachian Plateau and Appalachian Mountains was not as intensive as Paleo-Indian occupations in southeastern United States or the Middle Atlantic region.

Research in western Pennsylvania corroborates the lack of a Paleo-Indian presence in the uplands. Of a total of 210 Paleo-Indian loci in 23 counties, only 12 were found in upland locations. Paleo-Indian sites in the uplands of Washington and Allegheny counties were found on benches above springs, suggesting these sites were utilized as temporary bivouac or habitation loci (Lantz 1984).

4.1.2 THE ARCHAIC PERIOD (8,000 TO 1,000 B.C.)

The Archaic period in West Virginia, as in the eastern United States in general, lasts from approximately 8,000 to 1,000 B.C. This cultural period is commonly divided into three subdivisions: the Early Archaic (8,000 to 6,000 B.C.), the Middle Archaic (6,000 to 3,000 B.C.), and the Late Archaic (3,000 to 1,000 B.C.). Some researchers suggest, however, that the Late Archaic is further subdivided by the presence of a Transitional or Terminal Archaic period, which lasted from approximately 2,000 to 1,000 B.C., or later in some instances (Turnbaugh 1975).

Cultural developments during the Early Archaic period represent, in part, responses to dramatic climatic changes associated with the retreat of glacial ice at the end of the Pleistocene, the extinctions of a variety of Pleistocene floral and faunal species, and the subsequent emergency of new species. Hunters and gatherers demonstrated their ability to adapt to these changes as witnessed by the emergence of a more broad-based subsistence economy and the development of new tool and projectile point technologies. Evolving settlement-subsistence patterns reflect the exploitation of seasonally available resources. Stylistic changes and shared technological innovations may also indicate emerging territoriality and concomitant interaction between various aboriginal groups.

The St. Albans Site, located along the Kanawha River in Kanawha County, West Virginia, has produced a stratified series of Archaic projectile points, tools, and a radiocarbon sequence ranging from approximately 8,000 B.C. to 6,000 B.C. Early Archaic point types recovered from St. Albans include Kessell Site-Notched; Charleston Corner-Notched; Kirk Corner-Notched, including the small variety of Palmer corner-notched type (Justice 1987); MacCorkle Stemmed, St., Albans Side-Notched; LeCroy Bifurcate; and Kanawha Stemmed. In addition to the projectile points, the artifact inventory includes drills, knives, scrapers, blades, hoes, gouges, worked fling fragments, hammerstones, and hematite (Broyles 1971). Early Archaic occupations were also recorded on ridge tops and knolls, adjacent to springs or heads of streams in Braxton County. Broyles et al. (1975) interpreted these sites to be short term occupations related to hunting and gathering activities.

Although significant quantities of Archaic artifacts have been recovered from the uplands of West Virginia, no stratified sites have been recorded or excavated in the area (Brashler et al. 1987). With the exception of the Dennison Site (46 LG 16), a mountaintop site located in Logan County (Moxley 1982), few upland sites have produced diagnostic artifacts that span the Early Archaic period. In southeastern West Virginia, the Mill Pond site near Greenville in Monroe County produced a variety of Early Archaic points from a surface collection (Broyles 1964). Point types included specimens that fall within the Kirk Corner Notched Cluster and the LeCroy Cluster. Broyles (1964) also reported artifacts similar to the Mill Pond assemblage were collected from two surface sites in Summers County by an avocational archeologist. Elsewhere, Kirk, MacCorkle-like, and bifurcate points (LeCroy) have occasionally been reported from upland settings within the Monongahela National Forest (Brashler 1984).

The Middle Archaic in West Virginia is generally placed between about 6,000 and 3,000 B.C. On the basis of available evidence, it is generally agreed that social, economic, and technological adaptations initiated during the Early Archaic continued and intensified during the Middle Archaic period. For example, the Middle Archaic period is characterized by a more intensive exploitation of diverse habitats (uplands, valleys, rivers, etc.) which is accompanied by the utilization of a wider variety of raw materials for tool production. The toolkit is also characterized by a dramatic increase in woodworking and plant processing tools. These tools include axes,

adzes, celts, choppers, nutting stones, mortars, and pestles. The archaeological record of the Ohio Valley, and the eastern United States in general, indicates that this period witnessed the emergence of regional differences which may have developed in response to the significant changes in the environment that were associated with the warm, moist climatic "optimum" which occurs at this time.

The Hansford Site (46FA104), located on the Kanawha River in Fayette County, West Virginia, produced a series of projectile points that are considered typical of the Middle Archaic in the region (Wilkins 1977). This inventory includes Stanly points (5,700-5,000 B.C.); Morrow Mountain points 5,000-4,000 B .C.); and Guilford Lanceolates (5,000 and 4,000 B.C.) (Coe 1964). Wilkins (1977:123) has noted that the frequency of Middle Archaic points on upland sites in Boone County is significantly less than those reported from the Early and Late Archaic. Similar low frequencies of Middle Archaic point types were reported by Broyles et al. (1975:91) and Fitzgibbons et al. (1980) in the Burnsville Reservoir area of Braxton County.

More recent work at the Hansford Site yielded evidence of a Middle Archaic notched point tradition for the Kanawha Valley (Wilkins 1985). Based on the suggested placement of these points at ca. 4,600 B.C., Wilkins suggests that these points are affiliated with the Midcontinent Tradition of the Ohio Valley rather than the Morrow Mountain-Guilford Tradition of the Carolina Piedmont, as defined by Coe (1964). Differing cultural traditions may therefore occur in the upland areas of West Virginia during the Middle and Late Archaic (Wilkins 1985:22).

The suggested range for the Late Archaic in West Virginia extends from approximately 3,000 to 1,000 B.C. Hunting and gathering strategies similar to those of the Early and Middle Archaic continue to be employed through this period, but evidence suggests a shift toward more intensive exploitation of certain wild floral species. This emphasis on plant foods is suggested by (1) the increased incidence of mortars, pestles, and plant processing tools on Late Archaic sites, (2) the increased number of sites in riverine settings, and (3) the increased number of hearth and pit features at sites from this period. In southeastern West Virginia, Wilkins (1978) has documented a number of Late Archaic sites in rockshelters as well as bottomland sites. The variety of site types, in conjunction with their extent and quantity, suggests a possible increase in population and/or functional specialization of sites. It is also during this period that more sedentary lifestyles begin to emerge and population increases. These changes, accompanied by the development of more pronounced regional differences, may be indicative of the social evolution from band level to tribal level social organizations.

Diagnostic artifacts identified with the Late Archaic in West Virginia include a wide variety of notched and stemmed points. Archeological surveys and excavations in the Kanawha Basin have produced Brewerton Side-Notched, Brewerton Eared-Notched, Hansford Corner-Notched, Hansford Concave Base, and an assortment of stemmed projectile points. The Hansford Site has produced several of these point types in association with hearths that yielded radiocarbon dates of 3,700-3,600 B.C. (Wilkins 1977). The Burnsville Reservoir surveys produced a substantial quantity of Late Archaic stemmed points. Other point types recorded in the course of these surveys included Brewerton and Lamoka-like forms. Late Archaic projectile points recovered from the Burnsville survey area include Buffalo Straight and Expanded Stemmed types and Steubenville Stemmed forms which may date toward the end of this period (Fitzgibbons et al. 1980). Savannah River points are relatively common in southeastern West Virginia, and Fitzgibbons et al. (1980) suggest that their presence indicates a possible affinity with the Savannah River Phase of the Carolina Piedmont.

The Transitional Archaic period is not well defined for West Virginia. With the exception of new point styles and the addition of sandstone and soapstone vessels to the artifact inventory, the lifestyle of Transitional period groups seems to have been an extension of an essentially Late Archaic system. Among the point types considered to be diagnostic of the Transitional Archaic period are Orient Fishtail-like points, Perkiomen points, Susquehanna Broad points, Snook Kill points, Lehigh Broad points, and Dry Brook points. Evidence for a shift to an extensive reliance on cultigens is lacking although riverine resources were intensively exploited by these groups.

Wilkins (1977) suggested the appearance of stone bowls at these loci indicated a greater degree of stability and permanence (Wilkins 1977). More recently, Klein has suggested that the use of steatite vessels during the terminal Late Archaic was primarily for ceremonial or ritualistic events and that the use of these vessels served to solidify social relationships across regional boundaries and perpetuate group identity. Fitzgibbons et al. (1980) and Wilkins (1977) have both noted that artifact frequency for the Transitional Archaic period shows a marked decline relative to the incidence of artifacts associated with the Early and Late Archaic periods. Wilkins (1977) asserts that this apparent decline is related to the strict focus on exploiting riverine environments, to the virtual exclusion of others, at this time. As a result, many sites from this time period remain undetected as they lie buried beneath one or more feet of alluvial sediment.

4.1.3 THE WOODLAND PERIOD (1,000 B.C. TO A.D. 1000)

The Woodland period in West Virginia is placed between 1,000 B.C. and A.D. 1000. Distinguished from the Archaic period by the appearance of ceramics and by an economy increasingly dependent on the exploitation of cultivated plants, the Woodland period represents a dramatic change from the broad spectrum hunter/gatherer populations of the preceding period. The increasing role of cultigens in the subsistence base fostered a greater economic stability. The declining dependency on seasonal residential movements in combination with a more stable subsistence base encouraged population growth, which in turn produced larger and more permanent settlements. The emergence of these new economies was accompanied by the appearance of distinct social hierarchies and class stratification, elaborate mortuary rituals, pubic works, and the development of extensive trade networks.

The Early Woodland period in West Virginia, dated between 1,000 B.C. and A.D. 100, is distinguished by the emergence of the Adena complex, which was centered in the Middle Ohio Valley and extended into the Kanawha River Valley of West Virginia. The Adena complex is characterized by the appearance of Fayette Thick and Marion Thick pottery, stemmed point types, large earthen burial mounds, blocked-end tubular pipes, and variously shaped stone and copper gorgets. These people lived in small villages and hamlets that were dispersed on floodplains, river terraces, and uplands in proximity to major drainages. Although domesticated squash is present by ca. 800 B.C. and domesticated corn by ca. 400 B.C. (Carlisle and Adovasio 1982), the relative importance of these cultigens in the economic system of these people remains a question.

No Early Woodland mounds or sites are reported from the immediate vicinity, but Solecki (1949) reports on several mound sites and rockshelters in the New and Greenbrier valleys. Sites reported by Solecki (1949) in Summers County along the New Rive include Hinton Mound, Hinton Bridge Mound, Richmond Mound, and the Buffalo Rockshelter. Also in southeastern West Virginia, Fayette Thick pottery has been reported from the Pence Springs site (O'Malley 1985). Brashler et al. (1987) suggest that the absence of Early Woodland inhabitants in this area may a result of their more conservative nature. That is, people in this part of the state remained hunter/gatherers and were only marginally affected by the socio-economic and technological developments to the

west. Concomitantly, the absence of these diagnostic artifacts potentially renders Late Archaic and Early Woodland occupations virtually indistinguishable from one another.

The Middle Woodland period lasts from approximately 100 B.C. to A.D. 600, while the Late Woodland period persists between A.D. 600 to A.D. 1200. The Middle Woodland period is best known for the Hopewell Culture which evolved from and superseded the Adena Culture. Hopewell influences can be traced across a large portion of the eastern United States and are identified with the construction of extensive earthworks, large burial mounds, and elaborate mortuary practices. Hopewell groups also possessed a high level of technology and art as expressed in the quality of their tools and grave goods. The distribution of these goods indicates the presence of a sophisticated trade network and widespread stylistic influences. These characteristics are generally considered to represent evidence of a ranked social organization, but Ford (1979) asserts that the notion of ranked societies during the Hopewell period is not universally accepted.

In West Virginia, the Upper Ohio Valley has the best documented cultural sequence during these time periods. Two related complexes, Fairchance and Watson, have been incorporated by Hemmings (1984) into the "Watson Tradition," a ceramic complex which spans the Middle and Late Woodland periods. The earlier Fairchance Phase is radiocarbon-dated between A.D. 120 and A.D. 420 and may persist as late as A.D. 660, based on the dated Watson component at the Hughes Farm site (Maslowski 1985). Hopewellian influences are evidenced in the form of small but significant quantities of exotic flint, copper, and marine shell ornaments, and mound burial. The physical type at the Fairchance Mound and Village Site is said to be Hopewellian as well (Hemmings 1984). Subsistence needs were met chiefly by hunting and gathering, with settlements consisting of large hamlets located along small streams and small camps, hamlets, and rock shelter occupations on terraces and in the uplands (Maslowski 1985). The Watson Phase appears to date between about A.D. 500 and A.D. 1000. Mound building and burial ceremonialism appears to decrease. There appears to be a gradual shift to larger, more densely occupied sites located on high terraces adjacent to major waterways such as the Ohio River. Watson Phase sites also include hamlets which are located on both bottomlands and uplands (Maslowski 1985). An increasing reliance on cultivated plant foods may characterize the subsistence regime at this time.

In southeastern West Virginia, a comparable sequence occurs in the Kanawha Valley and extends into southern and central West Virginia (see Fitzgibbons et al. 1980). The Middle Woodland manifestation has been termed the Armstrong Phase (McMichael 1968) and demonstrates a mix of Adena and Hopewell characteristics. Shale-tempered Armstrong pottery appears quite early and is contemporary with Adena, lending ambiguity to the nature and extent of this phase (Hemmings 1985). Unfortunately, no village sites have been found, although numerous small open sites and rock shelters have minor Armstrong components. The Hoke Mill site on Second Creek in Greenbrier County has been identified as Middle Woodland (Wall 1989), and excavations by Ison et al. (1985) at the Spring site in Summers County produced a radiocarbon date of A.D. 310 in association with Armstrong ceramics and Snyders and Jack's Reef points.

The succeeding Buck Garden Phase, which spans the late Middle Woodland and the early Late Woodland, has been dated between ca. A.D. 700 and A.D. 1200 (Maslowski 1985:27; Wilkins 1979; Railey and Henderson 1986). McMichael (1968:26-27) suggests that the preceding Armstrong Phase gradually changed into the Buck Garden Phase. More recently, Fuerst (1988) has divided the Late Woodland in southeastern West Virginia into an early Schoolyard Phase (A.D. 500-800) and a late Buck Garden Phase (A.D. 800-1200). McMichael (1968:27) reports that Buck Garden pottery is tempered with crushed rock (generally chert or sandstone). However,

Buck Garden pottery from the Green Sulphur Spring site is predominantly limestone tempered (Henderson 1986). Diagnostic lithic artifacts include Chesser Notched, Lowe Flared, and Levanna, Madison, and Hamilton triangular points. Hamlets and camps appear along the Kanawha and other major rivers, but no large, nucleated settlements with which these sites can be associated have been discovered. McMichael (1968) believes that people associated with the Buck Garden phase were driven out of the Kanawha Valley, probably by Fort Ancient people, by A.D. 1200.

4.1.4 THE LATE PREHISTORIC AND CONTACT PERIOD (A.D. 1000 TO A.D. 1780)

The Late Prehistoric period is characterized by the emergency of a fully horticultural subsistence system, augmented by seasonal hunting and gathering, the manufacture of shell-tempered pottery and the utilization of small triangular arrow points. The developmental trend to a nucleated settlement pattern is manifested in permanently occupied villages, which demonstrate a tendency to be fortified through time. However, the dominant Late Prehistoric groups of this region, the Monongahela and Fort Ancient cultures, lack the complex settlement hierarchy that is characteristic of more culturally complex Mississippian populations to the south and west. In fact McMichael (1968) points out that in more remote parts of central and eastern West Virginia a Woodland lifestyle persisted for several centuries. Fort Ancient cultures are generally defined by three important traits: (1) increased reliance on agriculture, (2) increased sedentism, and (3) a rise in socio-political complexity (Orr 2002). However, within West Virginia, Fort Ancient (and Monongahela) cultures lacked the attendant socio-religious hierarchy associated with Mississippian temple-mound communities to the south and west. Instead, Fort Ancient and Monongahela villages appear to be more self-sufficient, with social interaction more characteristic of tribal level societies.

As noted above, two distinct Late Prehistoric cultural expressions occur in West Virginia, namely Monongahela and Fort Ancient. In the Upper Ohio Valley (i.e., the panhandle of northern West Virginia, southeastern Pennsylvania, and the Upper Monongahela drainage in West Virginia), the local Watson Phase groups gradually develop into Monongahela. Their large, circular, nucleated villages are located on high bottomlands near major rivers or on saddles and hilltops, often at a great distance from water. Smaller hamlet-like and special purpose sites have rarely been documented, much less excavated, leaving a gap in our present knowledge. Several phases have been proposed for southwestern Pennsylvania, with the earliest components recognizable as Monongahela beginning as early as A.D. 900 (George 1983).

Fort Ancient sites tend to be located south and west of the Monongahela "Core" on portions of the Ohio and Kanawha rivers in West Virginia. Several alternative models to account for the Fort Ancient presence in West Virginia have been advanced. One model suggests that Fort Ancient was derived from local Late Woodland antecedents at a relatively early date (Graybill 1980). Based on a lack of evidence for early intrusions and the resemblance of early Monongahela and Fort Ancient pottery, it has been argued that terminal Middle Woodland/early Late Woodland groups in both the Middle and Upper Ohio Valleys participated in a common ceramic tradition with its center in the Middle Ohio Valley around the mouth of the Kanawha. Each area or phase developed elements of this stylistic tradition in a uniquely local fashion (Johnson 1981). More recently, it has been suggested that the Feurt-Clover continuum can be derived from the Buck Garden Phase centered in the Upper Kanawha drainage (Graybill 1984). However, the prevailing view is that Fort Ancient represents a late intrusion into West Virginia (Mayer-Oakes 1955) which began in the Lower Ohio and gradually moved upstream to the Kanawha River (Maslowski

1985). Mississippian influences are consistently stronger among Fort Ancient groups than Monongahela groups.

Graybill (1988) has identified three interrelated Fort Ancient complexes in the Plateau Area of West Virginia. These complexes are Mount Carbon (A.D. 1050-1700?), Bluestone (A.D. 1200-1500), and Woodside (A.D. 1500-1630). Graybill (1988) argues that the Bluestone complex and other early Fort Ancient sites in the area developed from local Late Woodland populations such as Buck Garden. Conversely, others suggest that the Bluestone complex represents a mixing of traits from the Roseberry Phase (A.D. 1050-1250) of the lower Kanawha Valley and Virginian-Siouan traits. Within the Plateau area, Fort Ancient ceramics are both shell tempered and limestone tempered, and projectile points are triangular for the most part. Available evidence suggests that habitation loci were concentrated in the river valleys, while the uplands were exploited primarily for hunting and the procurement of other special resources. Rock shelters and hunting camps that were heavily used as hunting and gathering stations during the Middle and Late Woodland appear to be used less frequently or for a more limited suite of activities, perhaps primarily as hunting camps. Given a consistent lack of ceramics from upland sites, definitive cultural associations may be difficult, it not impossible, to make.

The Contact Period is marked by the presence of trade goods at Late Prehistoric archaeological sites. The presence of trade goods often only indicates limited, if not indirect, contact with European populations. Sites from this period reflect a continuation of Fort Ancient village patterns (i.e., fortified villages along major rivers) and a subsistence based on plant domesticates such as maize, squash, beans, and other cultigens, supplemented by hunting, fishing, and gathering. Principal trade items included glass beads, iron axes and ploughs, knives, and copper and metal ornaments. The first attempts to explore and settle the wilderness of the trans-Allegheny region of Virginia occurred in the late seventeenth century. These efforts were, for a time, successfully resisted by Native American groups like the Susquehannock. Between 1763 and 1780, representatives of the British and American governments negotiated a series of treaties with the Cherokee and Iroquois Confederacy that gave Euro-Americans right of access to increasingly larger portions of the trans-Allegheny frontier. By 1780, Native American groups had forfeited all legal claims to the region which would become West Virginia (Rice 1986).

4.2 HISTORIC CONTEXT

4.2.1 EARLY SETTLEMENT AND FRONTIER FORTS (1700–1783)

The earliest European explorers to reach Greenbrier County was an expedition organized by Colonel Abraham Wood, a fur trader, and led by Captain Thomas Batts and Robert Fallum in 1671 (Rice 1986). The Batts-Fallum expedition reached present-day Alderson via a series of Indian trails and proceeded to cross the New River. Rice (1986) reports that two major Indian trails traversed Greenbrier County in the late seventeenth and early eighteenth centuries. The Seneca Trail, which linked the Cherokee and the Iroquois League of Nations, traversed the state in a north/south route and more or less followed US 219 through the county. The Kanawha Trail or Buffalo Trail traversed the state in an east/west direction and connected the Ohio Valley and the Great Valley of Virginia. These two historic trails crossed in Greenbrier County near Lewisburg. At this time, most of West Virginia served as a buffer zone between the Iroquois Confederacy, Cherokee, Mingo, and Shawnee tribes and was used as common ground for hunting, trading, and the like.

European settlement of what is now Greenbrier County began in the 1720s and 1730s as immigrants from Pennsylvania and Virginia were encouraged by the British government and the Virginia assembly to settle in the fertile valleys west of the Allegheny Mountains. The British government wished to strengthen the colonies' western defenses and offered up to 100,000 acres in land grants as long as one non-Virginia family settled every 1,000 acres (McBride et al. 2003). Ironically the first application for a land grant in the area was denied because the Virginia assembly believed the land was too isolated and the risk of Indian attack too great. However, in 1745 portions of present-day Greenbrier, Monroe, and Pocahontas counties were opened for settlement by the Greenbrier Land Company, which received a land grant for 100,000 acres. Settlers quickly moved westward, including Henry Baughman, namesake of Baughman's Fort, who received a grant for 780 acres south and west of Alderson, near the mouth of Muddy Creek (Dixon 1967). Stephen Sewell (namesake of Sewell Creek and Sewell Mountain) and Jacob Marlin founded Marlinton along the Greenbrier River in what is now Pocahontas County in 1749, and settlers moved in the Meadow River valley as early as 1758 (Anonymous 1972). Sewell and Marlin's partnership dissolved and Marlin returned to Virginia, while Sewell relocated in the vicinity of Sewell Creek and the Meadow River (near present day Rainelle). Sewell later encountered hostile Indians along the New River and was killed in a skirmish.

Between 1750 and the end of the Revolutionary War, western Virginia was marked by unceasing hostilities between the Euro-American settlers and various Indian tribes, that more often than not were either supported or encouraged by the French. In order to secure their western defenses and continue to encourage settlement in the area, the Colonial government constructed a series of forts along major drainages (McBride and McBride 1991, 1993; McBride et al. 2003). Three short periods of fort construction are identified by McBride et al. (2003). They are as follows: (1) 1755-1756, the French and Indian War; (2) 1774-1782, Lord Dunmore's War and the American Revolution; (3) 1786-1791, US efforts to claim and dominate lands north of the Ohio River (McBride et al. 2003). The forts were part of a defensive system that included a military presence, offensive campaigns, and government-sponsored peace negotiations. This system, established during the French and Indian War, was fine-tuned over time and allowed for the colonization and conquest of a rugged and disputed territory that eventually became the State of West Virginia.

Only two forts were constructed in the vicinity of Greenbrier County during the French and Indian War. Baughman's Fort (or stockade), constructed near Alderson in Summers County at the mouth of Muddy Creek, was attacked by Indians during the summer of 1755. The other fort constructed at this time was Marlin's Fort, in present-day Marlinton (Pocahontas County), near the confluence of Knapp Creek and Greenbrier River. Between 1770 and 1782, many forts were constructed in what is now West Virginia (McBride and McBride 1991). The list includes forts on the Potomac, Monongahela, Greenbrier, New, Tygart, Kanawha, and Upper Ohio rivers. Several forts were built within Greenbrier County, including Arbuckle's Fort (Keeny Fort) built in 1774 at the confluence of Muddy Creek and Mill Creek, Donnally's Fort, McClanahan's Fort, McCoy's Fort, Fort Savannah (Fort Charles) built perhaps as early as 1755 near Lewisburg, Renick's Fort, and Stuart's Fort, built in 1774 near Fort Spring (GAI 2000; McBride et al. 2003). Archeological investigations by McBride et al. (2003) have demonstrated that residential forts, such as Donnally's Fort, produced more artifacts and a higher percentage of ceramics, especially compared to architectural artifacts, than the non-residential forts such as Arbuckle's Fort, Fort Savannah, and Stuart's Fort, which historical and archeological data indicate were occupied on a more intermittent basis (McBride et al. 2003). Arbuckle's Fort was built by Captain Matthew Arbuckle in the spring of 1774, and later that year Captain Arbuckle and his men directed Colonel Andrew Lewis and his troops to Point Pleasant at the mouth of the Kanawha River, where they defeated the Indian Confederacy in the climatic battle of Lord Dunmore's War.

4.2.2 *GREENBRIER COUNTY, FORMATION AND PROSPERITY (1778–1860)*

Greenbrier County was formed from Botetourt County in 1778. Initially, Greenbrier County extended from the current Virginia-West Virginia state line on the east to the Ohio River on the west, and included all or parts of Greenbrier, Monroe, Summers, Pocahontas, Fayette, Nicholas, Webster, Clay, Kanawha, Putnam, Roane, Jackson, and Mason counties. As settlement continued and population increased, other counties were formed from the original county. Fort Donnally was attacked by a group of Wyandot and Mingo warriors in 1778, but as the war continued, the British were forced to withdraw their troops from the area and their support of Indian raids on the western frontier. After 1782 no British attacks occurred within the Greenbrier Valley (CRI 2002). The first courthouse was erected in Lewisburg in 1782, and it remains the county seat today.

By 1790, at least a dozen gristmills were operating within the county (CRI 2002). During the late eighteenth and early nineteenth century, Virginia, including what was to become West Virginia, experienced an agrarian transformation from a tobacco-based plantation economy to a more diversified grain-based economy. The grain-based economy (and later a secondary dairy industry) characterized the area for the next 100 or more years. Between 1790 and 1820 as many as 250,000 Virginians (and perhaps as many as 150,000 slaves) moved from the older settled parts of the state to the newly opened western and southwestern frontier. During this time, Greenbrier County became the home of both high-status planters and small subsistence farmers. Despite the increased number of settlers, the county retained its agrarian character.

White Sulphur Springs was known for its healing effects by as early as 1778, though local county lore claims the springs were visited much earlier by the Powhatan Indians to help cure rheumatism (CRI 2002). White Sulphur Springs was widely known for its healing properties and by as early as 1815 the resort was known as "The Old White." By the 1830s the resort was popular with both northern aristocrats and southern plantation owners.

Improved transportation routes were critical in order to move the county's agricultural products to markets in the east. In 1821 construction began on the James River and Kanawha Turnpike and the route between Lewisburg and Charleston was completed by 1824 (Figure 4). Today, US 60 closely follows the route of the old turnpike. The James River and Kanawha Turnpike helped to promote commerce and Thompson's Tavern (Inn) was built in the 1830s just west of Rainelle (Anonymous 1972). The development of steam locomotion and the construction of railroads, beginning in the 1840s, proved to be the demise of overland turnpikes and canals. The fertile valleys of the area proved to be conducive to the growth of corn and other grain crops, and along with dairy cattle, sheep, and horses, the region quickly became an important source of food to support the ever-increasing industrial population along the east coast. In 1855 Virginia authorized the construction of the Covington and Ohio Railroad across the Allegheny Mountains. It was decided that the railroad would be routed through Greenbrier County in order to serve White Sulphur Springs. Railroad construction was halted during the Civil War.

4.2.3 *CIVIL WAR YEARS (1861–1865)*

At the outbreak of the Civil War, Greenbrier County immediately raised troops for the defense of Virginia and the Confederacy. Although small skirmishes occurred in the eastern valleys, the whole of the county was largely untouched. However, by the winter of 1861 and 1862, more than 1,500 wounded Confederate soldiers were hospitalized at White Sulphur Springs. Between the spring of 1862 and late summer of 1863, Greenbrier County was the site of three battles. The first battle, the Battle of Lewisburg, occurred in May, 1862. The Federal Mountain Department, under

the command of General John C. Fremont, was tasked with protecting Federal rail lines and destroying the Confederate rail lines. To that end, Colonel George Crook and 1,400 Ohio troops passed through Lewisburg on their way to cut the Confederate Virginia Central Railroad near Covington. Upon hearing that Confederate troops were massing on his rear to attack, Crook quickly retreated to Lewisburg. Confederate forces attacked his position, but under the Federal counter-attack, the untested Confederates broke rank and fled. Throughout 1862 Federal troops maintained control over most of the western counties of Virginia. Although forces loyal to the Confederate cause continued to control Greenbrier County, most of the western counties maintained allegiance to the Union.

Although Federal forces assumed control of the western counties, Greenbrier County continued to contribute men, materials, and animals to the Confederates. The county also provided General Robert E. Lee with his famous mount, "Traveler"; the horse was presented to General Lee as a gift while he visited the White Sulphur Springs area. The second major engagement in Greenbrier County occurred in the spring of 1863 at Tuckwillers Hill, two miles north of Lewisburg (Orr 2002). During this battle, Federal troops were forced to withdraw. However, by June of 1863, Greenbrier County and the western counties of Virginia succeeded from the Commonwealth of Virginia and formed the State of West Virginia, which maintained allegiance to the United States. The final battle within Greenbrier County is known as the Battle of White Sulphur Springs, or the Battle of Dry Creek, and occurred in August, 1863. Federal forces, under the direction of General Averell, attacked the Confederate troops that consisted of infantry, light cavalry, and some artillery. Averell's forces attacked the Confederate lines four times over a two day period but were unsuccessful in moving the Confederate troops. With no reinforcements coming to his aid, Averell ordered his men to retreat and the Confederates refused to pursue. Wounded soldiers of both the Union and Confederate troops were hospitalized at White Sulphur Springs during and after the battle. Although this was the last major battle in the county, the entire countryside felt the affects of the war for years to come. The constant troop movement and occupation throughout the region and the ravages of war took a heavy toll on agricultural crops and fields, livestock, horses, draft animals, and forests. In addition, the loss of manpower and the destruction of the infrastructure (railroads and roads) coupled with high property taxes that most families could not pay served to pave the way for the reconstruction era.

4.2.4 *RECONSTRUCTION YEARS (1865–1890S)*

The years following the Civil War were difficult times throughout the south and West Virginia, despite siding with the Union, was no exception. The loss of manpower, neglect of agricultural fields, loss of livestock and draft animals, disruption (or in some cases destruction) of transportation networks, plummeting property values, and the emancipation of slaves combined to have a deleterious effect on the economic and social landscape in post-War West Virginia. Gradually, the economy improved as fields were cleared and planted, livestock were replaced, and infrastructure was rebuilt. By 1873 the Chesapeake and Ohio Railroad had been constructed through Greenbrier County and other roads were rebuilt. During the first half of the reconstruction era, the county remained largely agrarian, and various organizations (e.g., Grange or Patrons of Husbandry) were formed to assist farmers to restore their land and curb erosion. Farmers continued to change crops and crop rotation cycles as new methods of agriculture were introduced to the area. Many farmers began the transition from grain crops to dairy farming and market gardening, in part as a response to infrastructural improvements. By 1880 the population in the county had grown to 15,000 (CRI 2002). Despite efforts to rebuild the infrastructure of the region, the economic recovery was slow to develop. The farmers in Greenbrier County and elsewhere in the region sought alternative methods of income. The solution for many was to sell

off their timber or their land to timber moguls. The timber industry began on a large scale as early as 1882 in some parts of the county, but within the project area the timber industry did not begin until the first decade of the twentieth century. Despite these new endeavors, Greenbrier County was still more than 80% agrarian into the 1890s.

4.2.5 THE ECONOMIC BOOM YEARS (1890S–1930S)

The industrial period from the late 1880s to the early 1910s saw a major transformation not only across the eastern United States and Great Lakes region, but also within West Virginia. The initial transformation in West Virginia was triggered by a change in the lumber industry from small-scale local or portable saw mills that selected only the finest timber for cutting to a huge factory-based industry that consumed entire forests within a few years and employed as much as 100 people or more. The expansion of the railroad industry provided the precipitance. As the steel industry continued to grow rapidly in cities like Pittsburgh, Detroit, and Chicago, the demand for coal also increased, and as coal fields in Ohio and Pennsylvania were exhausted, new mines opened in West Virginia and Kentucky. In order to tap these new, high-quality coal reserves, it was necessary to expand the railroad network throughout the area. Consequently, numerous railroad and/or coal companies began to lay rail lines into West Virginia. This in turn allowed the timber industry to exploit the vast stands of yellow pine and mixed hardwoods that covered most of the Appalachian Plateau and the Allegheny Mountains. The Chesapeake and Ohio Railroad (C&ORR) was the first company to construct new lines in the county. In 1896 and 1897, the C&ORR began surveying possible rail lines up the Greenbrier Valley, and construction began in the summer of 1899 for a line running from Caldwell in Greenbrier County to Marlinton in Pocahontas County. Rail service began in October of 1900 and by May of 1902 the line extended all the way to Durbin at the north end of the valley. The C&ORR also extended a line through Ronceverte, west of Caldwell by 1902. With the railroad infrastructure in place, the timing was right for the timber industry to take advantage of the virgin forests that covered much of the county. As noted previously, this area was dominated by a mixed mesophytic forest that included a variety of hardwood species in addition to yellow pine. Prominent tree species included hemlock, various oak, chestnut, yellow or tulip popular, ash, and spruce. After the trees had been removed (essentially clear-cut) in one area, the cutters moved to harvest the trees in another area. Within Greenbrier, Nicholas, and Fayette counties, coal was not exploited on a widespread basis until the 1920s and early 1930s. For the most part, the coal fields, like the forests, were exploited, exhausted, and abandoned within 10 to 20 years, or 30 years at most.

4.2.6 RAINELLE AND THE MEADOW RIVER LUMBER COMPANY (1906–1970)

The early histories of Rainelle and the Meadow River Lumber Company (MRL) are intertwined with the lives of Tom and John Raine. Tom Raine (1851-1933) and John Raine (1863-1940), both born in southern Ohio, had experience in both logging and railroads prior to starting the MRL and the Meadow River Coal and Land Company (MRC&L) in 1906. Tom worked in the construction of railroads during his early years before moving into the logging business in the 1870s and 1880s in Pennsylvania, and John worked in a logging camp at the age of 13. In 1892 the brothers formed a partnership under the name Raine and Raine in Rainetown, Pennsylvania (Collins 1999; Bagdon 2002). Based on the success of their work in Pennsylvania, the Raine brothers, with the backing of F.L. and W.M. Andrews (sons of a wealthy and influential banker), purchased land tracts in Randolph County, West Virginia, and the Raine and Andrews logging company started businesses at Gladwin (1901-1906) and Evenwood (1904-1922). These operations were so successful that the Raine's, again with financial support from the Andrews brothers, sought an even larger tract of virgin hardwoods in order to start another business venture (Bagdon 2002).

The Raine's purchased 32,000 acres of virgin hardwood forest (the Beury Tract) on Meadow River. The land was available for sale because the former owners believed the timber was inaccessible and did not envision any railroads extending service to the area for many years.

The MRL and the MRC&L were chartered on June 6, 1906. The Raine brothers selected the site for the new mill and the town at the confluence of Wolfpen Creek and Sewell Creek, just upstream from the mouth of Sewell Creek and the Meadow River. Initially, the charter members were hopeful that the C&ORR would extend a railroad up the Kanawha Valley to the Meadow River basin that would connect with Ronceverte or Alderson, but after two years of waiting, the organization realized that it would be up to them to build a railroad into the middle of nowhere. Thus, their first order of business was to build a railroad feeder line to connect the mill to the existing C&ORR in Summers County. The feeder line, which extended ca. 21 miles, was initially known as the Sewell Valley Railroad (SVRR). The feeder line ran from Meadow Creek Station, to Springdale, over Wallow Hole Mountain, and down Sewell Creek to Rainelle. Tom Raine undertook the construction of the railroad, while John worked a tract of land near Hillsboro Academy in Pocahontas County (Collins 1999; Bagdon 2002). Tom Raine also began work on the construction of the mill and the town. The Sewell Valley railroad was completed to Rainelle in 1910. The railroad and many of the subsequent rail lines constructed by the MRC&L was built by Italian laborers that had worked for the Raine and Andrews Company elsewhere in West Virginia.

Construction of the town began in 1908 with the utilization of hemlock trees cut in proximity to the town site (Bagdon 2002), and construction of the mill began in 1909 (MRF n.d.). The company soon entered the railroad business, and they purchased Sewell Valley No. 1 (a Shay-geared engine, Class 50-2) in June, 1909 (Bagdon 2002). The company discarded the first Sewell Valley No. 1 and purchased a second Sewell Valley No. 1 (a two-truck, Shay geared engine, Class 42-2) in the winter of 1910 (www.cr.nps.gov/history/online_books/steamtown). Historians are not clear as to whether the second Sewell Valley No.1 became the Meadow River No.1 (www.cr.nps.gov/history/online_books/steamtown) or the Meadow River No. 4 (Bagdon 2002), but most likely it became Meadow River No. 4 1916. The second Sewell Valley No. 1 began hauling logs to Rainelle in the winter and spring of 1910, and later in 1910 the company purchased another two-truck, Shay-geared engine (Class 42-2), known as Meadow River No. 1, along with 20 cars. The mill, which had three six-foot bandsaws, was completed in 1910, and the first logs were cut on September 10, 1910 (Bagdon 2002). The principal tree species on company tracts included red and white oak, chestnut, hickory, poplar, maple, hemlock, bass, beech, cherry, and ash (Larson 1916). Initially, the principal stock was rough lumber, but with time the mill expanded to accommodate stock of ties, flooring, siding, lath, and chair stock (Larson 1916).

With the MRL up and running, Tom Raine returned to Evenwood (until its closing in 1922) to devote himself to railroading and the Evenwood Lumber Company (Collins 1999). L.C. Dyer, one of the founding charter members, became President of the MRL and John Raine moved to Rainelle to become the General Manager. Because of the profits generated from Evenwood and the other Raine and Andrews businesses, John Raine was able to purchase 14,000 acres in 1914 from the Gauley Coal and Land Company as well as an additional few thousand acres from several smaller purchases (Collins 1999). In 1928 an additional 30,000 acres was purchased from the Gauley Company on Big and Little Clear Creeks, bringing the company's land holdings to nearly 80,000 acres. Eventually the MRC&L land holdings grew to more than 125,000 acres or nearly 200 square miles. Tom Raine later formed the Raine Lumber Company in 1916 and built a sawmill at Honeydew in Fayette County which operated until 1923 under the supervision of his son J. W. Raine. Raine Lumber Company also purchased an operation in Pocahontas County that operated between 1923 and 1928 on what is now Seneca State Park (Collins 1999). During the

1920s Tom Raine also became interested in the developing coal industry, and in 1921 he bought the Loop and Lookout railroad (L&LRR) and the SVRR form MRL. He then proceeded to extend the SVRR to Glencoe and Duo, north of Rupert, and later extended lines to Nallen and Swiss to meet the New York Central (NYC). At the time he sold the SVRR to NYC in 1924, the Sewell Valley railroad was more than 100 miles in length. Eventually this rail line was operated as the Nicholas, Fayette, and Greenbrier railroad (NF&GRR). At the time of the sale, Tom Raine realized a profit of $3.75 million.

John Raine, along with assistance from his nephew, Howard L. Gray, continued to oversee the rapid growth and expansion of the MRL, the MRC&L, and the town of Rainelle. The town of Rainelle, which was incorporated in 1913, quickly earned a reputation for being one of the best hardwood mill towns in the United States (Collins 1999). John Raine studied George Pullman's efforts to create a "model town" and reportedly built some of the finest company housing in the state (Collins 1999; Larson 1916). At the time the first houses were built, beginning around 1908-1910, each house was built with an eye toward comfort and sanitation. All the residences were two-story, frame houses with clapboard siding, a front porch and an enclosed rear porch/storage room. The houses were plastered and papered on the interior and painted white on the exterior. The houses contained a living room, dining room, and kitchen downstairs, and two bedrooms and a bathroom upstairs**.** Each house had running water and most of the houses also had modern bathrooms, steam heat, and electricity. Each house had a lawn and garden, including a fruit tree, and in later years each was provided with a garage. The initial worker's houses were constructed in the area opposite the mill, south of US 60 and north of Wolfpen Creek. Housing for the foremen and officers of the company was constructed on the north side of US 60 opposite the worker's housing. Most of these original houses are still occupied today with few changes, save for the addition of vinyl or aluminum siding. During the early years, a company farm also existed (Collins 1999).

John Raine was elected President of MRL in 1917 and he named his nephew as plant foreman. John Raine was concerned about worked motivation, as he desired to place the worker in a position that "… he will be interested in the accomplishment of a good piece of work, and where he will feel that it is all a part of his honest toil and effort" (Lumber World Review 1920). To that end, the MRL instituted a pay scale that included various incentives for all laborers rather than a scale that was based strictly on an hourly wage. Because of the success of the MRL, the New York State College of Forestry began sending students to Rainelle in 1916 to study various aspects of the logging industry and the MRL operations. On of the more comprehensive studies was presented by Andrew Larson in his "Report on the Meadow River Lumber Company of Rainelle, West Virginia" (Larson 1916). Students from the New York State College of Forestry continued to study at MRL for the next two decades (Bagdon 2002).

Throughout the late 1910s and the early 1920s, MRL, MRC&L, and Rainelle continued to expand and prosper. The MRC&L continued to purchase land and expand the SVRR railroad and numerous spar lines into valleys throughout. Meanwhile the MRL grew quite rapidly, which necessitated an expansion of company housing and other company buildings. During the early 1910s, the company constructed a number of buildings in the original downtown area of Rainelle. The original downtown area started at the railroad depot, located on the south side of the intersection of Route 20 and US 60, and extended eastward along US 60. Adjacent to the railroad depot was the main corporate offices and company bank (owned by the Raine brothers) and next to the bank was the company store, which was razed within the last 20 years for construction of a gas station. The company also constructed the United Methodist Church at what was the east end of town in 1914. The Raine brothers built their personal homes on small hills on either side of the church. Tom Raine's house was built on the west side of the church and was torn down to

construct the Rainelle Medical Center. John Raine's house, located on the east side of the church, is still occupied and little changed from the original. With the growth of the various business enterprises, the company built more worker housing on the hillside immediately east of John Raine's house and north of where the railroad tracks cross US 60. These houses, which are still occupied and relatively unchanged from the original, were very similar in style and size to the initial workers' houses on the west end of town. During the 1920s the company also built a hotel and restaurant, a post office, and a movie theater; and in 1923-1924, the company provided the land and the bricks to build a new high school, which today is used as the elementary school.

In 1924, disaster struck Rainelle as the mill was burned. Fortunately, the company carried extensive fire insurance, and the net loss was minimal. Construction began immediately and a new mill opened in March of 1925, less than seven months after the fire. The new mill contained three nine-foot band mills and was able to cut more than 110,000 board feet (bf) per day (Collins 1999; Bagdon 2002). In addition to cross-cut saws, band saws, and thinning saws, the plant consisted of a dimension mill, a flooring mill, a planing mill, a lumber-grade warehouse, a door and window warehouse, drying kilns, a glue room, train repair shop, boiler house/power plant, fire pump house, furniture room, laminated wood room, a shoe heel room, various sorting and loading sheds, numerous storage docks, and a refuse burner. By the end of the decade, MRL employed nearly 500 workers, and production had increase from about 3 million bf in 1910 to an average of over 30 million bf in the late 1920s, or the equivalent of cutting nearly 3,000 acres of virgin forest every year (Collins 1999; WV Review 1929). By 1929, the MRL shipped products to 26 states and several foreign countries and was renowned as the "largest hardwood lumber mill" in the world (WV Review 1929).

The company hit some hard times during the depression years, and John Raine was removed as president of the company, in part because he refused to lay his men off of work and continued to cut wood at the same rate as the pre-depression years. John Raine was replaced by his nephew Howard L. Gray, and under Gray's leadership (1935-1961), the company was able to recapture its status as the largest hardwood lumber mill in the world. During the height of company success in the 1940s and 1950s, MRL continued to employ nearly 500 men and cut in the neighborhood of 30 million bf per year. The company manufactured a variety of products. These included railroad ties that were used to extend railroad lines throughout West Virginia and other states; hardwood spokes that were shipped to the Ford plant in Michigan for use as spokes on automobile wheels; flooring that was used not only in the housing and automobile industries, but was also used in construction of the Waldorf-Astoria Hotel in New York; doors, siding and window frames were shipped throughout the country for use in the growing market of single family detached houses; and laminated wooden floors were shipped to various parts of the country for use in bowling alley floors. During WWII, specially crafted ship keels were purchased by the British for use in submarine chasers. Also during WWII, a German Prisoner of War (POW) camp was built on MRC&L land near the town of Rainelle. The POW camp housed between 40-60 prisoners that worked on the railroad or on the log skidder teams up Big Clear Creek (MRF n.d.).

Between 1910 and the mid-1950s, the MRL owned and operated well over 100 miles of track between the SVRR and the L&LRR and their various logging spurs. The SVRR and the L&LRR became the NF&G RR during the 1920s and continued to operate into the 1960s. They also owned at least 7 Shay engines and as many as 600 cars. Meadow River No. 1, purchased in 1910, was sold to Edaville Railroad of South Carver, Massachusetts in 1959 for use in an exhibit. It eventually was sold to Steamtown (NPS) and moved to Bellows Falls, Vermont. The engine was badly damaged when the roof of the building in which it was stored collapsed due to excessive snow. The engine is listed on the National Register of Historic Places (NRHP) and has been recommended for restoration and use by the NPS in a static, museum exhibit at Steamtown,

Pennsylvania (www.cr.nps.gov/history/online_books/steamtown). Meadow River No. 2 and 3, both purchased in the early days of the MRL, were 70-ton, three-truck Shay engines that were dismantled and used to build Meadow River No. 7, which was sold to the Cass Scenic Railroad Museum when the plant closed in 1970. Meadow River No. 4 was sold to Birmingham Rail and Locomotive Co. in 1944, and the Meadow River No. 5 was sold to City Mining Co. in Tuscaloosa, Alabama in 1959. Meadow River No. 6, the last Shay engine to be purchased by MRL was bought in 1939 and reportedly was still in use when the plant closed. After a successful run of nearly 50 years, the Shay engines of the MRL were replaced by diesel-electric locomotives by 1957. During the last years, the MRL operated with two 70-ton diesel-electric engines. Mismanagement, inattention to shrinking markets, the lack of technological updates, and two labor strikes (1963 and 1969) proved too much for the company to overcome. The end of the era came in 1970 when MRL was sold to Georgia-Pacific (GP). GP operated the plant for about one year before it closed the mill and the last lumber was shipped out of town in 1971. At the time the mill was sold, the number of board feet cut per year had dropped to 18,000 bf per year. The mill was razed by 1975, and HAER documentation was completed in 1984.

4.2.7 GROWTH OF THE "SMOKELESS" COAL INDUSTRY (1920–1960S)

Beginning in the 1920s, interest in the coal industry reached Greenbrier County and the surrounding region. As noted previously, Tom Raine became interested in the coal industry at this time and purchased the SVRR and the L&LRR. Tom Raine extended the NF&G to his property on Big Clear Creek, north of Rupert, in 1929, but the onset of the depression precluded mining the coal reserves in this area until 1932. In 1932 he formed the Raine Coal Company, and the company, under family ownership and supervision, continued to operate until 1959 when the company and property was sold to the Gauley Coal and Land Company.

The community of East Rainelle, which was founded in the 1910s and incorporated in 1921, was developed to accommodate the growing population of Rainelle. In the early years, East Rainelle, also referred to as "Slabtown" because the first houses were temporarily sided with "slabs" from a portable sawmill," was located east and south of Sewell Creek, primarily along US 60 (Whitman 1977). During this time East Rainelle served as the business and commercial center for Rainelle and the surrounding area. Beginning in 1921, the Greenbrier and Eastern Railroad (G&ERR) extended rail service the Meadow River Valley area in order to exploit the low volatile, or 'smokeless,' coal supplies in the region. Many mines were opened in the Meadow River region after construction of this railroad, and additional mines were opened in the vicinity of Charmco, Quinwood, Duo, Clearco, and Anjean after the railroad was extended to the Big Clear Creek area in 1928-1929. East Rainelle benefited from the development of the coal industry in the 1920s and 1930s, and the town's population eventually surpassed Rainelle. Between 1921 and 1950, the population of East Rainelle more than tripled from nearly 450 people in 1921 to nearly 1,700 people in 1950, whereas the population of Rainelle in 1950 was about half at 850 people (Whitman 1977). In 1969, Rainelle and East Rainelle were joined under the name of Rainelle. Today East Rainelle contains a mix of historic and modern homes, as does the well-defined commercial district (also a blend of old and new buildings) along Route 60, Main Street.

The town of Anjean and the Anjean coal mine were founded by the Leckie Smokeless Coal Company in 1926 (Odor 1977). The coal company was founded by William S. Leckie and his brother Andrew F. Leckie, sons of Colonel William Leckie, who moved from Scotland to West Virginia in 1870. Anjean was named after Colonel Leckie's wife Anna, and Andrew Leckie's daughter, Jean. The Leckie Smokeless Coal Company operated mines in West Virginia and Kentucky for 30-40 years, including the Anjean mine that operated from 1926 until its closing in

1954 (Odor 1977). During the height of the mining period, Anjean contained 100 houses and supported a mixed population of Euro-Americans (ca. 67%) and Afro-Americans (33%) (Odor 1977). Many of the mines in the area were re-opened in the late 1950s and 1960s under the name of the Royal Scot Coal Company.

4.2.8 END OF AN ERA (1971–PRESENT)

The Meadow River Lumber Company was sold to the Georgia-Pacific Company in December of 1970, and the plant was closed completely by 1972. Prior to the sale to G&P, MRL had sold many of their assets such as the railroads, the power plant and the Pioneer Hotel. When G&P purchased the remaining assets from MRL, they also purchased the company housing. G&P immediately turned around and allowed the families to purchase their home rather than continuing to pay rent. Reportedly, over 80 homes were sold in this manner in the first year (MRF n.d.). G&P sold over 200 acres of land on the fringes of town to prospective home owners and developers, and they also sold many of the outdated businesses such as the company bank, company store, and post office (MRF n.d.). Thus, the purchase of the MRL by G&P turned a "lumber company town" into just a "plain town" (MRF n.d.). Eventually, the lumber mill was razed, the mill pond was filled, and the railroad tracks serving the mill were removed. All this was accomplished by 1975. Except for the company housing that still dominates the residential area west of Route 20 and on either side of US 60 west of the Route 20/US 60 interchange, only a few buildings remain from the original company town. Extant buildings include the former Fire Pump House (Greenbrier County Public Service District #2) (Plate 13), the abandoned railroad depot (Plate 14), the former company bank (APCO offices) (Plate 15), the former high school (currently the elementary school), the United Methodist Church (Plate 16), and the John Raine house (Plate 17). Within recent years the company store, located next to the bank, has been razed, the Tom Raine house was torn down to build the Rainelle Medical Center, and in 1982 the Pioneer Hotel (former theater) was closed and torn down due to a lack of clientele.

5.0 SURVEY METHODS

As noted previously, field investigations were conducted in two stages: Stage 1 was in April, 2004 and Stage 2 was in November, 2004. Stage 1 investigations, conducted from April 5-8, 2004, consisted of a walkover survey of the plant site, a pedestrian survey of pipeline and power line corridors, and limited soil probes at the plant site. At the time of survey (April 5-8, 2004), design plans for the plant site and related infrastructure (e.g., steam pipeline corridor, transmission line corridor, etc.) were not finalized. The proposed locations for the plant site and associated infrastructure during the Stage 1 survey (April 2004) are illustrated in Figures 1 and 2.

The purpose of the Stage 1 walkover survey was to conduct a preliminary field check of the study areas in order to identify obvious cultural resources and assess the potential for subsurface archeological sites. Areas investigated during the walkover survey included (1) the proposed 26-acre plant site south of Rainelle, (2) the proposed location of the transmission corridor between the plant site and the existing power line to the west, (3) the proposed steam and water line corridor that parallels the existing railroad bed north of the plant site, (4), the proposed location of the loading facilities in Anjean, and (5) selected refuse piles on Little Clear Creek Mountain east of Anjean (see Figures 1 and 2).

A meeting was held with the WV SHPO, PHE, and the DOE on May 12th, 2004, to discuss the results and recommendations of the Stage 1 walkover survey. During the Stage 1 investigations, JMA identified areas that have the potential to contain prehistoric or historic archeological deposits. JMA also identified several areas within the project area that were heavily disturbed and had little or no potential to contain archeological deposits. The latter areas included the truncated ridgetop and areas on either side of the ridge that contained a minimum of 3-6 feet of fill (Figure 3). Based on the design plans at the time (May 2004), JMA prepared a map that illustrated high probability areas that may be impacted by the project (Figure 3). The WV SHPO indicated that the high probability areas should be targeted for intensive Phase I investigations. The WV SHPO also noted that areas not yet identified but may be impacted by the project are also subject to Section 106 review, and therefore these areas should be surveyed, as appropriate. During the May 12th meeting, the DOE and PHE emphasized that design plans were not finalized and that the plant site location as well as the transmission line corridor and the steam pipeline corridor were subject to change as the project moved through the design phase.

Between May and November, design plans and locations changed frequently. At the time of the Stage 2, Phase I archeological investigations (November 2004), several changes had occurred to the design plans. The plant layout as of the Stage 2 investigations is presented in Figure 9. It is important to note that, unlike the plant design depicted in Figure 9, alternatives currently under consideration call for a smaller footprint and no disturbance to Sewell Creek (save for the bridge) or the oxbow meander. As of November, the following changes had occurred in the design plans: (1) the plant site location was moved from the west side of Sewell Creek to the east side of the creek adjacent to the truncated ridge, thus necessitating the need for a permanent bridge crossing; (2) contrary to previous design plans, no project impacts were to occur within the Plum Creek tract south of the property fenceline; (3) the steam and water pipeline corridor was redesigned to parallel the right-hand bank of Sewell Creek rather than follow the existing railroad bed; (4) a 17-acre land exchange property was added to the project area. The areas investigated during the Phase I survey are illustrated in Figure 10. The aforementioned changes in the design plans necessitated multiple revisions in the Scope of Work for the Phase I survey. A discussion of the survey areas is presented below.

- **Phase I intensive survey and deep testing of high probability areas between Sewell Creek and the toeslope of the truncated ridge (i.e., the terraces and bench east of Sewell Creek and west of the ridge)**: This area contains both alluvial and colluvial deposits and is located on the east side of Sewell Creek and west of the ridge. Portions of this area appear to contain relatively undisturbed soils, esp. the alluvial terraces closer to the stream and north of the fence line. Soils in this area have the potential to contain deeply buried archeological deposits. However, it should be noted that except for the proposed bridge (Figure 9), the design plans were modified to reduce the potential for impacts to wetlands or within 50 feet of Sewell Creek. Given the frequency of flood events and the magnitude of these events, it is possible that deeply buried deposits, if present, would be at a depth of more than 3 feet below ground surface. Because three feet is the maximum depth for hand excavated shovel test pits (STPs), backhoe trenches will be excavated in these areas to determine the presence of buried cultural deposits.

  As observed during the Stage 1 walkover survey, fill deposits removed from the truncated ridge were been placed on top of the colluvial deposits at the base of the ridge. Contour mapping at 1-foot intervals confirmed that several feet of fill had been placed on the colluvial deposits at the toeslope of the ridge. In order to determine the depth of the fill deposits as well as the presence or absence of buried deposits on the alluvial soils, JMA excavated six backhoe trenches in the alluvial deposits adjacent to Sewell Creek, and two backhoe trenches were excavated in the colluvial/fill deposits located at the base of the ridge (Figure 11). The survey procedures to be followed after completion of the backhoe trenches were outlined in the May 12th meeting with the WV SHPO. Two scenarios were presented. If the alluvial (or the fill) deposits were found to be deeper than 3 ft (or if the soils were undisturbed below 3 ft) then the high probability areas were to be examined through the excavation of additional backhoe trenches. If, however, the backhoe trenches indicated that the alluvial deposits (or the fill above the colluvial deposits) were relatively shallow (3 ft or less), then a systematic Phase I shovel test survey would be required in the high probability areas.

  As discussed below, the backhoe trenches indicated that (1) the alluvial soils were shallow and did not contain buried soils or cultural materials, and (2) the colluvial deposits were buried beneath four or more feet of fill. All trenches had to be terminated at depths between 5 to 7 feet below surface because ground water seeped into the trenches and collapsed the sidewalls. Based on the results of the backhoe trenches, STPs were excavated in high probability areas at 15-m intervals along parallel transects spaced at 15-m intervals. As per WV SHPO guidelines, STPs were .5 m in diameter and were excavated to sterile subsoil. Soils were screened through ¼ inch hardware cloth to ensure uniform recovery of artifacts. Artifacts 50 years of age or more were collected. Recent artifacts were noted but not collected. Due to the extensive modifications of the land surface (e.g., road cuts, sewer lines, fill deposits, etc.) and the numerous backchannels and meander scars that traverse the project area, the size of the high probability area was further reduced during the Phase I investigations. As a result, 32 STPs were excavated in high probability areas (one other STP was skipped due to inaccessibility). Figure 11 illustrates the location of the STPs in the high probability areas along Sewell Creek. One gouge auger core was also placed in the proposed plant site. The location of the gouge auger core is illustrated in Figure 11. Plates 19 and 20 depict typical landscapes in the high probability areas within the proposed plant site. Plate 19 depicts wetland vegetation in the vicinity of Trench 5, and Plate 20, taken next to Trench 7, illustrates the location of the proposed bridge crossing of Sewell Creek.

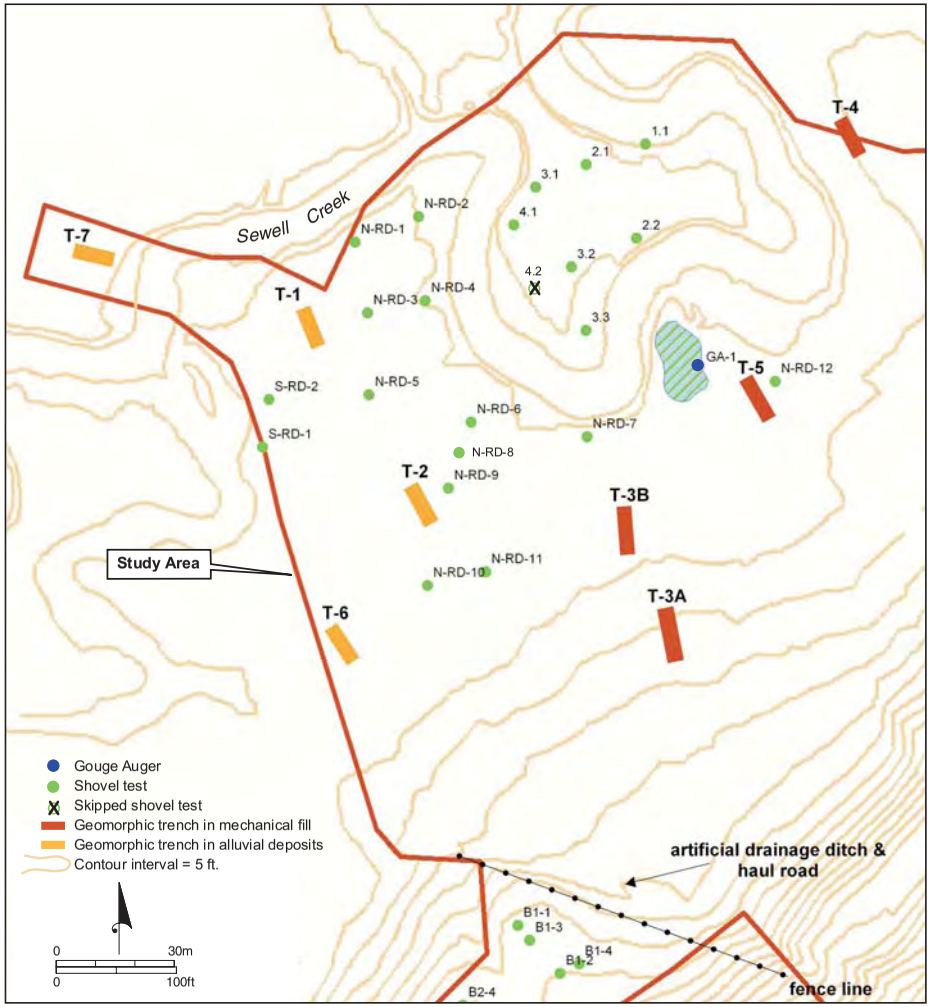


Figure 11. Detail of proposed plant site* showing location of backhoe trenches and shovel test pits.
*Note: Construction footprint not likely to impact oxbow or stream, except for bridge crossing.



Plate 19. View of Alluvial Terraces (right foreground and left background) near Trench 5; wetland vegetation in middle of picture, facing southwest.



Plate 20. View of proposed bridge crossing near Trench 7, facing northeast.

- **Phase I archeological survey and excavation of judgmental STPs on the benches in the Plum Creek tract south of the property fenceline.** Immediately prior to initiating the Stage 2 field investigations, JMA was informed that the benches south of the fenceline within the Plum Creek tract would not be part of the project area. However, during the Stage 2 field investigations (i.e., Phase I survey) in November, 2004, JMA was subsequently informed that the Plum Creek tract south of the fenceline was to be included as part of the project area. As a result, PHE instructed JMA that the high probability areas (three small benches) previously identified during the walkover survey in April, 2004 should be investigated. The benches are located on the north side of the truncated ridge overlooking Sewell Creek and the surrounding valley bottom. The three small benches decrease in size from northeast to southwest and together measure no more than 1 acre in size. Visual inspection of the benches indicated that much of the level or nearly level surfaces have been disturbed by logging haul roads that crisscross the ridge slope. Because of the diminutive size of the benches and the extensive presence of logging road disturbances, it was determined that close interval, judgmental STPs would be the best methodological approach to testing the area. Eleven STPs were place on the benches; the location of these STPs is presented in Figure 12. A photo of the benches is presented in Plate 4.

- **Walkover survey and judgmental soil probes of the steam/water pipeline corridor and preparation of archeological sensitivity map.** Between the walkover survey in April and the Phase I survey in November, the proposed route of the steam/water pipeline corridor was changed from one that paralleled the railroad tracks to one that followed the right-hand bank of Sewell Creek. Although the exact location of the pipeline corridor was not finalized at the time of the November survey, it was known with some degree of certainty that the corridor would be adjacent to and parallel to the right-hand bank of Sewell Creek in order to take advantage of existing pipeline easements held by the City of Rainelle. The proposed pipeline corridor is illustrated in Figure 13. Survey of the proposed pipeline corridor consisted of a pedestrian survey of the entire corridor and the placement of 11 soil probes within the corridor. The pedestrian survey identified three areas of major disturbance that were not investigated by soil probes. These disturbed areas include the following: (1) a 300 m segment on either side of US 60 where the corridor would be located within the existing sewer line corridor (this is also an area where the Sewell Creek was entrenched and channelized many years ago); (2) an area of pavement and the associated junkyard near the confluence of Little Sewell Creek and Sewell Creek (again Sewell Creek has been channelized); (3) the entire corridor on the north side (left-hand bank) of Sewell Creek consists of man-made land in order to fill in the swampy area near the confluence of Sewell Creek and Meadow River. The location of the 11 soil probes, the high probability areas, and the disturbed areas are presented in Figure 13.

- **Walkover survey of the 17-acre exchange property and preparation of archeological sensitivity map.** At the time of the survey, the proposed corridor for the transmission line encroached on some city land (i.e., golf course) that is zoned for park and recreational use. Under the terms of the property easement along the golf course, any use of the property (e.g.., the power line corridor) would require the replacement of a comparable number of acres of new land. The purpose of the easement is to ensure that no park or recreational lands are lost to the city by granting the encroachment of a power line. The land selected for the additional park or recreational activities is adjacent to Wolfpen

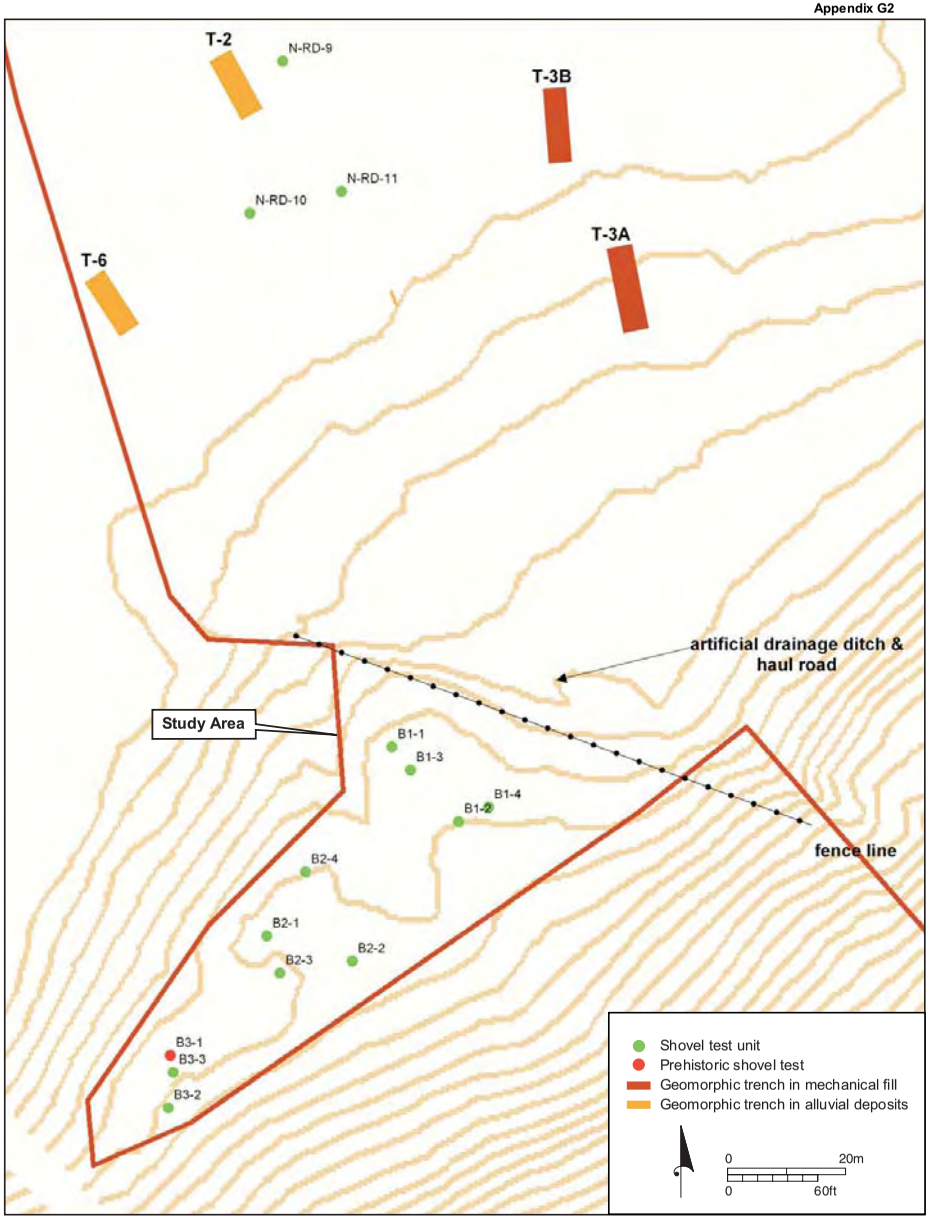


Figure 12. Detail of benches south of fenceline, showing location of shovel test pits.

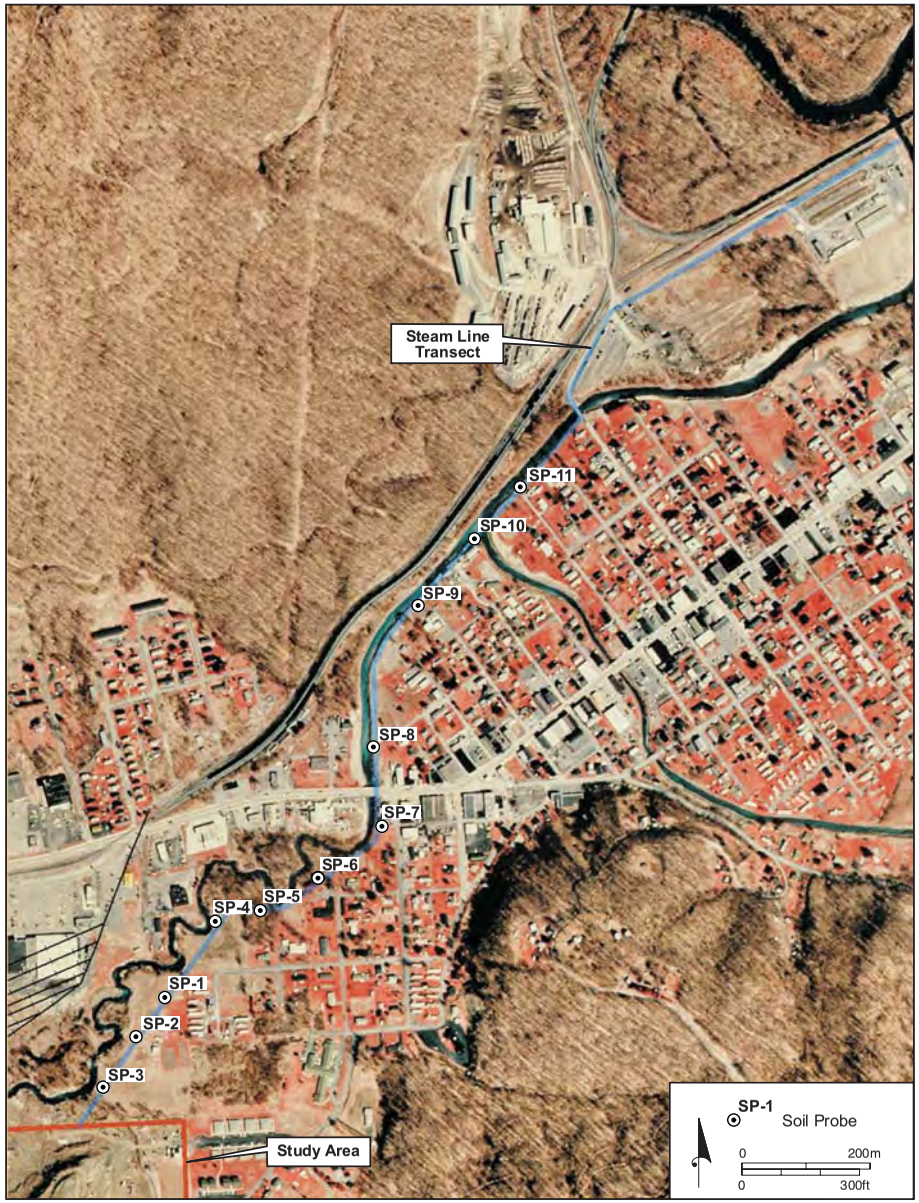


Figure 13. Detail of aerial photo showing steam pipeline corridor and location of soil probes.

Creek and immediately west of the golf course (Figure 10). As part of the agreement reached between the WV SHPO and PHE and the DOE for NEPA compliance, JMA conducted a walkover survey of the area. The purpose of the walkover survey was to identify the presence or absence of any archeological sites visible on the surface, assess the degree and extent of previous disturbance, and assess the potential for the property to contain historic or prehistoric archeological sites. The results of the survey and the archeological sensitivity of the land exchange property will be discussed in the subsequent chapter of this report.

6.0 PHASE I SURVEY RESULTS

Stage 1 investigations, conducted from April 5-8, 2004, consisted of a walkover survey of (1) the proposed 26-acre plant site south of Rainelle, (2) the proposed location of the transmission corridor between the plant site and the existing power line to the west, (3) the proposed steam and water line corridor that parallels the existing railroad bed north of the plant site, (4), the proposed location of the loading facilities in Anjean, and (5) selected refuse piles on Little Clear Creek Mountain east of Anjean (see Figures 1 and 2). The purpose of the Stage 1 investigations was to identify any archeological sites that appeared as surface manifestations as well as areas that have the potential to contain prehistoric or historic archeological deposits. JMA identified several areas within the project area that were heavily disturbed and had little or no potential to contain archeological deposits (Figure 3). Heavily disturbed areas at the plant site location included the truncated ridgetop near the plant site, the areas on either side of the ridge that contained a minimum of 3-6 feet of fill, and the former mill pond, lumber mill, and lumber yard. Figure 3 also identifies disturbed areas along the proposed steam pipeline corridor. Review of this figure illustrates disturbed areas along the railroad tracks within town as well as the area from the wastewater treatment plant to the mouth of Sewell Creek. The Stage 1 survey of the originally proposed loading facilities at Anjean as well as the selected coal refuse piles demonstrated that these areas are heavily disturbed and have no potential to contain archeological sites. At the conclusion of the Stage 1 investigations, JMA prepared a map of high probability areas that may be impacted by the project (Figure 3). As noted previously, design plans were changed prior to initiation of the Stage 2 investigations in November.

At the time of the Stage 2, Phase I archeological investigations (November 2004), the following changes had occurred in the conceptual design plans: (1) the plant site location was moved to the terraces on the east side of Sewell Creek and the base of the truncated ridge, this change in design necessitated the need for a permanent bridge crossing; (2) contrary to previous design plans, no project impacts were to occur within the Plum Creek tract south of the property fenceline; (3) the steam and water pipeline corridor was redesigned to parallel the right-hand bank of Sewell Creek rather than follow the existing railroad bed; (4) a 17-acre land exchange property was added to the project area. The areas investigated during the Phase I survey are illustrated in Figure 10. The results of the Stage 2 survey areas are discussed below, including the results of the geomorphological investigations at the plant site and along the steam and water pipeline corridor.

6.1 GEOMORPHOLOGIC EVALUATION

Eight backhoe trenches and one gouge auger sample were excavated within the proposed plant site to conduct a geomorphological evaluation of landforms within this part of the project area. These eight trenches were located on the floodplains on both sides of Sewell Creek and on the toe slope of the truncated ridge east of Sewell Creek. The floodplain on the east side of Sewell Creek is highly dissected by numerous paleochannels, point bars, and cut banks. Trenches were excavated to lengths ranging from 3.4 to 8.0 m (11.2 ft to 26.3 ft) and to depths extending from 1.2 to 2.6 m (4 ft to 8.5 ft) below ground surface. The floodplains are approximately 2 to 3 m above the normal water level of Sewell Creek. An Eijkelkamp gouge auger was used to extract a 6 cm (2.4 in) diameter sample from a wetland near Sewell Creek. This type of auger extracts a sample of deposits without compacting or mixing the stratigraphic layers or soil horizons.

Backhoe Trench 1 was located just northeast of the access road and approximately 17 m east of Sewell Creek (Figure 11). Trench 1 was located on the floodplain and was excavated

perpendicular to the trend of Sewell Creek. Backhoe Trench 2 was located 44 m south-southwest of Trench 1 and approximately 7 m west of STP N-RD-9. Trench 2, also located on the dissected floodplain, was excavated perpendicular to the trend of Sewell Creek. Backhoe Trench 3a and 3b were excavated towards the terminus of the toe slope of the colluvial fan. Trench 3a was located approximately 46 m southeast of STP N-RD-11, and Trench 3b was excavated 15 m northwest of Trench 3a and 37 m east of STP N-RD-11. Trench 4 was located on the floodplain near the northwestern terminus of the plant site. Trench 4 is located between a large dump to the east and Sewell Creek to the west. Backhoe Trench 5 was located approximately 5 m west of STP N-RD-12, 24 m south of Sewell Creek, and approximately 6 m southeast of a wetland. Trench 6 was located on the floodplain near the terminus of the toe slope of the colluvial fan portion. Backhoe Trench 6 was excavated north of the access road and approximately 6 m east of a paleochannel of Sewell Creek. Backhoe Trench 7 was excavated on the floodplain west of Sewell Creek near the location of the proposed bridge. Trench 7 is located approximately 5 m northwest of Sewell Creek and within the trend of the proposed road.

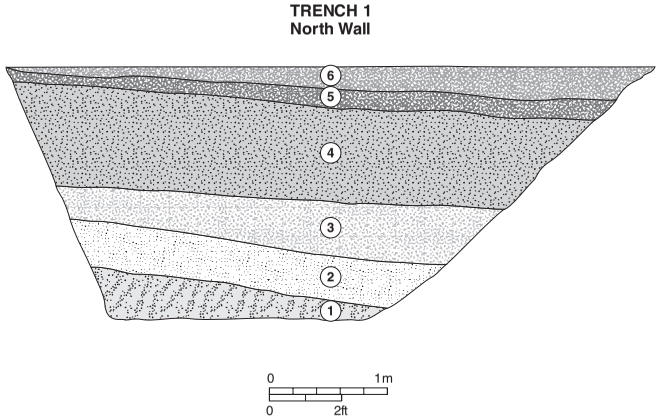
6.1.1 GEOMORPHIC TRENCH DESCRIPTIONS

Trenches East of Sewell Creek

Trench 1 was excavated to a length of 5.5 m (18 ft), with the greatest total depth of 2.13 m (7 ft). A representative profile of the north wall of Trench 1 is shown in Figure 14. The A horizon averages 12cm (0.4 ft) in thickness with a texture of silt clay loam that is very dark grayish brown (10YR 3/2). The A horizon grades into a firm AB horizon that is characterized as a dark brown (10YR 3/3) silt clay loam that averages 10 cm (0.3 ft) in thickness. This AB horizon then grades into a firm Bw horizon that extends to an average depth of 110cm (3.6 ft) below the ground surface. This Bw horizon is a dark yellowish brown (10YR 4/6) silty clay. The Bw horizon then has a gradual contact with a firm C1 horizon that is a yellowish brown (10YR 5/6) silty sand that averages 40cm (1.3 ft) in thickness. The C1 horizon grades into a C2 horizon that consists of a light yellowish brown (10YR 6/4) friable fine sand that is mottled with yellowish brown (10YR 5/6) fine sand. The C2 horizon then grades into a C3 horizon that is a light brownish gray (10YR 6/2) friable medium sand. The C3 horizon extends to the base of the excavation at 200 cm below ground surface. The C3 horizon deposits are unidirectionally cross bedded. Taken as a whole, the C horizon deposits represent a fining upward sequence.

Trench 2 was excavated to a length of 6.5 m (21.3 ft) and was excavated to a maximum depth of 1.9 m (6.2 ft). A representative profile of the west wall of Trench 2 is shown in Figure 15. Trench 2 has a similar profile to Trench 1. The A horizon in Trench 2 is a very dark grayish brown (10YR 3/2) silt clay loam that extends below ground surface to an average depth of 15 cm (0.98 ft). Below the A horizon is a 10 cm (0.3 ft) thick, yellowish brown (10YR 5/6) friable silty clay loam AB horizon. The AB horizon grades into a friable dark yellowish brown (10YR 4/6) silty sand Bw horizon that extends to an average depth of 65 cm (2.1 ft) below the ground surface. The Bw horizon has a sharp contact with a firm dark yellowish brown (10YR 4/6) silty clay C1 horizon. The C1 horizon then grades into the C2 horizon. The C2 horizon is a light yellowish brown (10YR 6/4) clay mottled with brownish yellow (10YR 6/6) clay that extends to the base of the excavation at 1.75 to 1.9 m below ground surface.

Trench 3a was excavated to a length of 8 m (26.3 ft) and to a total depth of 2 m (6.56 ft). A representative profile of the south wall of Trench 3a is shown in Figure 16. The Ap horizon (mechanical fill from the ridge) is a reddish brown (5YR 4/3) clay loam that encompasses the total excavation. The excavation of Trench 3a resulted in the removal of several large sandstone



6 10YR 3/2 very dark grayish brown silty clay loam; A Horizon

5 10YR 3/3 dark brown silty clay loam; AB Horizon

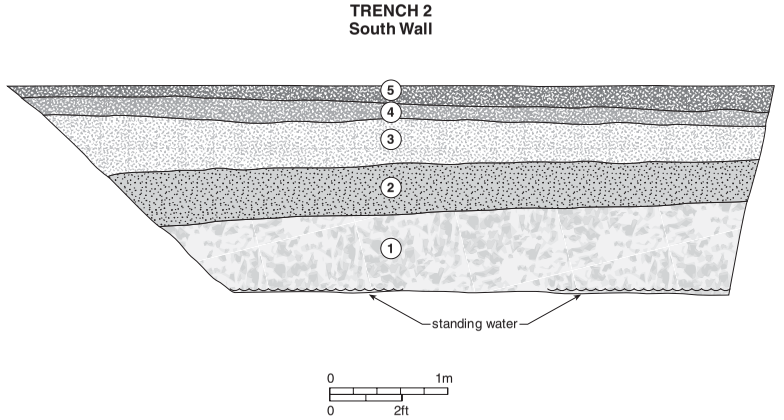
4 10YR 4/6 dark yellowish brown silty clay; Bw Horizon

3 10YR 5/6 yellowish brown silty sand; C1 Horizon

2 10YR 6/4 light yellowish brown mottled with 10YR 5/6 yellowish brown sand; C2 Horizon

1 10YR 6/2 light brownish gray sand with unidirectional cross beds; C3 Horizon

Figure 14. Trench 1 profile, north wall.



5 10YR 3/2 very dark grayish brown silty clay loam; A Horizon

4 10YR 5/6 yellowish brown silty clay loam; AB Horizon

3 10YR 4/6 dark yellowish brown silty sand; Bw Horizon

2 10YR 4/6 dark yellowish brown silty clay; C1 Horizon

1 10YR 6/4 light yellowish brown mottled with 10YR 6/6 brownish yellow clay; C2 Horizon

Figure 15. Trench 2 profile, south wall.

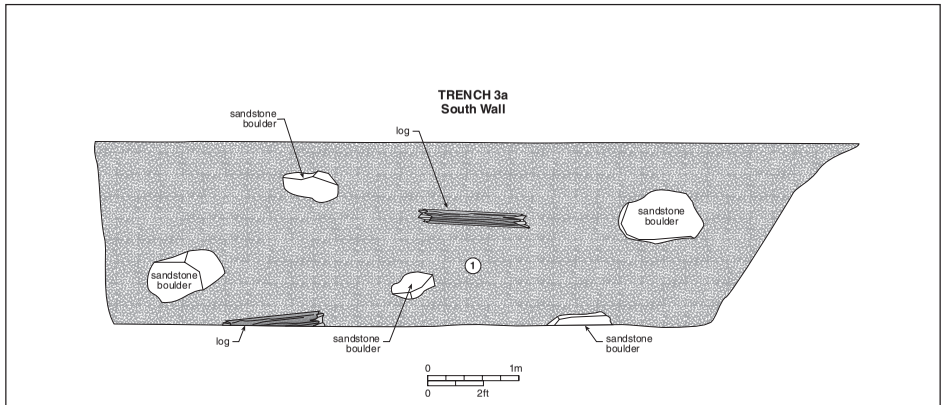


Figure 16. Trench 3a profile, south wall.

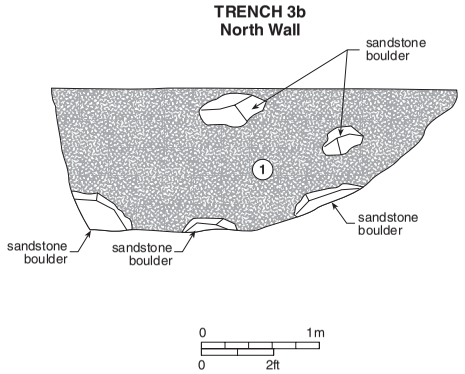
boulders, comparable to those found underlying the truncated ridge to the south east. Several large log fragments were also removed during the trench excavation. The excavation was terminated due to water seeping into the trench and collapsing the side walls.

Trench 3b was excavated to a length of 3.4 m (11.2 ft) and to a maximum depth of 1.2 m (3.9 ft) before excavation was halted due to large boulders inhibiting the continued excavation of the trench. A representative profile of the north wall of Trench 3b is shown in Figure 17. The Ap horizon (mechanical fill from the ridge) is composed of a reddish brown (5YR 4/3) clay loam and large sandstone boulders. The fill encompasses the total excavation. The excavation of Trench 3b resulted in exhuming several large sandstone boulders, comparable to those found underlying the truncated ridge to the south east.

Trench 4 was excavated to a length of 7 m (11.2 ft) and a depth of 2.1 m (6.9 ft) with a backhoe. A soil probe, placed at the bottom of the trench, extended the geomorphic sampling to a depth of 2.6 m below ground surface. A 1 m (3.2 foot) bench was excavated along south wall for safety concerns related to instability of the trench walls. A representative profile of the north wall of Trench 4 is shown in Figure 18. The surface horizon consists of a 3 cm thick O horizon of very dark grayish brown (10YR 3/2) silty clay loam, which was formed on the underlying Ap horizon. The Ap horizon (composed of mechanical fill from the ridge) is a reddish brown (5YR 4/3) silt clay loam that extends from the ground surface to an average depth of 132 cm (4.3 ft). The fill contains several large sandstone boulders. A sharp boundary separates the Ap horizon from the underlying C1 horizon. The C1 horizon is a dark grayish brown (2.5Y 4/2) silt clay mottled with very dark gray (2.5Y 3/1) silt clay that extends to approximately 177 cm below ground surface. This horizon contains many wood fragments and wetland plant rhizomes. The C1 horizon grades into a firm C2 horizon composed of a dark gray (5Y 4/1) clay. The water table was encountered at approximately 255 cm below ground surface within the soil probe excavation.

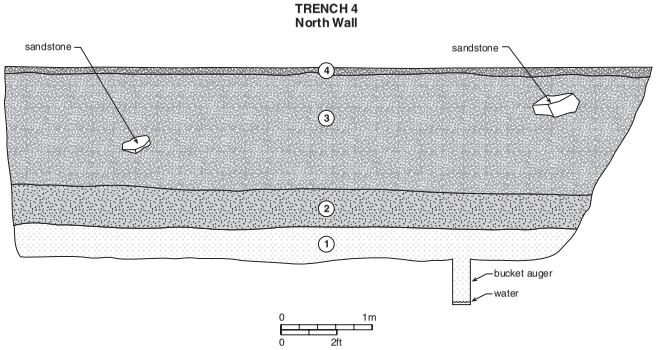
Trench 5 was excavated to a length of 6.5 m (21.3 ft) and to a maximum depth of 1.6 m (5.3 ft). A representative profile of the north wall of Trench 5 is shown in Figure 19. The Ap horizon (mechanical fill from the ridge) in Trench 5 is a strong brown (7.5YR 4/6) silty clay loam that extends below ground surface to an average depth of 65 cm (2.1 ft). As observed elsewhere, the Ap horizon contains large sandstone boulders and a log within its loose matrix. The Ap horizon sharply overlays the C1 horizon, which is defined as an olive gray (5Y 5/2) silty clay with many wetland plant rhizomes. This C1 horizon sharply covers a very dark gray (5Y 3/1) silty clay B2wb horizon with wetland plant fragments and rhizomes. This B2wb horizon grades into an olive gray (5Y 5/2) clay C2 horizon. The C2 horizon is sharply bounded at its base with a very dark gray (5Y 3/1) clay loam B3wb horizon mottled with olive gray (5Y 5/2) clay loam that contains many wetland vegetation fragments and rhizomes. The B3wb horizon then grades back into an olive gray (5Y 5/2) clay C3 horizon. The C3 horizon sharply overlies a dark gray (5Y 4/1) clay loam B4wb horizon that again contains wetlands plant fragments and rhizomes. This B4wb horizon grades into a gray (2.5Y 5/1) clay. All the horizons below the Ap horizon exhibit soft sediment deformation that likely occurred as a result of the placement of the log (see Figure 19) on the C1 horizon and its subsequent burial by mechanically deposited fill.

Trench 6 was excavated to a length of 8 m (26.3 ft), with the greatest total depth of 1.5 m (4.9 ft). A representative profile of the north wall of Trench 6 is shown in Figure 20. The A horizon is a very dark grayish brown (10YR 3/2) silty clay loam that averages 5 cm (0.2 ft) in thickness. The A horizon grades into a friable Bw horizon that is composed of a silt clay loam that averages 20 cm (0.7 ft) in thickness and is dark grayish brown (10YR 4/2). This Bw horizon grades into a firm C1 horizon that extends to an average depth of 84 cm (2.6 ft) below the ground surface. This C1



1 5YR 4/3 reddish brown clay loam; Ap Horizon (mechanical fill)

Figure 17. Trench 3b profile, north wall.



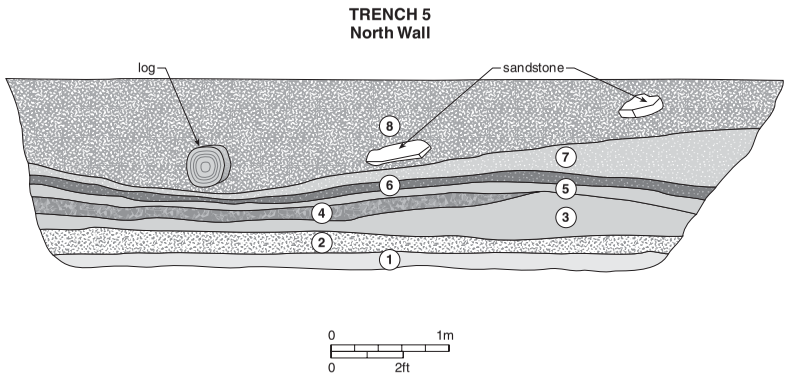
4 10YR 3/2 very dark grayish brown silty clay loam; Ap Horizon (mechanical fill)

3 5YR 4/3 reddish brown clay loam; Ap Horizon (mechanical fill)

2 2.5Y 4/1 dark grayish brown mottled with 2.5Y 3/1 very dark gray silty clay; C1 Horizon

1 5Y 4/1 dark gray clay; C2 Horizon

Figure 18. Trench 4 profile, north wall.



8 7.5YR 4/6 strong brown silty clay loam; Ap Horizon (mechanical fill)

7 5Y 5/2 olive gray silty clay; C1 Horizon

6 5Y 3/1 very dark gray silty clay; B2wb Horizon

5 5Y 5/2 olive gray clay; C2 Horizon

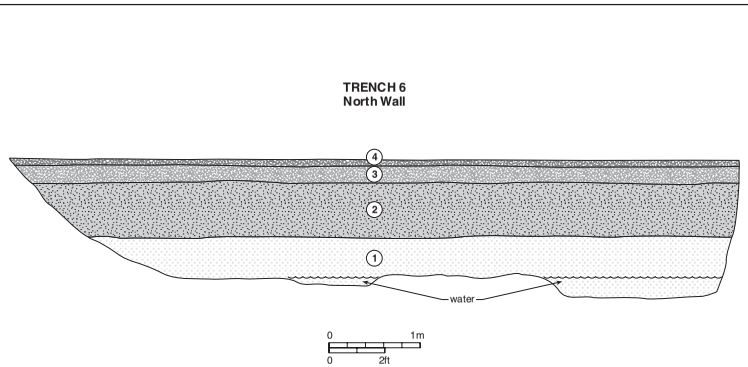
4 5Y 3/1 very dark gray mottled with 5Y 5/2 olive gray clay; B3wb Horizon

3 5Y 5/2 olive gray clay; C3 Horizon

2 5Y 4/1 dark gray clay loam; B4wb Horizon

1 2.5Y 5/1 gray clay; C4 Horizon

Figure 19. Trench 5 profile, north wall.



4 10YR 3/2 very dark grayish brown silty clay loam; A Horizon

3 10YR 4/2 dark grayish brown silty clay loam; Bw Horizon

2 10YR 5/6 yellowish brown silty clay; C1 Horizon

1 10YR 6/2 light brownish gray sand; C2 Horizon

Figure 20. Trench 6 profile, north wall.

horizon is a yellowish brown (10YR 5/6) silty clay. The C1 horizon then changes abruptly into a light brownish gray (10YR 6/2) friable fine sand. Because the eastern end of the trench contained standing water (Figure 20), the last two meters of the trench were not mapped due to the instability of the walls.

Trench West of Sewell Creek
Trench 7 was excavated to a length of 8 m (26.3 ft), with the greatest total depth of 1.83 m (6 ft). A representative profile of the north wall of Trench 7 is shown in Figure 21. The A horizon, which averages 15cm (0.5 ft) in thickness, is a very dark gray (10YR 3/1) silty clay loam. The A horizon grades into a Bw horizon of loose dark grayish brown (10YR 4/2) silt clay loam. The Bw horizon exhibits a gradual contact with a firm C1 horizon that is dark yellowish brown (10YR 4/6) silty clay that extends from 50 cm to 125 cm (1.6 ft to 4.1 ft) below ground surface. The inclination of the base of this horizon is in the direction of the current channel of Sewell Creek. The C1 horizon sharply transitions into a Bwb horizon that is a yellowish brown (10YR 5/8) friable silty sand. The Bwb horizon is oriented to the same inclination as its upper boundary and maintains a thickness of approximately 20 cm. The Bwb horizon then gradually grades into a C1b horizon of gray (5Y 6/1) fine sand mottled with brownish yellow (10YR 6/6) fine sand. The C1b horizon then grades into a C3b horizon of gray (5Y 6/1 to 5Y 5/1) fine friable sand. A reddish yellow (7.5YR 6/6) unit of medium sand is found within the C3b horizon entering from the eastern terminus of the trench. The upper boundary of the C3b horizon is nearly horizontal.

Gouge Auger East of Sewell Creek
This gouge auger sample (GA-1) was extracted from the wetland located immediately northwest of Trench 5 (Figure 11). GA-1 was excavated to refusal at 40 cm (1.3 ft) below ground surface. The examination of GA-1 revealed a layer of mechanical fill from the ridge (Ap horizon) consisting of strong brown (7.5Yr 4/6) loose silt clay loam overlying primary wetland deposits (C horizon) that are dark greenish gray (4/5GY 4/1) very firm clay (Figure 22).

6.1.2 SUMMARY AND INTERPRETATIONS

Eight backhoe trenches and one gouge auger core were excavated on the floodplains of Sewell Creek and on the toe slope of a colluvial fan within the footprint of the proposed plant site. The trenches were placed on different landforms in order to assess the archeological potential of these areas. Specifically, trenches were placed on a floodplain west of Sewell Creek, on a dissected floodplain east of Sewell Creek (portions of which have been mechanically and naturally altered in the past), and on the toe slope of a mechanically truncated ridge. The floodplain east of Sewell Creek can be separated into several distinct landforms based on its dissection by paleochannels, remnant floodplains, and areas of mechanical fill. The floodplain west of Sewell Creek, which is higher in elevation, does not exhibit the fragmentary nature of the floodplain to the east.

The eastern floodplain of Sewell Creek exhibits landscape disturbance as a result of paleochannel cuts, crevasse splays, the filling of wetlands, and the toe slope of the ridge altered by mechanical filling and grading. The dissection of the floodplain has resulted in remnant cut banks and point bars preserved on the interfluves of the paleochannels of Sewell Creek. These interfluves, which represent topographic highs, have the highest potential to contain archeological deposits. As a result, the backhoe trenches and STPs were excavated on these landforms whenever possible.

Trenches 1, 2, and 6 all exhibited soils depicting a classic transition between fluvial (channel) deposits and alluvial (floodplain) deposits. This complete transition can be seen in Trench 1 where the sequence begins at the base with medium-grained sand deposits with unidirectional

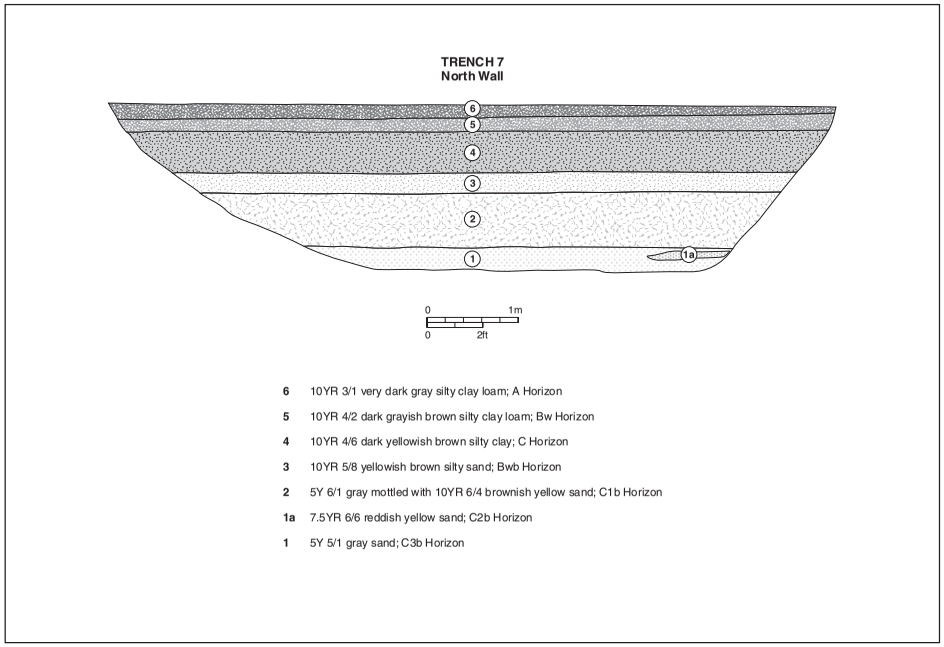


Figure 21. Trench 7 profile, north wall.

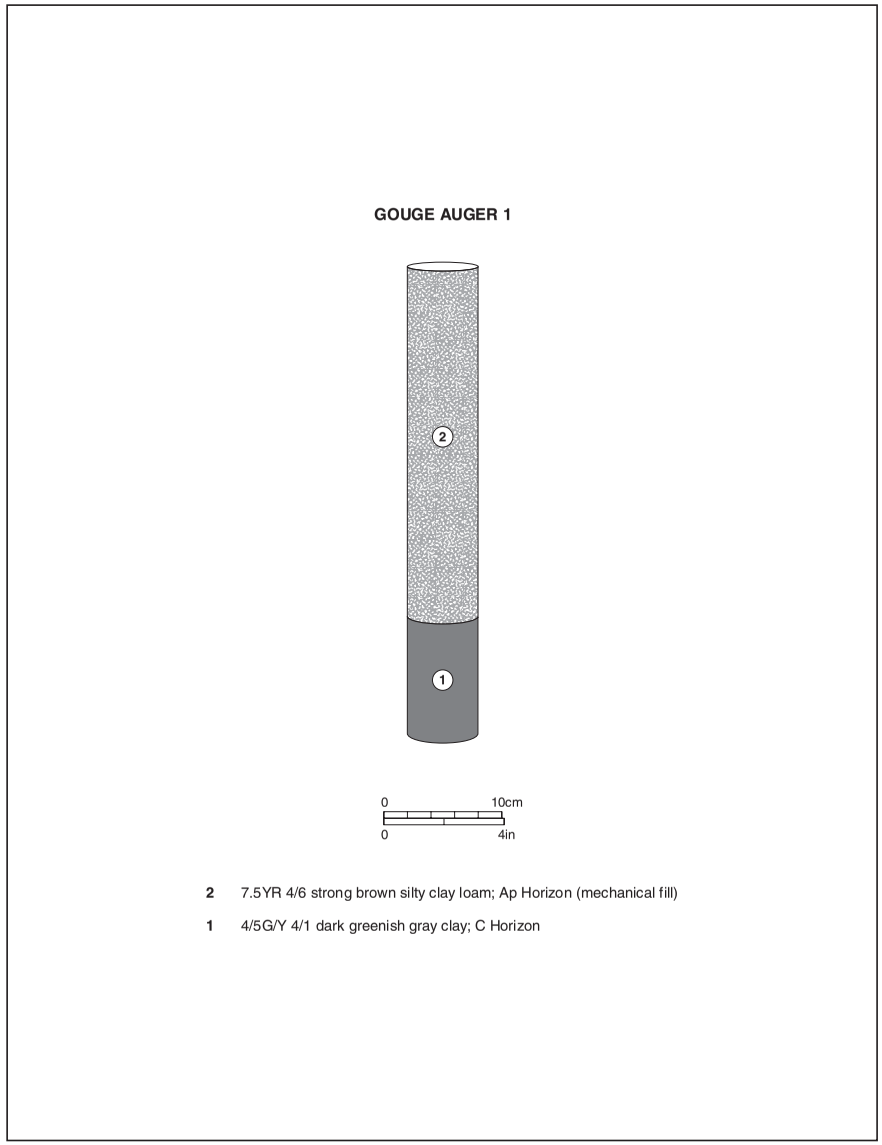


Figure 22. Gouge Auger 1 profile.

cross beds grading up to silty fine sand. This transition from medium-grained sand to silty fine sand is interpreted to represent a transition from a high energy environment (lower point bar below water level) to a low energy environment (upper point bar above water level). Capping this interpreted point bar sequence in Trench 1 are silty clay loam deposits typical of a floodplain. In Trenches 4 and 5, and gouge auger sample GA-1, the soils depict a sequence of wetland deposits covered with mechanical fill from the truncated ridge. The wetland deposits exposed in the trenches and gouge auger sample may be related to one or more oxbows or to one or more back levee swales typical of floodplains. Due to the filling of these wetlands, it is difficult to get a true understanding of the spatial relationship of the wetland deposits to the floodplain deposits found in Trenches 1, 2, and 6. Trenches 3a and 3b were located on the colluvial toe slope below the truncated ridge. The excavation of these trenches did not result in the exposure of anticipated colluvium. These trenches were terminated within mechanical fill due to the number and size of sandstone boulders encountered during their excavation, or the instability of the side walls which were undercut by water seeping into the bottom of the trench.

Trench 7, located on the floodplain west of Sewell Creek, occupies a higher elevation than the dissected floodplain to the east of Sewell Creek. Trench 7 depicts a sequence similar to that found in Trenches 1, 2, and 6. The soils in Trench 7 indicate a sequence of transitioning from a fluvial (high energy) environment to a floodplain environment (low energy). This can be seen by the transition from a fine gray sand at the base of the trench to silt clay deposits at the top of the trench that have undergone soil development.

Based on the soil profiles exposed in Trenches 1, 2, 6, and 7, it is interpreted that there are no deeply (greater than 4 ft) buried alluvial soils that could have supported human occupation in the proposed plant site area. In the areas where Trenches 3a and 3b were located, the exact depth of the mechanical fill deposits is not known, but in the vicinity of Trench 3a the mechanical fill deposits are at least six feet thick and at least 4 feet thick in the vicinity of Trench 3b. It is known through an examination of Trenches 4 and 5 that the mechanical fill does thin towards the northwest (i.e., towards the floodplain of Sewell Creek). However, the geomorphic examination of Trenches 4 and 5 revealed that the deposits below the mechanical fill are wetland deposits rather than floodplain or colluvial deposits. Therefore there is little, if any, potential for soils in these areas to contain buried archeological deposits. For the reasons explained above, no colluvial deposits were exposed in the trenches excavated for this geomorphic evaluation. Based on the results of this geomorphic evaluation, a map of disturbed landscapes has been produced (Figure 23). The geomorphic evaluation of the plant site not only demonstrated the nature and origin of the floodplain deposits along Sewell Creek, but it also demonstrated that both prehistoric and historic archeological sites, if present, would necessarily be confined to the upper 30 cm or less. Given this fact and the horizontal and vertical extent of historic and recent disturbances in the project area, there is very little potential for finding undisturbed sites.

6.2 RESULTS OF STAGE 2 STP AND WALKOVER SURVEY

Phase I intensive survey and deep testing of high probability areas between Sewell Creek and the toeslope of the truncated ridge (i.e., the terraces and bench east of Sewell Creek and west of the ridge). Based on information learned from the geomorphic evaluation, JMA excavated 32 STPs in the terraces east of Sewell Creek (Figure 11). As noted previously, STPs were placed on terrace surfaces (i.e., topographic highs) and areas that exhibited the least amount of surface disturbance.

Although every effort was made to excavate the STPs at 15 m intervals along transects spaced at 15 m intervals, this was not always possible given the numerous paleochannels and swales that characterize the area as well as the extensive amount of disturbance that has occurred in the area. Figure 23.

Based on field observations, JMA identified four different interfluve (terrace) surfaces on the east side of Sewell Creek within the high probability area. These surfaces occurred at slightly different elevations above the stream and were generally separated from one another by paleochannels (stream back channels). Because of the different terrace surfaces, the soil profiles exposed in the STPs often varied from terrace to terrace and even sometimes within what appeared to be the same terrace. One of the key points regarding the various interfluve surfaces and paleochannels is that these features demonstrate that the floodplain is not static and therefore there is a low potential for preserved deposits.

Soil profiles ranged from Ap and Bw sequences to O, Ap, A/B, Bw sequences. The O horizon, if present was no more than 3-4 cm in thickness and consisted of a black (10YR2/1) silt loam humic zone. The Ap horizon, generally 10-15 cm in thickness, was a very dark grayish brown (10YR3/2) silt loam with many roots. Depending on whether or not the A/B horizon was present or not, the Bw horizon was encountered between 17-20 cm below surface. This soil consists of a yellowish brown (10YR5/6 to 10YR5/8) silty clay loam with weak subangular blocky structure. STPs were generally terminated between 40-50 cm below surface. More detailed soil descriptions of the STPs are presented in Appendix A, Table A. Review of Table A indicates the soils on the oxbow were quite variable depending on where the STP was located. For example, STPs along the baseline were excavated in alluvial soils, as evidenced by the fine silt loam to silty clay loam texture, whereas soils excavated near the point bar (furthest from the baseline) were formed in medium-course to fine-grained sands, indicative of fluvial deposits.

JMA excavated a total of the 32 STPs in the high probability areas along Sewell Creek, and all 32 STPs were negative. That is, no archeological materials or sites were identified as a result of the shovel test investigation along Sewell Creek. Based on the results of the geomorphic evaluation and the negative results of the STPs excavated in high probability areas, JMA believes that there is no potential for significant archeological sites in this area, and JMA recommends that no further investigations are warranted in this area.

Phase I archeological survey and excavation of judgmental STPs on the benches in the Plum Creek tract south of the property fenceline. JMA excavated 11 STPs on three small benches south of the fenceline on the Plum Creek tract (Figure 12). The west-northwest facing benches, which overlook Sewell Creek and a broad low-lying area that currently supports wetland vegetation, become increasingly smaller as one moves further south along the ridgeslope. Currently the benches support an oak-beech forest with sassafras, ferns and greenbrier in the understory. Based on the size of stumps in the area, the benches have been disturbed by timber harvesting on at least two occasions and logging haul roads crisscross the benches and adjacent ridgeslope. STPs were excavated in this area for two reasons: (1) the benches were identified as high probability areas during the Stage 1 investigations, and (2) JMA was informed by PHE and WGC that there was renewed interest in this tract since the scope of work for the Stage 2 investigations had been finalized.

The pedestrian survey of exposed ground surfaces on the three benches and the excavation of 11 STPs resulted in the recovery of one flake fragment of dark gray chert from STP B3-1 (Figure 12). The bench that contained the artifact measured less than 8 x 10 meters in size and had been disturbed by two separate haul roads that crossed the more level portions of the bench. The flake

fragment was broken medially and exhibited no cortex. Two radial shovel tests were excavated on the bench, but no other cultural material was recovered. Eight STPs on the two larger benches were also negative. Because the flake is an isolated find, no site number was assigned to the find and no site form was completed.

The soils on the benches are shallow to moderately shallow depending on the extent of erosion. It should be noted that all forested ridges in the region have been subjected to extensive erosion since these forests were harvested during the first quarter of the twentieth century. Appendix A, Table B presents a summary of soil information and soil depths from the 11 STPs excavated on the three benches. In general, these soils exhibit an O, Ap, A/B, Bw soil profile. The O horizon (0-3 cm) consists of a 10YR2/2 (very dark brown), silt loam humic layer (leaf litter). The Ap horizon, which extends to a depth of 12-18 cm below surface (cbs), consists of a 10YR3/2 (very dark grayish brown) silt loam, mottled with a 10YR4/3 (brown) silt loam. Many rocks and tabular slabs of sandstone occur throughout the profile. The Ap soil exhibits loose crumb structure and a clear irregular boundary. The E/B horizon extends to ca. 22-25 cbs and consists of a 10YR5/3 (brown) silty clay loam, mottled with 10YR4/3 silty clay loam. This soil has weak to moderately well developed subangular blocky structure with a clear smooth boundary. The Bc horizon is defined by a 10YR6/6 (brownish yellow) silty clay loam with moderately well developed subangular blocky structure. As before, sandstone spalls and slabs occur throughout the profile. The flake fragment from STP B3-1 was recovered from the Ap horizon. With the exception of a .22 caliber bullet casing from STP B2-3, no other cultural materials were recovered from the STPs and pedestrian survey of the three benches. No further archeological work is recommended on these benches.

Walkover survey of the 17-acre exchange property and preparation of archeological sensitivity map. The 17-acre exchange property is illustrated in Figures 10 and Plates 10 and 11. For practical purposes, the southern boundary of the land exchange property is Wolfpen Creek, and the eastern boundary is defined by an unnamed intermittent tributary of Wolfpen Creek. The northern boundary of the tract follows US 60. As noted previously, although the eastern half of the project area contains tens of thousands of large boulders and cobbles, an oak-beech-holly forest is dominant. The western half of the land exchange property is extremely steep (20-40+ percent slopes) and supports an oak-beech-pine forest with a dense understory of mountain laurel, holly and greenbrier. The western portion of the land exchange tract contains evidence of numerous former logging roads (see Plate 11). No archeological sites and no high probability areas were identified in the land exchange property as a result of the pedestrian survey. No further archeological work is recommended for the land exchange tract.

Walkover survey and judgmental soil probes of the steam/water pipeline corridor and preparation of archeological sensitivity map. Although the exact location of the pipeline corridor was not finalized at the time of the November survey, it is expected with some degree of certainty that the corridor would be adjacent to and parallel to the right-hand bank of Sewell Creek in order to take advantage of existing pipeline easements held by the City of Rainelle. Survey of the potential pipeline corridor consisted of a pedestrian survey of the entire corridor and the placement of 11 soil probes within the corridor (Figure 13). The pedestrian survey identified four areas of major disturbance, three of which were not investigated by soil probes because the extent of disturbance precluded any potential for intact archeological deposits. The disturbed areas are depicted on Figure 13 and include the following: (1) an area beginning at the plant site and extending north along the pipeline corridor for ca. 300-400 m; (2) a 300 m segment on either side of US 60 where the corridor would be located within the existing sewer line corridor (this is also an area where Sewell Creek was entrenched and channelized many years ago); (3) an area of pavement and the associated junkyard near the confluence of Little Sewell

Creek and Sewell Creek (this is another area where Sewell Creek has been channelized); (4) the entire length of the pipeline corridor on the north side (left-hand bank) of Sewell Creek between the bridge crossing and the railroad bridge near the confluence of Sewell Creek and Meadow River. The later area consists of man-made land, elevated by as much as 12-15 feet, that was created in order to fill in the swampy area near the confluence of Sewell Creek and Meadow River.

The location of the 11 soil probes are presented in Figure 13, and Appendix A, Table C presents soil information and descriptions for the 11 soil probes. Soil probes #1-3 revealed that the vast majority of the surface horizon (Ap) in this area has been striped and removed. The Ap horizon in this segment of the corridor is only 0-2 cm in thickness and overlies the B horizon soils. Based on the trench profiles excavated in the adjacent plant site location, JMA determined that there is little if any potential for these alluvial soils to contain any buried cultural deposits beneath the B horizon. Therefore, this segment of the pipeline corridor has very low to zero potential for containing archeological sites. Soil probes #4-6 demonstrated the only portion of the pipeline corridor that has the potential to contain archeological sites in an undisturbed context. Soil probes in this portion of the corridor are relatively undisturbed and exhibit a moderately thick Ap horizon underlain by A/B, and either Bw or Bt soil horizons. This segment of the pipeline corridor is the only segment (except for the area defined by soil probes #1-3) that has not been impacted by construction impacts during the second half of the twentieth century. Soil probes #7-11 demonstrate the soils in these areas have been disturbed. Soil probes #7 and #8 confirm the presence of the existing sewer line in this area, and soil probes #9-11 suggest that Sewell Creek has been channelized, and as a result these soils have been truncated and replaced with fill.

Once the pipeline corridor is finalized, it is recommended that a Phase I survey be completed for the segment of the proposed corridor that would be located between soil probes #4-6 (see Figure 13). This survey should be conducted prior to initiating any ground disturbance activities. As per discussions between the DOE, PHE, and the WV SHPO at the May 12, 2004 meeting, additional Phase I investigations (and Phase II evaluations, if necessary) will be coordinated under the Section 106 process.

7.0 SUMMARY AND RECOMMENDATIONS

7.1 PROJECT SUMMARY AND SUMMARY OF STAGE 1 AND 2 SURVEY RESULTS

JMA was retained by PHE of Bethesda, Maryland to conduct Phase I archeological and geomorphological investigations and to contribute to an EIS for the WGC Demonstration Project. Specifically, the DOE and PHE are preparing an EIS for the referenced Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by WGC, with DOE providing financial support through a 5-year cooperative agreement with WGC. The DOE, PHE, and JMA, in consultation with the WV SHPO, followed a staged approach to the field investigations in order to comply with Section 106 scope of work. WGC is proposing to design, construct, and operate a 90 MWe power plant that would generate electricity and steam by burning approximately 2,700 tpd of waste coal as the primary fuel. The power plant would be located on ca. 26-acre site immediately on the east side of Sewell Creek and immediately south of the city limits of Rainelle in the extreme western corner of Greenbrier County. Waste coal would initially be obtained from abandoned waste coal piles located in the vicinity of Anjean.

The project area for the WGC plant site is located on and adjacent to the former location of the MRL in Rainelle. The MRL began operations to harvest hardwoods from the area in 1906, initially building the SVRR spur to provide access to the C&ORR. Rainelle was established as the MRL company town in 1910, when the mill opened, and Rainelle was incorporated in 1913. Over the 60+-year history of operations, the MRL harvested timber from 125,000 acres around Rainelle (Whitman 1977). From its inception, this company was one of the largest hardwood lumber operations in the United States, and by the 1930s was the largest hardwood mill in the world. It maintained this position through the 1960s (HAER 1984). The MRL ceased operations in 1970, and the entire mill and lumber yards were razed by 1975.

Field investigations were conducted in two stages: Stage 1 was in April, 2004 and Stage 2 was in November, 2004. Stage 1 investigations, conducted from April 5-8, 2004, consisted of a walkover survey of the plant site, a pedestrian survey of pipeline and power line corridors, and limited soil probes at the plant site. The purpose of the Stage 1 investigations was to identify obvious cultural resources and assess the potential for subsurface archeological sites. At the time of the Stage 1 survey, design plans for the plant site and related infrastructure (e.g., steam pipeline corridor, transmission line corridor, etc.) were not finalized. Areas investigated during the walkover survey included (1) the proposed 26-acre plant site south of Rainelle, (2) the proposed location of the transmission corridor between the plant site and the existing power line to the west, (3) the proposed steam and water line corridor that parallels the existing railroad bed north of the plant site, (4), the proposed location of the loading facilities in Anjean, and (5) selected refuse piles on Little Clear Creek Mountain east of Anjean.

During the Stage 1 investigations, JMA identified areas that have the potential to contain prehistoric or historic archeological deposits. JMA also identified several areas within the project area that were heavily disturbed and had little or no potential to contain archeological deposits. The latter areas included the truncated ridgetop at the plant site, areas on either side of the ridge that contained a minimum of 3-6 feet of fill, and the former mill pond, lumber mill, and lumber yard. A meeting was held with the WV SHPO, PHE, and the DOE on May 12th, 2004, to discuss the results and recommendations of the Stage 1 walkover survey. During the May 12th meeting,

the DOE and PHE emphasized that design plans were in the conceptual stages and that the plant site location as well as the transmission line corridor and the steam pipeline corridor were subject to change as the project moved through the design phase. Between May and November, design plans and locations changed frequently.

Stage 2 of the Phase I investigations included the excavation of STPs, soil probes, and backhoe trenches. More specifically, the following areas were surveyed: (1) an intensive Phase I survey and deep testing of alluvial terraces between Sewell Creek and the toeslope of the truncated ridge that have a high probability for containing archeological deposits; (2) Phase I archeological survey and excavation of judgmental STPs on the benches in the Plum Creek tract south of the property fenceline; (3) walkover survey and judgmental soil probes of the steam/water pipeline corridor and preparation of archeological sensitivity map**;** (4) walkover survey of the 17-acre exchange property and preparation of archeological sensitivity map.

JMA excavated eight backhoe trenches and 32 STPs in high probability areas in the construction footprint for the plant site. The backhoe trenches were placed across the plant site in order to assess the potential of the area to contain buried soils that may contain archeological materials and to determine the horizontal and vertical extent of the fill that was placed on the colluvial slopes below the ridge. Backhoe trenches in the alluvial terraces exhibited similar soil profiles, and all the profiles indicated there are (1) no buried soils and (2) no potential for buried soils within the project area for the plant site. Thus, if archeological sites are present within this part of the project area, then evidence of the sites would necessarily be limited to the upper 30-35 cms. The backhoe trenches on the colluvial slopes demonstrated that the fill in these areas is 6 ft or more, but because water seepage caused the side walls of the trenches to collapse, the exact depth of the fill could not be determined. Based on the results of the pedestrian survey and the information gleaned from the backhoe trenches, the STPs were located on various alluvial terraces within the plant site location. STPs that fell in disturbed areas or stream backchannels were relocated to nearby areas that were less disturbed or were terrace surfaces. No cultural material was recorded as a result of the STP excavations.

The field observations within the plant site indicated the presence of four different interfluve surfaces, generally separated by paleochannels. The dissected nature of the floodplain deposits indicates that this landscape has not been static over the last few thousand years. Based on the results of the backhoe trenches and the STPs, it was determined that the plant site has little, if any, potential to contain preserved archeological deposits or buried soils. It is also interpreted that the relative age of the preserved interfluve floodplain surfaces are Middle Holocene (ca. 4,000 BP) or younger. The relative age of these surfaces is based on the degree of soil development and the knowledge that the floodplain has been highly dissected over time. It should be pointed out that the age estimate is presented without the benefit of radiometric dating or diagnostic artifacts. A more accurate date of the floodplain chronology would be possible with the benefit of diagnostic artifacts and radiometric dates.

JMA also excavated 11 STPs on the three small benches south of the fenceline in the Plum Creek tract. The STPs resulted in the recovery of a single flake fragment of gray chert on the third or smallest bench. Two additional STPs were excavated on the bench, but no other artifacts were recovered. The bench, which measures less than 8 x 10 m, has been disturbed by logging activities as well as two former logging roads. The flake fragment represents an isolated artifact find and therefore no site number was assigned and no site form completed. The eight STPs on the two larger benches produced negative results. These benches have also been disturbed by erosion and logging activities and logging roads in the past. No further archeological work is recommended.

The pedestrian survey and subsequent placement of 11 soil probes within the pipeline corridor was successful in that it was possible to differentiate disturbed areas from those relatively undisturbed. The disturbed areas include the following: (1) an area beginning at the plant site and extending north along the pipeline corridor for ca. 300-400 m; (2) a 300 m segment on either side of US 60 where the corridor would be located within the existing sewer line corridor (this is also an area where Sewell Creek was entrenched and channelized many years ago); (3) an area of pavement and the associated junkyard near the confluence of Little Sewell Creek and Sewell Creek (this is another area where Sewell Creek has been channelized); (4) the entire length of the pipeline corridor on the north side (left-hand bank) of Sewell Creek between the bridge crossing and the railroad bridge near the confluence of Sewell Creek and Meadow River. Soil probes #4-6 are located in the only portion of the pipeline corridor that has the potential to contain archeological sites in an undisturbed context. Soil probes in this portion of the corridor are relatively undisturbed and exhibit a moderately thick Ap horizon underlain by A/B, and either Bw or Bt soil horizons. Once the pipeline corridor if finalized, it is recommended that an intensive subsurface investigation of the area between soil probes #4-6 be undertaken.

Finally, JMA conducted a walkover survey of the 17-acre land exchange property. This property varies from relatively steep to very steep as one moves away from Wolfpen Creek. The area between Wolfpen Creek and US 60 is marked by a rocky talus slope that contains numerous boulders, and the northern half of the 17-acre property is extremely steep. Numerous former logging roads crisscross this area. In sum, the land exchange area is steep, extremely rocky in parts, and heavily disturbed by former logging roads. Erosion of exposed soils on these steep slopes has reduced the surface horizon to only a few cms. No archeological sites and no high probability areas were identified in the land exchange property as a result of the pedestrian survey. No further consideration of archeological resources is recommended for the land exchange tract.

7.2 MANAGEMENT RECOMMENDATIONS

Stage 2 of the Phase I investigations for the proposed WGC Plant Site and associated infrastructure included both pedestrian survey and the excavation of STPs, soil probes, and backhoe trenches. Stage 2 field investigations were conducted in the following areas: (1) high probability areas at the plant, (2) the benches in the Plum Creek tract south of the property fenceline; (3) the steam/water pipeline corridor, and (4) the 17-acre land exchange property. Despite the excavation of 32 STPs and eight backhoe trenches, no archeological materials were recovered in the proposed plant site during the Phase I survey, and only a single isolated chert flake fragment was recovered from the STPs on the benches. Based on the results of the background research, Stage 1 and 2 (Phase I) archeological investigations, and the excavation of eight backhoe trenches, it is JMA's recommendation that the proposed plant site and the benches in the Plum Creek tract have no potential to contain significant archeological deposits. JMA recommends that these areas should be considered cleared for purposes of Section 106 compliance and no additional archeological consideration is warranted in these areas. It should be reiterated that the proposed construction footprint for the plant site is likely to be smaller than the area illustrated in Figure 9. As discussed previously, the most current design plans do not disturb Sewell Creek or the oxbow meander along the creek.

The pedestrian survey and the placement of judgmental soil probes along the steam pipeline corridor demonstrated that the majority of the corridor is highly disturbed and has no potential to contain significant archeological sites. However, one section of the potential pipeline corridor,

between Soil Probes #4-6, contains relatively undisturbed soils and this area has the potential to contain intact archeological deposits (see Figure 23). It is recommended that this segment of the pipeline corridor be subjected to an intensive Phase I survey, as per WV SHPO guidelines, once the exact alignment of the corridor is finalized. As discussed in the May 12th meeting with the WV SHPO, any additional surveys that are required to satisfy Section 106 consultation requirements will be formalized. The survey of the land exchange property did not identify any sites or any high potential areas. Therefore, this area is recommended cleared for purposes of Section 106, and no further archeological consideration of the land exchange property is warranted.

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Phase I Archeological Survey of the Proposed Transmission Line Corridor Western Greenbrier Co-Production Project Greenbrier & Nicholas Counties, West Virginia

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WV SHPO File Report # FR 04-705-GB 1

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PHASE I ARCHEOLOGICAL SURVEY OF THE PROPOSED TRANSMISSION LINE CORRIDOR WESTERN GREENBRIER CO-PRODUCTION PROJECT GREENBRIER & NICHOLAS COUNTIES, WEST VIRGINIA

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ABSTRACT

In July 2006, Potomac-Hudson Engineering, Inc. (PHE) retained John Milner Associates, Inc. (JMA) to conduct an intensive Phase I archeological survey of the proposed electrical transmission line corridor from Rainelle in Greenbrier County to Grassy Falls in Nicholas County. The transmission line corridor, which totals approximately 17.7 miles, was divided into three segments. Segment A, surveyed by JMA in 2004, measured less than a mile in length and extended westward from the proposed power plant facility to the existing Appalachian Electric Power (AEP) transmission line. Segment B, approximately 2.75 miles in length, paralleled the existing AEP line from just south of the Rainelle golf course to a point approximately 3,000 ft. north of Meadow River. Segment C, which measured approximately 14.2 miles in length, trended north-northeast from its split with the existing AEP line to the terminus at the Grassy Falls subdivision. Segment C was subjected to a pedestrian survey by URS in 2005. Although no sites were identified, the URS team did identify several areas with a moderate potential for containing archeological sites. The archeological study included four major tasks: (1) background research and a site file search at the West Virginia State Historic Preservation Office (WV SHPO); (2) a pedestrian survey of Segment B; (3) a systematic shovel test survey of archeologically sensitive areas; and (4) preparation of an archeological report to the guidelines of the WV SHPO.

Background research was conducted July 31, 2006 at the WV SHPO and the WV Division of Archives and History. Review of the WV SHPO site files indicated that no archeological sites or surveys have been recorded within one mile on either side of the proposed powerline corridor. The intensive Phase I archeological survey was limited to areas of proposed ground disturbance (e.g., tower locations) within archeologically-defined sensitive areas, provided that these areas have not been too disturbed by previous land-use practices. Field investigations were conducted from August 1, 2006 through August 18, 2006 by a three-person crew. The pedestrian survey of the 2.75 mile Segment B corridor totaled about 50 acres. The survey crew was spaced at 15-m (50 ft.) interval transects along the 45 m (150 ft.) wide project area. Additional pedestrian survey was conducted along three re-routed portions of Segment C. The pedestrian survey along Segment C totaled approximately 46 acres. JMA excavated 353 STPs within areas WG 1 through WG 12, or the equivalent of almost 20 acres. STPs, which measured approximately 50 centimeters (cm) in diameter, were excavated at 15-m intervals on parallel transects that were spaced 15-m (50 ft.) on either side of the proposed corridor centerline. Judgmental STPs were excavated in areas not identified during the URS survey, but determined by JMA as having a potential for archeological resources. In addition, one judgmental shovel test was excavated in within a feature, and radial shovel tests were excavated at 7.5 m (25 ft.) intervals in cardinal directions around positive shovel tests.

The intensive survey resulted in the identification of one archeological site, Site 46NI655, also known as Hominy Mill. Background research suggests the town of Hominy Mill was most likely a logging camp related to the lumber mill operations at Hominy Falls. Hominy Falls is located approximately two miles upstream (south) along Hominy Creek at a prominent waterfall along the creek. The town of Hominy Falls and the associated lumber mill operation, including the railroad tracks in the surrounding areas, were owned and operated by the Pardee & Curtin Lumber Company. In 1900 the P&CL purchased a 25-year timber contract on several large tracts in Nicholas County, and sometime between 1900 and 1905, the company constructed and opened four lumber mill towns in Nicholas County.

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ABSTRACT

The archeological site, which is confined to the proposed powerline corridor (and immediately adjacent area), consists of an abandoned narrow-gauge railroad bed, five structural features, several surface artifact scatters, a surface concentration of brick fragments, and four positive STPs. The features include one depression (a possible well), one cut-stone foundation, a grouping of four stone piers, and two mounds of stone rubble and earth. The latter three features may represent the structural remains of former residences. For example, shanty railroad car houses may have been placed on stone piers or mounds adjacent to the tracks in order to elevate the house floor above the ground surface. The railroad bed bisects the site in an east-west direction. Field observations indicate that numerous structural features (mounds), depressions, and artifact scatters continue along both sides of the railroad bed for several hundred meters both east and west of the designated site area.

Hominy Mill first appears on the 1920 *Map of Nicholas County showing Topography*, but the town is not illustrated on the 1935 *Richwood, WV 15 Minute Quad* map (Figure 8), nor does it appear on any subsequent maps. The artifacts collected from the site suggest a period of occupation during the first quarter of the twentieth century, which corroborates the historic information collected about Hominy Mill and the P&CL operations in Nicholas County. The features and artifact assemblage collected from Site 46NI655 are similar to the materials reported by Brashler from the Dogway site in southernmost tip of Webster County (1991). The Dogway site represents a short-term, family logging camp or town, as opposed to a single-gender, logging shanty camp. Surface features at the Dogway site included several depressions, a stone foundation (root cellar), brick chimney fall, rock piles, shanty house locations, and narrow-gauge railroad beds (Brashler 1991[4]:64).

Site 46NI655 is recommended eligible for the National Register under criterion “d” (information potential). The site retains integrity both spatially (i.e., the features and the artifact scatters appear to be undisturbed [except for years of neglect] on the surface) and temporally (i.e., positive shovel tests confirm that the artifacts are confined to the O and A horizons and that the soils have not been disturbed or truncated since the town was abandoned). The size of the hemlocks, yellow poplars, oaks, and beech trees provide indirect evidence that the site area has been abandoned and generally undisturbed for the last 50-60 years, and probably longer. The presence of structural features (e.g., foundations, stone piers, rubble mounds), associated artifact scatters, and positive shovel tests (both within features and yard areas) demonstrate that the site has the potential to yield significant information about the history of Hominy Mill and its inhabitants. The WV SHPO has identified more than a dozen historic context research themes. Of these, at least seven research themes may be relevant to the archeological site identified as 46NI655. These include the following (in no particular order): Community Planning and Development, Social and Cultural, Economic Development, Transportation, Domestic Life (and Lifeways), Industry, and Commerce and Trade.

At the present time, it appears the site could be adversely affected by ground disturbance activities. That is, ground disturbance within the corridor could disturb the integrity of the features, artifact scatters, and archeological deposits within the site boundaries. Ground disturbing activities (e.g., clearing and uprooting trees along the powerline corridor, dragging trees along the ground in order to remove them from the corridor, and vehicular traffic (logging trucks and other vehicles) could disturb and adversely effect the integrity of the features, artifact scatters, and archeological deposits. Given the currently proposed alignment, if the site is determined to be eligible, then the powerline corridor will have an adverse effect on Site 46NI655. If adverse effects to the site can not be avoided, then JMA recommends data recovery and oral history to mitigate the adverse effect to the site.

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TRANSMISSION LINE CORRIDOR SURVEY
GREENBRIER & NICHOLAS COUNTIES, WEST VIRGINIA

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

Previously in 2004-2005, John Milner Associates, Inc. (JMA) was retained by Potomac-Hudson Engineering, Inc. (PHE) of Bethesda, Maryland to conduct Phase I archeological and geomorphological investigations for the Western Greenbrier Co-Production Demonstration Project. Specifically, the U.S. Department of Energy (DOE) and PHE are preparing an EIS (and appropriate technical support documentation) for the referenced Co-Production Facility that would be sited in Rainelle, Greenbrier County, West Virginia. The proposed facility would be constructed and operated by Western Greenbrier Co-Generation, LLC (WGC), with DOE providing financial support through a 5-year cooperative agreement with WGC under the DOE Clean Coal Power Initiative (CCPI) Program. The facility would be designed for long-term commercial operation (at least 20 years) following completion of the cooperative agreement. DOE's support would amount to 50% of the development cost for the proposed facility.

DOE's sponsorship of the cultural resources investigations is required under several federal regulations, including, but not limited to, the National Environmental Policy Act (NEPA) of 1969, as amended; the National Historic Preservation Act (NHPA) of 1966, as amended, and its implementing regulations 36 CFR 800; and the Native American Graves Protection and Repatriation Act (NAGPRA). The DOE, PHE, and JMA, in consultation with the West Virginia State Historic Preservation Office (WV SHPO), followed a staged approach to the field investigations in order to comply with Section 106 and NEPA requirements. The results of the 2004-2005 cultural resource investigations are presented in a report prepared by JMA (Stevens and Chadwick 2005).

In the fall of 2005, WGC contracted with URS Corporation (URS) "to conduct initial cultural resource and ecological evaluations of the section of the proposed "Alternate" electrical transmission corridor [that was] not part of the initial EIS studies (i.e., north of Meadow River to Grassy Falls" (URS Corp. 2005:1-2). The URS cultural resource evaluation consisted of background research and a pedestrian survey of the Alternate corridor, which measured approximately 14 miles long and 150 feet (ft.) (45 meters [m]) wide. The background research and the pedestrian survey failed to identify any archeological sites within the corridor. However, the survey did locate seven areas with a medium probability of containing archeological sites. URS recommended an intensive subsurface investigation of these seven locations.

In July 2006, PHE retained JMA to conduct an intensive Phase I archeological survey of the proposed electrical transmission line corridor. As part of the power-generating plant, WGC has proposed an alternative electrical transmission route. "The Alternate Route would follow the [existing] American Electric Power (AEP) line from the golf course at Route 60 to a point approximately 3,000 feet (ft.) north of Meadow River and then proceed directly north to the Grassy Falls subdivision near Nettie, WV (URS Corp. 2005: 1-1)." More specifically, the Alternate Route, which totals approximately 17.7 miles, has been divided in three segments (Figure 1). Segment A, surveyed by JMA in 2004, measures less than a mile in length and extends westward from the proposed power plant facility to the existing AEP line. Segment B, which measures approximately 2.75 miles in length, would parallel the existing AEP line from just south of the Rainelle golf course to a point approximately 3,000 ft. north of Meadow River. Segment C, which measures approximately 14.2 miles in length, would trend north-northeast from its split with the existing AEP line to the terminus at the Grassy Falls subdivision (Figure 1).

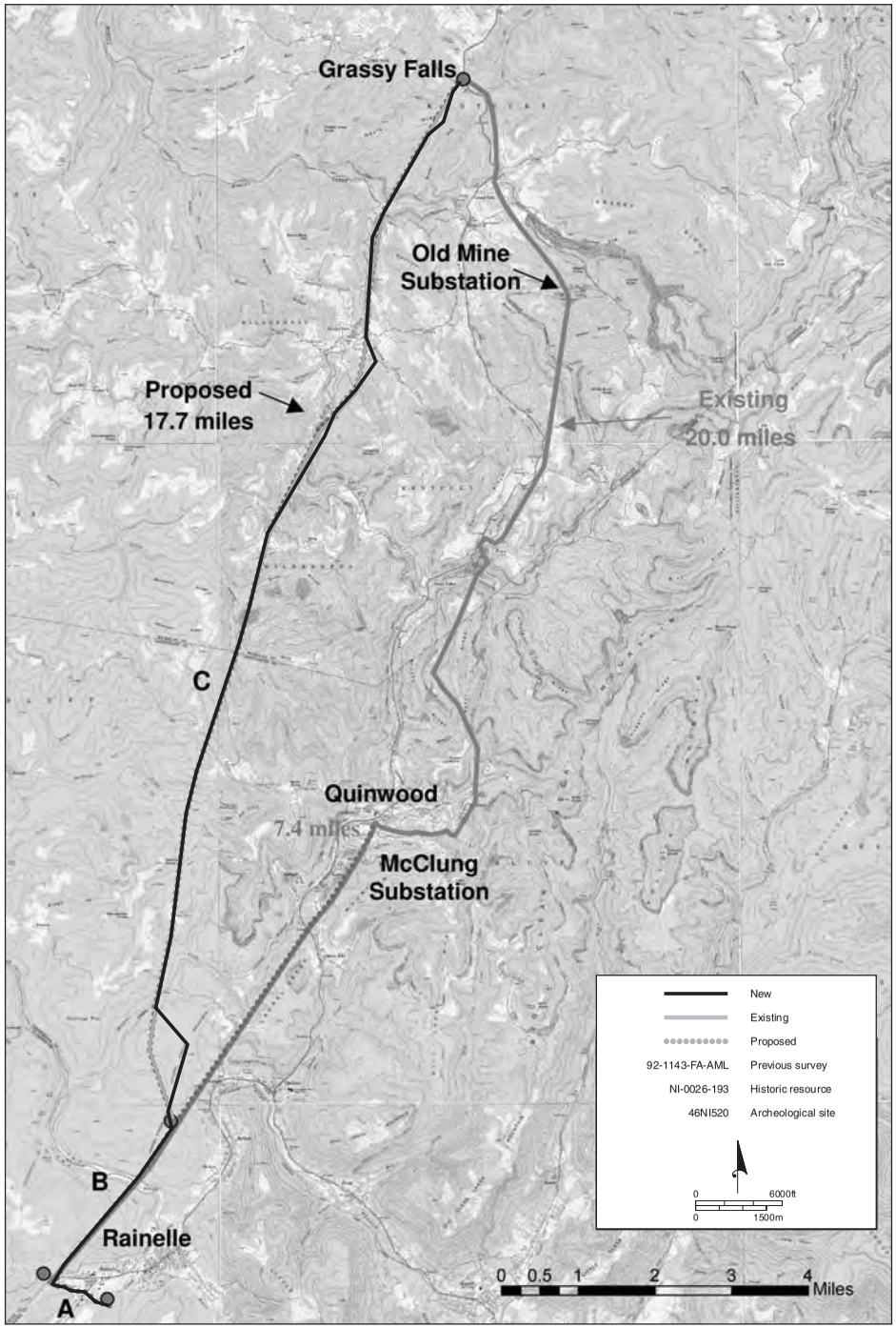


Figure 1. Detail of transmission line corridor showing segments A-C, *Rainelle* (USGS 1976), *Corliss* (USGS 1980), *Quinwood* (USGS 1995), and *Nettie* (USGS 1995).

JMA was contracted by PHE to conduct an intensive archeological survey of the proposed transmission corridor. The archeological study included four major tasks: (1) background research and a site file search at the West Virginia State Historic Preservation Office (WV SHPO); (2) a pedestrian survey of Segment B; (3) a systematic shovel test survey of nine archeologically sensitive areas; and (4) preparation of an archeological report to the guidelines of the WV SHPO. Prior to initiation of the JMA field investigations, the systematic shovel test survey was to include the seven archeologically sensitive areas identified by URS in Segment C, as well as two sensitive areas within Segment B. The determination of archeologically sensitive areas located in Segment B was based on review of existing map data because the area had not been subjected to a pedestrian survey, as was done in Segment C. Figure 2 illustrates the proposed transmission line corridor with both the pedestrian survey areas and the shovel test areas highlighted separately. Figure 2 also illustrates the location of previous cultural resource surveys in the area as well as cultural resources recorded with the WV SHPO.

1.2 STUDY AREA AND AREA OF POTENTIAL EFFECT

The study area for purposes of the background research (see Chapter 3.1) was one mile on either side of the proposed centerline for the powerline corridor. The 17-mile corridor traverses parts of Greenbrier and Nicholas counties. However, in terms of the intensive Phase I archeological survey, the Area of Potential Effect (APE) was limited to areas of proposed ground disturbance (e.g., tower locations) within archeologically-defined sensitive areas, provided that these areas have not been too disturbed by previous land-use practices. Within the aforementioned archeologically sensitive areas, the APE (i.e., the areas of proposed ground disturbance) is limited to the various tower locations within the 17 plus mile corridor. The shovel test survey within the aforementioned archeologically sensitive areas followed WV SHPO guidelines. That is, shovel test pits (STPs) were excavated at 15-meter (m) intervals along parallel survey transects that were spaced 15 m apart. As per the scope of work, two parallel rows of STPs were excavated within the sensitive areas.

Immediately prior to conducting the field survey, Mr. Brian Neely of WGC informed the JMA survey team that some alterations had occurred in the corridor alignment within Segment C. After discussions with Mr. Fred Carey, Project Manager for PHE, it was agreed that JMA would conduct a pedestrian survey of the new powerline corridors and shovel tests within the new corridor alignment would be excavated on an “as needed” or “judgmental” basis pending the outcome of the pedestrian survey.

1.3 TEAM ORGANIZATION AND REPORT FORMAT

Archeological investigations were directed and managed by Mr. J. Sanderson Stevens (Principal Investigator and Senior Author). Mr. Brian Corle, Project Archeologist, directed the field survey and contributed to the report. Ms. Kerri Holland served as Assistant Archeologist and assisted Ms. Lynn Jones with the artifact processing and cataloguing. Dr. William Chadwick and Mr. Matt Harris assisted in the preparation of GIS graphics. Mr. Robert Schultz prepared the final report graphics and plates, and Ms. Margy Schoettle prepared the final report manuscript.

Following the report introduction, Chapter 2 presents an overview of the environmental setting, Chapter 3 discusses the results of the background research, and Chapter 4 summarizes the prehistoric and historic cultural context. Chapter 5 outlines the field and lab methods used during the archeological investigations, and Chapter 6 presents the survey results and interpretations.

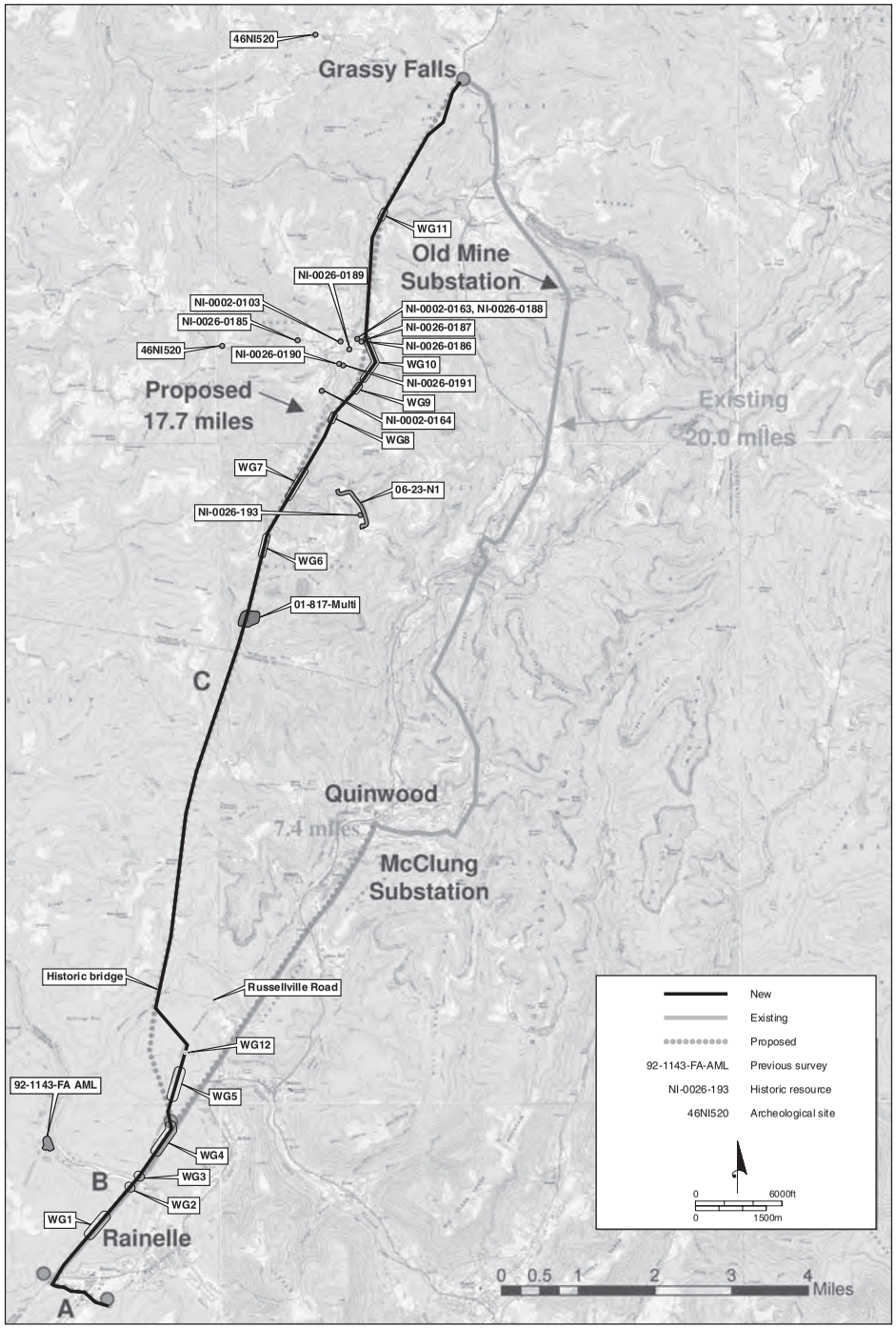


Figure 2. Detail of transmission line corridor showing new pedestrian survey areas, shovel test areas, and results of site file search at WV SHPO, (*Rainelle* (USGS 1976), *Corliss* (USGS 1980), *Quinwood* (USGS 1995), and *Nettie* (USGS 1995).

Chapter 7 provides the report conclusions and management recommendations, and Chapter 8 presents the References Cited. Appendices, tables, figures, and plates conclude the report.

2.0 ENVIRONMENTAL SETTING

2.1 PHYSIOGRAPHIC PROVINCES

Greenbrier and Nicholas counties, located in southeastern West Virginia, are situated near the eastern margin of the Appalachian Plateau Physiographic Province. The Appalachian Plateau, which dominates the western two-thirds of the state, consists of a heavily dissected, western-tilting plateau that is underlain by sedimentary rocks of the Mississippian, Pennsylvanian, and Permian periods (WVGES 1969). Rock formations in the Appalachian Plateau Province typically consist of relatively flat-lying rocks that frequently contain easily mined coal deposits. The eastern margin of the Appalachian Plateau also contains the Allegheny Front subprovince, a prominent geological feature that runs from northeast to southwest across the state. Immediately east of the Allegheny Front are the folded mountains and valleys of the Valley and Ridge Physiographic Province. Coal is limited to the western one-third of the county and is more or less defined by the extent of the Appalachian Plateau.

The eastern third of the state is dominated by the Valley and Ridge Physiographic Province, which is more widespread in Pennsylvania, Virginia, and North Carolina. Within Greenbrier County, the Valley and Ridge Province generally lies east of the Greenbrier River and consists of series of parallel mountain ridges and narrow valleys. The structural geology of the Valley and Ridge Province is complex and includes extensive thrust faults and folds. Valley formations are generally underlain by less-resistant shale and siltstone, while Ridge formations are generally underlain by more resistant rock such as sandstone and limestone. Rock formations are oldest in the eastern part of the state and become progressively younger in the western part of the state, likewise rock formations in the northern part of the plateau are younger (Permian) than those in the southern part of the plateau (Mississippian). Elevation ranges from about 2,000 feet or less in the valley bottoms in the eastern part of the county to over 4,400 feet in the mountain ranges in the northwest corner of the county.

2.2 GEOLOGY

The Greenbrier Formation, which underlies the central and western portions of Greenbrier County, dates to the Mississippian Period (323–354 million years ago [Ma]). The Greenbrier Formation predominantly consists of limestone with red beds of shale and sandstone. This formation, which depicts a time when the inland seas were expanding, represents the last significant marine deposits in the state (2004 www.wvgs.wvnet.edu/www/geology/geolhist.htm). Low-grade coal seams occur within this formation, but for the most part the more prominent and higher grade coal deposits are associated with the Pennsylvania formations that occur in the western two-thirds of the Appalachian Plateau.

Pennsylvanian Period rocks (290–323 Ma) consist of various sequences of limestone, coal, shale, clay and sandstone. During the early Pennsylvanian Period, the land dropped to near sea level, and land continued to sink for the next 50 million years at about the same rate that deposition was taking place (2004 www.wvgs.wvnet.edu/www/geology/geolhist.htm). Thus, swamp conditions prevailed throughout the period, resulting in the thousands of feet of non-marine deposits of sandstone, shale, and coal. In general, formations in the southern part of the Appalachian Plateau are older than those to the north.

During the subsequent Permian Period (290–248 Ma), the Appalachian Orogeny began, and West Virginia and other portions of eastern North America were uplifted. Permian-aged formations in West Virginia are confined to the northwestern one-third of the state and mainly consist of sandstone, shale, and limestone. Coal beds occur within Permian formations in the northwestern part of the state. As mountain building continued, erosion of existing sediments increased, the inland seas disappeared, and marine deposition ceased. The Appalachian Orogeny resulted in major folding and thrust faulting events, which eventually lead to the development of the Appalachian Mountains (WVGES 1969). It is during this period that the Mississippian and Pennsylvanian sediments were uplifted and subsequently dissected to form the Appalachian Plateau (2004 www.wvgs.wvnet.edu/www/geology/geolhist.htm).

Rocks of the Mesozoic Era (248–65 Ma) do not occur in West Virginia, and with the exception of Quaternary Period (1.8 Ma – present) alluvial sediments in low-lying areas, Cenozoic Era (65 Ma – present) rocks are also absent in both Greenbrier and Nicholas counties as well as the remainder of the state (WVGES 1969). During the Pleistocene Epoch (1.8 Ma-10,000 yrs BP) large continental glaciers covered much of North America. Although glacial ice did not advance into West Virginia, the proximity of the ice front influenced paleoclimatic and paleoenvironmental conditions throughout the state. Drainage patterns were completely altered during the Pleistocene. For example, the Monongahela River, which formerly drained northward into the St. Lawrence River, was diverted westward and drained into the Ohio River system, which at the beginning of this time period followed the ancient Teays River channel across central Ohio, Indiana, and Illinois. The lower third of the Illinois River is the only surviving active channel segment of the ancient Teays River system.

Within the Nicholas County and northwestern Greenbrier County, Pennsylvanian-aged sedimentary rocks of the Pottsville Group dominate the transmission line corridor. The Pottsville Group, which consists of the Kanawha, New River, and Pocahontas Formations (from youngest to oldest), underlie the majority of the project corridor. The rock units within the Pottsville Group include various sequences of sandstone, clay, shale, coal, and limestone. The Kanawha Formation, the youngest of the three formations, is 50 percent sandstone, and sandstone comprises the most common rock unit in the other two formations. In the southeastern portion of Nicholas County, rocks of the New River Formation form a majority of the ridgeslopes and ridgetops; this is especially true along the southern portion of the corridor. In the northern portion of the corridor, rocks of the Kanawha Formation occur on some ridgetops, but rocks of the New River Formation are still dominant. In the northern part of the county, near Braxton County, rocks of the younger Kanawha Formation are more common (Carpenter 1992:76-77).

2.3 GEOMORPHOLOGY

The geomorphology within Greenbrier and Nicholas County is in part a reflection of the orientation of the underlying rock formations as they relate to the respective physiographic provinces. The landscape reflects millions of years of mountain building, seasonal cycles of weather, and the results of weathering and stream erosion for thousands of years. For example, eastern Greenbrier County, which lies in the Valley and Ridge province, is dominated by inclined rock formations and broad linear valleys which have resulted in narrow stream valleys that often contain surprisingly broad alluvial terraces. The project area (i.e., western Greenbrier County and southeastern Nicholas County) lies within the Appalachian Plateau. The Plateau contains predominantly horizontal or nearly horizontal rock formations that result in narrow, steep-sided stream valleys with little or no terrace development. The southern portion of the study area in Greenbrier County is drained by the Meadow River, while the northern half of the study area in

Nicholas County is drained by the Gauley River. Principal streams in the study area include Meadow and Sewell creeks in Greenbrier County and Anglins, Grassy, Hominy, and Roaring creeks in Nicholas County.

As noted above, Cenozoic deposits, with the exception of Quaternary-aged alluvium within the larger stream valleys are not present in Greenbrier or Nicholas counties. Within the study area, Holocene and historic alluvium (within the last 125 years), if present, are confined to larger stream valleys such as Meadow River, Sewell Creek, Meadow Creek, Hominy Creek, and Grassy Creek. The amount, depth, and age of the alluvium is highly variable between drainage basins and is dependent on the size of the drainage basin, the width of the floodplain, and the gradient of the stream and surrounding landforms. Many of the smaller streams are susceptible to extensive flooding and scouring, which effectively removes all but the most recent alluvial sediments.

Landforms within the project corridor can be classified between uplands and lowlands. Lowland landforms include floodplains and stream terraces; uplands include steep ridge and/or mountain slopes (including toeslopes), broad ridge and/or mountain tops, saddles, and benches. Landforms considered by URS (URS 2005) to be conducive to prehistoric or historic occupation include stream terraces, ridge tops, benches, saddles, and mountain tops. Toeslopes adjacent to stream terraces may have been occupied depending on slope, aspect, soil drainage, and amount of talus.

2.4 SOILS

Soils within Greenbrier County in part reflect the lithology of the underlying rock formations and the respective physiographic provinces. For example, eastern Greenbrier County, which lies in the Valley and Ridge province, consists of moderately deep to shallow soils that formed in material that weathered from shale (Gorman et al. 1972:1). The central part of the county (Allegheny Front) consists of deep, moderately fertile to fertile soils derived from limestone (Gorman et al. 1972:1). Finally, the western third of the county, which is part of the Appalachian Plateau, contains deep, easily eroded soils that formed in material weathered from shale (Gorman et al. 1972:1). Soils within the proposed project corridor belong to the Dekalb-Gilpin-Laidig-Cookport soil association.

Dekalb-Gilpin-Laidig-Cookport. Soils belonging to this soil association occur along the transmission line corridor from the inception of the proposed corridor west of Rainelle northward to the county line (Gorman et al. (1972: Map Sheets #10, #17, 27 and #37, from north to south). This soil association is described as having "moderately deep and deep, well drained and moderately well drained, very steep to gently sloping, very stony soils of the high mountains (Gorman et al. 1972: 3). This soil association is dominated by mostly steep to very steep mountains and ridges with elevations of 2,800 to 3,600 feet. These soils are underlain by gray sandstone and shale deposits that have extensive coal seams. Soils within this association consist of 35 percent DeKalb soils, 25 percent Gilpin soils, 15 percent Laidig soils, and 10 percent Cockport soils. Other soils comprise the remaining 15 percent. Nearly 90 percent of this soil association is covered in woodlands.

Review of Map Sheets #10, #17, #27, and #37 indicate that three soil series represent over 90 percent of the soils in the project corridor. These soils are as follows: (1) DeKalb-Gilpin very stony complex (20 to 40 percent and 40 to 65 percent), (2) DeKalb-Cockport very stony loams (5 to 20 percent), and (3) Laidig-Ernest extremely stony complex (15 to 30 percent). DeKalb-Gilpin very stony complex soils occur on steep ridge and mountain slopes, whereas DeKalb-Cockport soils occur on broad, sloping to gently sloping ridge and mountain tops. Finally, the Laidig-Ernest

soils occur on ridge toeslopes and represent colluvial deposits. Alluvial soils are found on floodplains and terraces along Meadow River and Meadow Creek.

Soils classified as Strip Mine Spoil make up the balance of the soils in the project corridor. These soils, which consist of a mixture of soil, shale, sandstone, and coal, frequently occur on level or nearly level areas that have been modified as a result of strip mining. This type of mining frequently follows contours around the mountain slopes, thereby reducing a portion of the stripped area by as much as 20 to 50 feet in elevation. The refuse piles are generally pushed to the middle of the leveled areas while the contoured margins usually have very steep slopes. Revegetation of these areas is difficult due to the stony nature of the soil residual, the extremely low Ph values, excessive erosion, and low available soil moisture capacity (Gorman et al. 1972).

Soils in Nicholas County within the powerline corridor belong to the Gilpin-Buchanan soil association. Soils in this association are classified as "gently sloping to very steep, well drained and moderately well drained, stony and very stony soils on uplands and foot slopes (Carpenter 1992: 5). The topography in this part of the county is characterized as rough, mountainous terrain with deeply dissected upland plateaus with broad and narrow ridges, steep to very steep side slopes, and narrow valley bottoms. Gilpin soils account for 53 percent of the soils in this association, followed by 28 percent Buchanan soils, and 19 percent other soils. Gilpin soils in the proposed corridor include Gilpin silt loam, 8 to 15 percent; Gilpin silt loam, stony, 15 to 35 percent; and Gilpin silt loam, stony, 35 to 70 percent. Gilpin soils are described as moderately deep, well drained, and gently sloping to very steep. Most of the Gilpin soils in the project corridor belong to either the Gilpin silt loam, stony, 15 to 35 percent or Gilpin silt loam, stony, 35 to 70 percent soil series. Buchanan soils within the corridor are primarily to two series: Buchanan channery fine sandy loam (8 to 15 percent) and Buchanan channery fine sandy loam (15 to 35 percent). These soils are strongly sloping to very steep, moderately well drained with stones 10 to 24 inches in diameter covering 3 to 15 percent of the ground surface (Carpenter 1992:12). Channery soils, by definition, are soils that "by volume are more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist that are as much as 6 inches along the longest axis (Carpenter 1992: 82).

Kaymine soils, which also occur within the corridor, are the equivalent to the Strip Mine Spoil soils described in Greenbrier County. That is, these soils dominate the landscape in areas of former surface coal mines. Stones and boulders cover 25 to 50 percent of the surface and siltstone fragments usually constitute 55 percent of the rock content in the soils and sandstone fragments account for about 45 percent of the rock fragments. The final soil series in the corridor are alluvial soils of the Pope-Craigsville complex. These alluvial soils are located on floodplains of rapidly flowing streams, such as Hominy Creek. These soils, which consist of 50 percent Pope sandy loam and 35 percent Craigsville gravelly sandy loam, are subject to frequent flooding.

2.5 CLIMATE

Greenbrier County has a humid continental climate, characterized by strong seasonal changes (Gorman et al. 1972:84). Climate within Greenbrier County is variable depending on both location and elevation. The Allegheny Mountains in the northwestern part of the county are some of the highest peaks in the state. Precipitation on the windward (west) side of the mountains is much higher than precipitation amounts on the leeward side (east) side of the mountains (Gorman et al. 1972:91). Additionally there are sharp differences in rainfall amounts between the valley bottoms and the mountain or ridgetops. Average precipitation in Rainelle over a 30 year period was 51 inches, compared to White Sulphur Springs in the southeast portion of the county with an

average of 38 inches (Gorman et al. 1972:91). The northwest part of the county averages about 80 inches of snow, whereas the central and eastern portions of the county average about 20 inches of snow. Both snowfall and thunderstorms are more numerous at elevations above 3,000 feet. Average daily maximum and minimum temperatures for the 30-year period in Rainelle (1931-1960) ranged from 62 to 38 degrees, with January (40 and 18 degrees) the coldest month and July and August (80 and 56 degrees) the warmest months. Rainfall in the Rainelle area and northwestern Greenbrier County averages about 25 inches during the growing season (the last week in May through September) compared to 18 inches of rain in the southeastern part of the county where the growing season is three weeks longer (Gorman et al. 1972:84).

Nicholas County also experiences a humid continental climate that is characterized by strong seasonal changes. Although mountains are often cold and snowy, valley bottoms frequently experience winter thaws that preclude a long-lasting snow cover. Average precipitation is over 46 inches per year, with about 58% coming in the months of April through September. Average snowfall is about 50 inches per year, but the number of snowy days and the amount of snow each year is highly variable. Growing season is generally considered early May through early October, with an average growing season of roughly 160 days. Temperature extremes range from -17 (1/17/1977) to 94 (8/30/1973) (Carpenter 1992:2). Compared to climatic conditions in the Rainelle area, the Nicholas County project area is somewhat more moderate with a longer growing season and less precipitation.

2.6 VEGETATION

Braun (1950:40) characterizes the modern flora of the Appalachian Plateau as a mixed mesophytic forest. This type of forest is characterized by a diversity of floral species, but there is no dominant species. Edaphic conditions, including slope, soil, elevation, available moisture, and aspect encourage the proliferation of different floral communities. At the time of initial European contact (and continuing into the early twentieth century when the Rain brothers settled in the area), common tree species of the mixed mesophytic forest included: various oak, chestnut, hickory, tulip poplar, beech, basswood, maple, and hemlock. Braun (1950) and Shelford (1963) note that different plant communities dominate at different elevations. True mixed mesophytic forests are found between 1,500 to 2,000 feet; oak-chestnut communities occur between 2,000 and 2,700 feet although maple-beech-basswood communities may occur between 2,500 and 3,500 feet. Birch-hemlock-spruce communities are more dominant between 3,500 and 4,200 feet, and spruce communities are dominant above 4,200 feet. Today, various oak species have replaced the chestnut. The secondary forests that typify the region today are markedly different than the true virgin forests encountered by the Rain brothers. The impact of deforestation, principally for timber harvesting and agricultural land clearing, decimated the mixed mesophytic forest, the associated open-forest understory, and the upland hardwoods. Today the forests in the region are characterized by xerophytic species (oak-hickory-beech) and a dense understory of thickets, vines, and greenbrier (Hubbard 1971).

Within the project area, vegetation is extremely diverse and ranges from a variety of landscapes on man-made soils to oak-hickory and oak-beech forests on relatively undisturbed ridge slopes and alluvial terraces. As note above, the soils at the waste coal piles are not conducive to revegetation and as a result very few plants grow in these areas.

Upland vegetation in the relatively undisturbed portions of the transmission line corridor consists of oak-hickory and oak-beech forests. Some of the trees in these areas have been harvested on more than one occasion over the last 100 years, thus some of the oak, hickory, and beech trees are

still relatively small. Conversely, other parts of the project corridor have not been harvested since the early 20th century. In these areas, many of the oaks and tulip poplars are quite large and have a mature understory. Understory vegetation includes ferns, sassafras, holly, greenbrier, and short grasses. Mountain laurel and pine trees are also common along the transmission line corridor on the northeast facing side of the ridge and at higher elevations. Oak-beech and pine are the dominant species within some sections of the corridor, especially those that have been disturbed by secondary logging in the last 20-25 years. Mountain laurel and holly are the dominant species in the understory along north facing slopes and more mature forests. In areas subjected to recent clear cutting, the emergent vegetation consists of oak saplings, greenbrier, wild rose thickets, vines, cow itch, and other scrub vegetation.

Vegetation in the lowland areas is somewhat variable depending on soil drainage, the degree of recent disturbance, and the duration since the most recent disturbance. For example, the higher terraces with moderately well drained soils and minor disturbances are dominated by oak-beech and pine forests with an understory of saplings and some shrubs. As the degree of land disturbance increases, or soil drainage deteriorates, vegetation is characterized by a marked increase of sweet gum and holly as well as a concomitant increase in the height and density of greenbrier, hawthorn, and other thorny vines. Some low-lying areas that have been spared extensive disturbance exhibit various types of wetland vegetation. Poison ivy and poison oak are pervasive in all low-lying settings.

3.0 PREVIOUS INVESTIGATIONS

3.1 BACKGROUND RESEARCH

Background research was conducted July 31, 2006 at the WV SHPO and the WV Division of Archives and History; both repositories are located in Charleston at the State Capital Complex. The purpose of the background research was to determine if previously recorded archeological and historic architectural resources occur within the Area of Potential Effect (APE) and to collect information on the history of settlement and development within the study area. For purposes of the background research, the APE was determined to be 1 mile on either side of the corridor. Background research included review of the state archeological sites files and records at the WV SHPO, review of published and unpublished archeological reports at the WV SHPO, and review of the state historic architectural files and records at the WV SHPO. In addition, historic photographs, maps, newspaper and journal articles, reports, and other types of information were examined and/or Xeroxed at the West Virginia State Archives. Topics researched at the State Archives included, but were not limited to, information on Greenbrier and Nicholas counties, the town of Rainelle, the Rain brothers, the Meadow River Lumber Company, the Meadow River Coal and Land Company, and Shays engines.

Records and files of the Greenbrier Historical Society in Lewisburg were also researched for information on the early history of the county and specifically on the town of Rainelle and the Meadow River Lumber Company. In addition, various websites were researched that had information on the Meadow River Lumber Company, the Pardee and Curtin Lumber Company, the history of the lumber and coal industries in West Virginia, and the Shays railroad. The West Virginia State Archives also maintains a website that contains more than 600 historic photographs of Rainelle and the Meadow River Lumber Company.

An archeological site file and records search was conducted at the West Virginia Division of Culture and History in Charleston on July 31, 2006. The powerline corridor, which trends northeast for over 17 miles from its origin just west of Rainelle, is located on four USGS 7.5' minutes maps. These include from south to north: Rainelle, Quinwood, Corliss, and Nettie. Review of the site files and 7.5' USGS maps indicated no archeological sites have been recorded on these quad maps. In fact only two archeological sites (46NI520 and 46 NI12) have been recorded within two miles of the powerline corridor. Site 46NI520 is located 1.5 miles west of Hominy Falls on a relatively flat ridgetop on the north side of County Road 13. The site, which has been disturbed by farming, produced both Archaic and Woodland points, including Kirk, LeCroy, Big Sandy, and Levanna (Ferrel 2001). Site 46NI12 reportedly consists of two conical mounds and an associated village (WVAS 1960). At the time the site was recorded in 1960, the larger mound measured 5 feet (ft.) high and 40 ft. in diameter while the smaller mound was 2-3 ft. high and 30 ft. in diameter. A number of flakes, ceramics, and broken tools were observed west of the mounds in a road bed cut, but the site form does not assign any temporal or cultural affiliation to the site. The site is located on a ridgetop northwest of Odell Town on the north side of County Road 18.

Although background research indicated that no surveys have been conducted within the powerline corridor, several small surveys have been conducted within or adjacent to the two-mile wide APE. Information regarding these surveys is presented in Table 1. The surveys, which were conducted by staff from the WV SHPO, produced negative results and no technical reports were prepared for these clearance surveys.

Table 1. Previous cultural resource surveys within or near the project corridor.

Survey No.	Proj. Name	Year	County	USGS Quad	Survey Request	Survey Result
92-1143-FA AML	Low Ash Smoke-less Coal Co.	1992	Fayette	Rainelle	Office of Surface Mining	Cleared No Effect
96-89-NI AML (Road)	Chestnut Lick Run Highwall	1996	Nicholas	Nettie	Office of Surface Mining	Cleared No Effect
01-817-Multi	Green Valley Coal Co.	2001	Nicholas & Greenbrier	Quinwood	Office of Surface Mining	Cleared No Effect
06-23-NI	Public Notice No. 200501115	2006	Nicholas	Quinwood	Corps of Engineers	Cleared No Effect

The West Virginia State and County Historic Building files and the National Register files at the WV SHPO were also checked to ensure that the powerline corridor would not impact any National Register properties or any historic buildings that have not been evaluated for National Register significance. No historic buildings or National Register properties have been recorded within the powerline corridor. However, 11 historic buildings have been recorded in the vicinity of Hominy Falls. All 11 buildings are located within the Kentucky Wilderness District of Nicholas County. Figure 2 depicts the location of the 11 historic buildings, and Table 2 summarizes important information regarding each resource. Inventory forms for the historic buildings were recorded by the WV SHPO in 2003 (Boger and Goulis 2003).

Table 2. Previously recorded historic buildings near Hominy Falls.

Resource No.	Resource Name	Bldg. Function	Date	NRHP Eligibility
NI-0002-0103		Orig. School or Store	ca 1890	Unevaluated
NI-0002-0163		Hominy Falls Store	ca 1915	Unevaluated
NI-0002-0164		Residence	ca 1910	Unevaluated
NI-0002-0185	Amick House	Residence	ca 1920	Unevaluated
NI-0002-0186	Burwell Grocery Store	Relocated Store	ca 1932/1942	Unevaluated
NI-0002-0187	Rader House	Farm Residence	ca 1942	Unevaluated
NI-0002-0188	Richardson House	UM Church Parsonage	ca 1930	Unevaluated
NI-0002-0189	Penile UM Church & Cemetery	3rd church on site, 2 log buildings previous	ca 1896	Unevaluated
NI-0002-0190	Rader House	Dr. McCutcheon	ca 1890	Unevaluated
NI-0002-0191	Rader House	Residence	ca 1903	Potentially Eligible
NI-0002-0193	Hume House	Hominy Cr. Hunt Club	ca 1910	Potentially Eligible

Based on current corridor alignments, the powerline will not physically impact any of the historic buildings in the vicinity of Hominy Falls, nor will the corridor require a physical taking of any property on which a historic building is located. Historic buildings within the town of Rainelle were discussed in a previous report on the WGC power plant site (Stevens and Chadwick 2005). As noted in the previous report, the power plant site and powerline corridor will not physically impact any historic resources in the town of Rainelle.

Background research was also conducted at the West Virginia Archives. Research at the West Virginia Archives focused on historic maps of the area and county and regional histories. Several historic maps of the area were Xeroxed for use in the report. Historic maps consulted included the 1821 Wood map, early 20th century USGS, soils, and geology maps, and maps and photographs of the Meadow River Lumber Company. Numerous documents and photographs regarding the early development of the timber and coal industries were reviewed at the West Virginia Archives.

3.2 RESULTS OF HISTORIC MAP RESEARCH

The earliest maps of the project vicinity are John Wood's 1821a "Map of Greenbrier County, Virginia" and his 1821b "Map of Nicholas County." Both maps shows very little detail in the project vicinity, save for the Meadow River, the Gauley River, and some unnamed tributary streams, such as Sewell Creek, Meadow Creek, and Hominy Creek. The first detailed map of the study area is the Harrison and Handley's 1887 "Map of Greenbrier County, WV (Figure 3). In the vicinity of Rainelle, Figure 3 identifies the Meadow River, Sewell Creek, the James River and Kanawha Pike (US 60), and a W.A. Stuart residence, which is either along Wolfpen Creek or at the confluence of Sewell Creek and the Meadow River. North of Meadow River, in the vicinity of the powerline corridor, the map provides little information. Meadow Creek and Russelville Road are labeled, but the majority of the study area is simply labeled as "Coal." Based on the configuration of Russelville Road, it appears likely that County Road 4 (CR 4) and Russelville Road are one in the same. The map indicates a bridge on Russelville Road across Meadow Creek. The name Grigg McClung appears on the map in the vicinity of present day "Crichton" and "Quinwood." The McClung substation, located on the south side of Meadow Creek, opposite Crichton, is named for the McClungs' early settlers in the region.

The next historic maps that depict the study area include two 15 minute USGS maps. From south to north these maps are *Meadow Creek*, 1912 (Figure 4) and *Winona*, 1914 (Figure 5). Figure 4 (*Meadow Creek 15'* USGS 1912) depicts the town of Rainelle. What was formerly called "East Rainelle" is labeled as "Sewell Valley" on the map. No historic buildings are depicted within the powerline corridor. Of some note is the fact that the quad map depicts railroad tracks along the south side of Meadow River, but no tracks are indicated along the north side of the river. Figure 5 (*Winona 15'* USGS 1914) presents a detail of the study area. The map identifies geographic place names in the area (such as Laurel Creek Mountain, Meadow Creek, and Walnut Knob). Two historic buildings are depicted outside of the two-mile wide study area. One is located on the western ridgeslope of Laurel Creek Mountain (above Meadow Creek) and the second building is located along an unnamed tributary of Meadow Creek, .6 mile east of Beargarden Knob and .65 mile south of Walnut Knob. Also of note is a bridge across Meadow Creek on CR 4.

Figure 6 presents a detail of "*Map I of Nicholas County Showing Topography* (White 1920). The map was compiled from existing USGS base maps and updated to reflect existing conditions. The map depicts a few houses in the vicinity of the powerline corridor between the Nicholas County line and the community of Hominy Falls. The map also depicts the community of Hominy Mill north of Hominy Falls. The communities of Hominy Falls and Hominy Mill are both located next to Hominy Creek and are connected by a railroad line. This line and others in the project vicinity are labeled as belonging to the Pardee and Curtin Lumber Company Railroad (P&CL CO RR). P & CL railroad lines are common throughout this portion of Nicholas County. The narrow gauge railroad tracks of the P&CL CO RR do not appear on modern USGS maps, nor does the community of Hominy Mill. According to Figure 6, Hominy Mill, which was located at the confluence of Hominy Creek and Grassy Creek, consisted of approximately 35 buildings. The community pattern was triangular in plan view with three narrow-gauge railroad beds contributing to the outside margins of the community pattern.

The final historic maps include Figure 7 (Price 1936) and Figure 8 (Richwood, W VA 15' USGS map, 1935). Figure 7, a topography map of Greenbrier County, depicts a railroad line on the north side of Meadow River. The railroad, the Nicholas, Fayette & Greenbrier Railroad NF&G RR) continues to the north and east up Meadow Creek to the towns of Bellburn, Leslie, Crichton, and

Appendix G3



Figure 3. Detail of *Map of Greenbrier County, W VA* (Harrison and Handley 1887), showing proposed powerline corridor.

Appendix G3

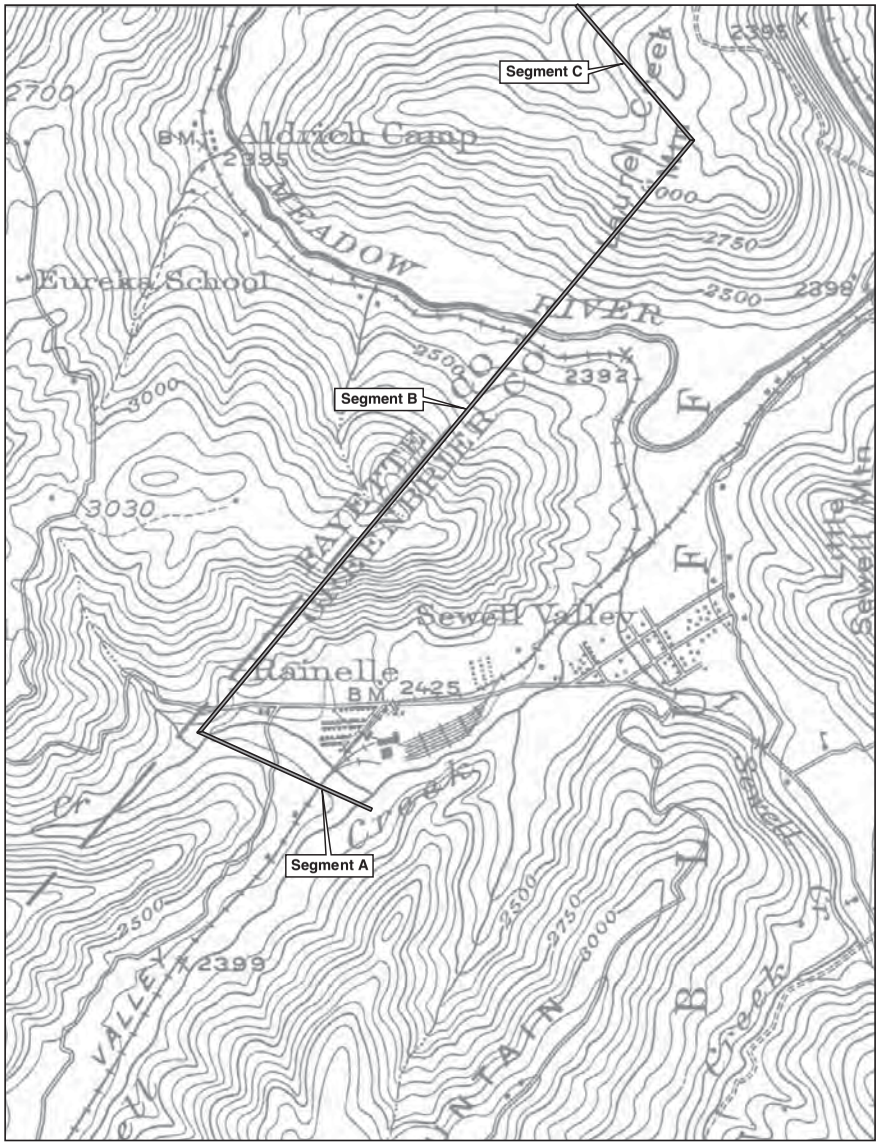


Figure 4. Detail of *Meadow Creek, W VA 15 Minute Quad* (USGS 1912), showing proposed powerline corridor.

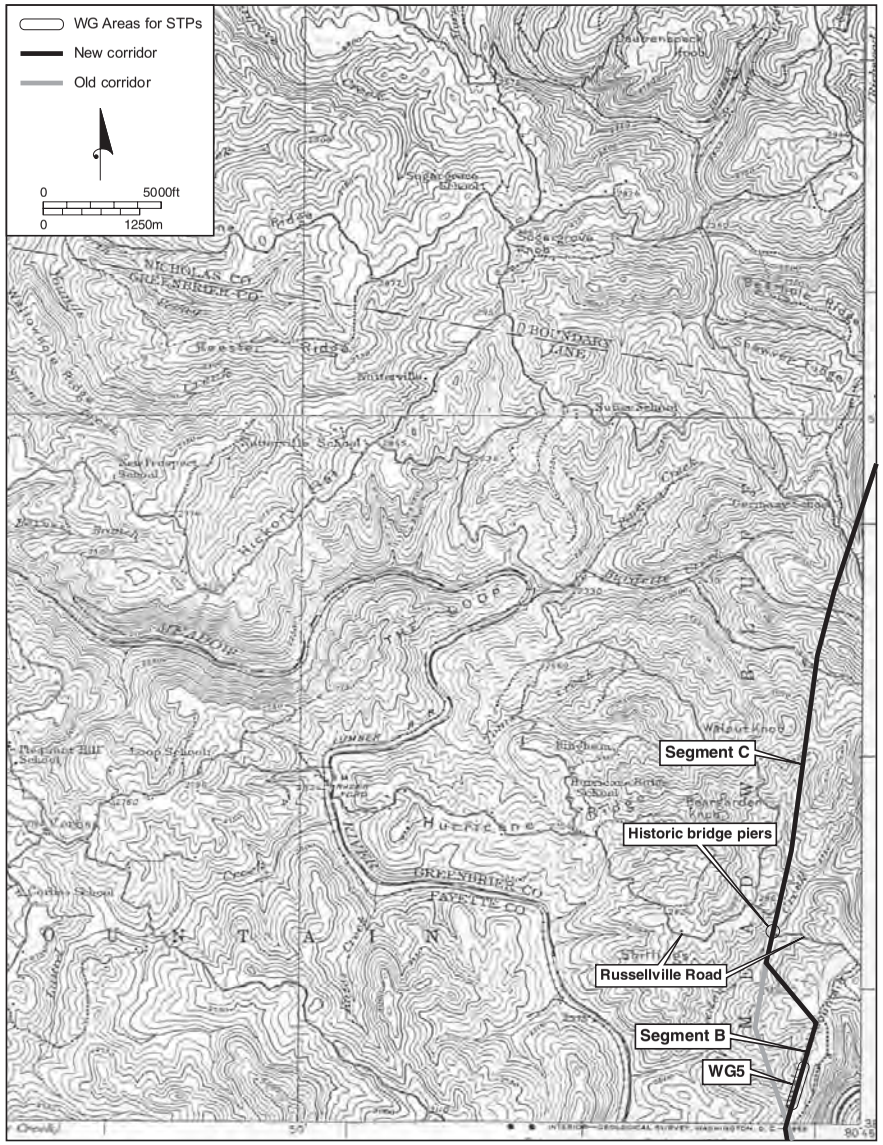


Figure 5. Detail of *Winona, W VA 15 Minute Quad* (USGS 1914), showing proposed powerline corridor.

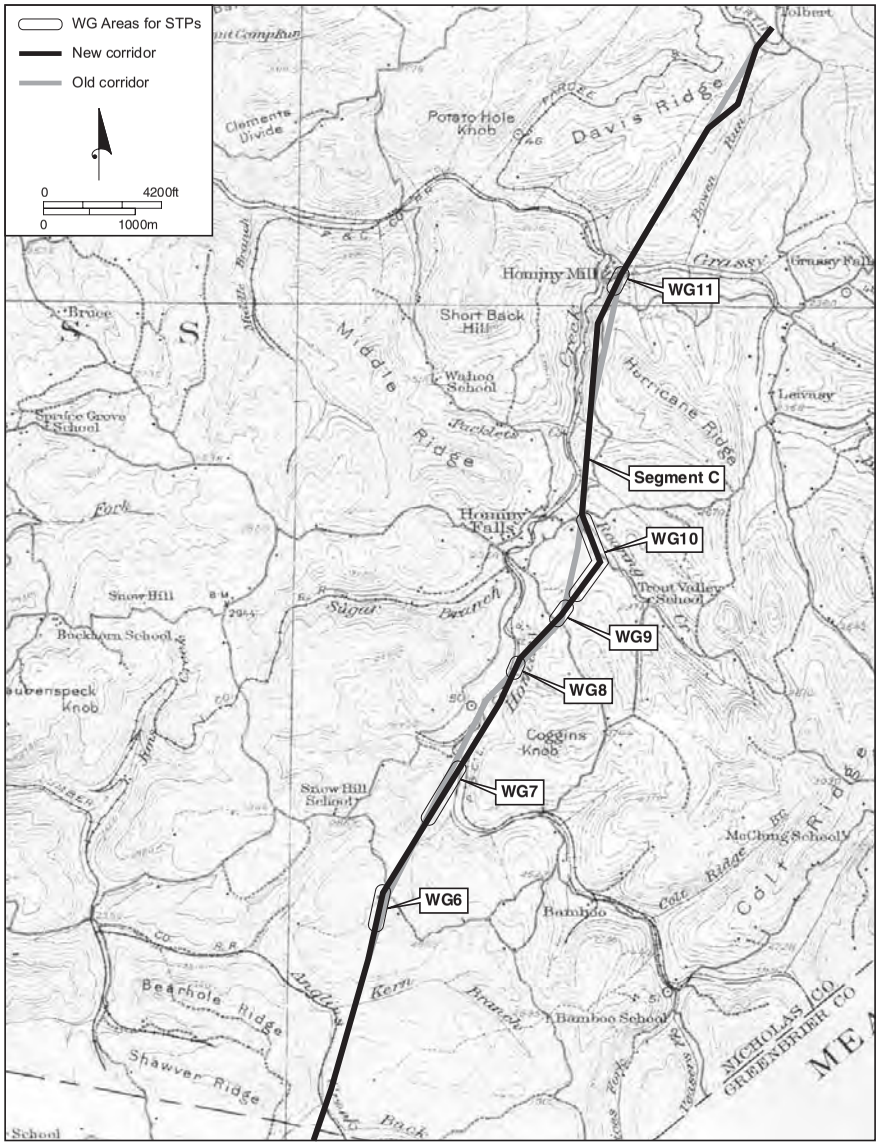


Figure 6. Detail of *Nicholas County Showing Topography* (White 1920), showing proposed powerline corridor.

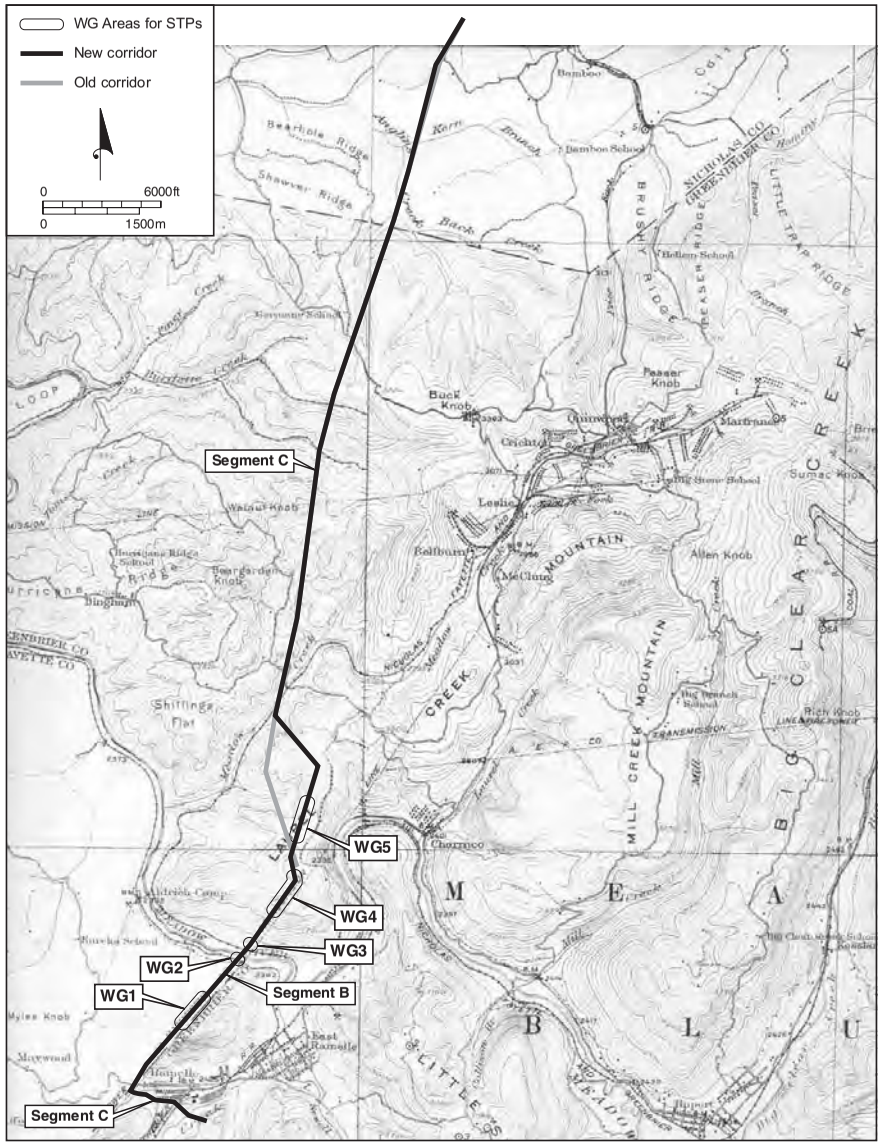


Figure 7. Detail of *Greenbrier County Showing Topography* (Price and Heck 1936), showing proposed powerline corridor.

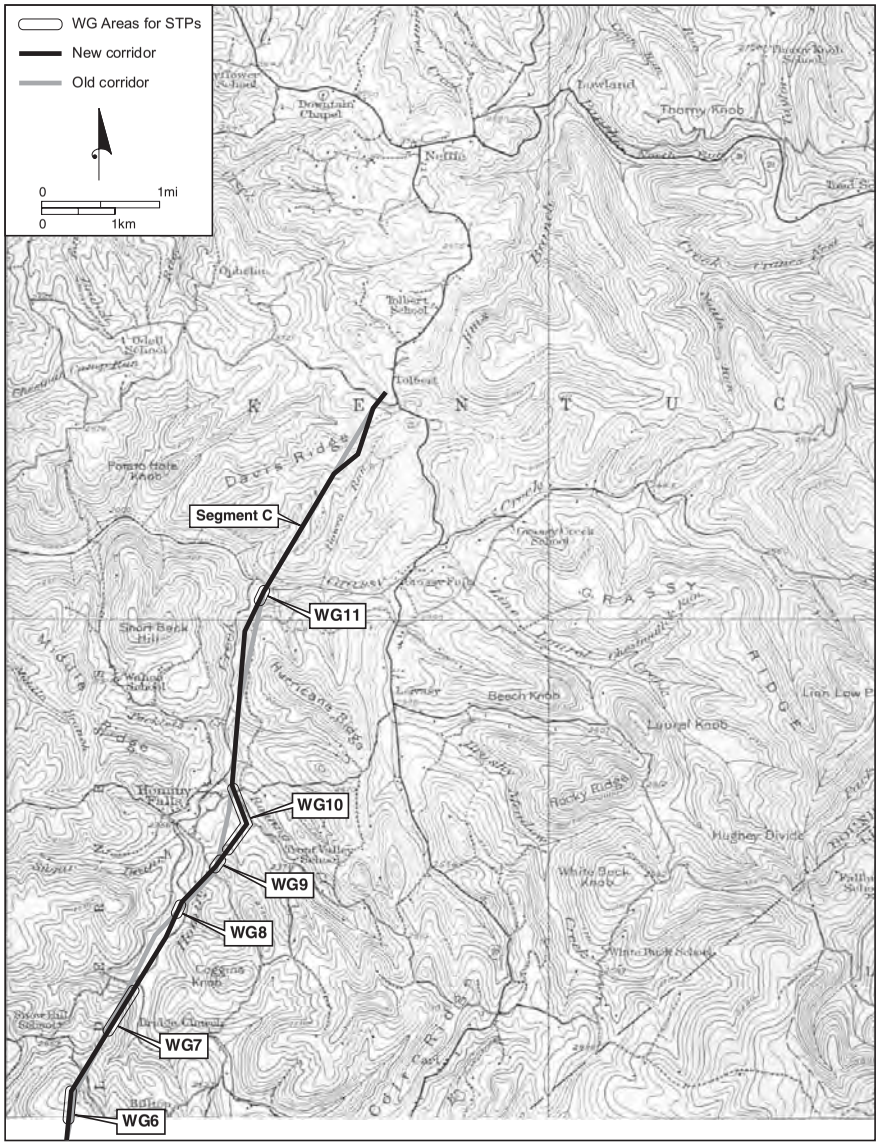


Figure 8. Detail of *Richwood, W VA 15 Minute Quad* (USGS 1935), showing proposed powerline corridor.

Quinwood. Also of note is the name change of the Sewell Valley RR (SVRR), south of Rainelle, to the NF&G RR. Tom Raine, brother of John Rain and the first General Manager of the Meadow River Lumber Company (MRL) developed an interest in low ash "smokeless" coal in the early 1920's. Tom Rain, in addition to his interests in the coal industry, bought the SVRR and other railroads in 1921. The SVRR became the NF&G RR in the mid 1920s, and the NF&G RR and its numerous logging and coal spurs continued to operate into the 1960s. Another feature of note on Figure 7 is the "Transmission Line" that parallels the Fayette and Greenbrier County line immediately west of Rainelle. The transmission line continues in a northeasterly direction to the town of Quinwood. Only a few houses are depicted in the vicinity of the proposed powerline corridor in Greenbrier County.

Figure 8, the 1935 Richwood, W VA 15' Minute quad map, shows a few houses within the vicinity of the powerline corridor. Although Hominy Falls is depicted on the map, Hominy Mill is not on the map, nor are most of the P & CL Co RR lines that were prominent on the 1920 map. The lack of additional development in this part of Nicholas County, compared to the 1920 map, can be attributed to the overexploitation of timber resources and the economic hardships of the Great Depression.

4.0 CULTURAL AND HISTORIC CONTEXT

4.1 PREHISTORIC CONTEXT

The prehistory of West Virginia reflects the developmental patterns established for eastern North America. It shares similar cultural manifestations and demonstrates affinities with the general Appalachian region, but cultural relationships are most similar to those that characterize the Middle and Upper Ohio River zone (Eddins 1980). While several generalized cultural sequences for the Upper Ohio Valley have been proposed (e.g. Griffin 1967), the earlier work of Mayer-Oakes (1955) provides a more localized chronology for the region. This sequence remains viable in the region, although more recent investigations and radiocarbon dates have refined temporal ranges in the years since Myer-Oakes first published his findings (Johnson n.d.).

4.1.1 THE PALEO-INDIAN PERIOD (10,000 TO 8,000 B.C.)

Although the temporal range of the Paleo-Indian period is the subject of much debate throughout North America, the available evidence suggests a range of approximately 10,000 to 8,000 B.C. for Paleo-Indian occupations in West Virginia. Of the excavated Paleo-Indian sites in the region, the Thunderbird Site Complex, located approximately 70 miles east of Seneca Rocks in the Shenandoah Valley of Virginia, has contributed extensively to our understanding of the Paleo-Indian period in the region.

Research to date indicates that the Central Appalachian Uplands were not extensively occupied by these early prehistoric peoples. This assertion rests on the paucity of fluted points reported for the uplands (Wilkins 1977). Two fluted points have been reported from a site on the Upper North Fork, within the Monongahela National Forest (Brashler et al. 1987). Another find, described as the basal section of a possible fluted point, was reported from an excavation 18 miles northwest of White Sulphur Springs (Brashler 1984). In the absence e of deliberate investigations that focus on higher probability areas like rock shelters or buried sediments, it is unlikely that Paleo-Indian sites amounting to much more than random surface finds will be identified.

Although evidence of Paleo-Indian occupations in other areas of West Virginia (e.g., along the Kanawha and Ohio rivers) and surrounding states is more extensive, Broyles (1967) reported several surface finds of fluted points in areas neighboring the Monongahela National Forest, and Anslinger reported surface finds of Paleo-Indian artifacts from Boone and Nicholas counties. Large numbers of fluted points have been reported from the Ohio River Valley and its tributaries in western West Virginia, including the Tygart and Monongahela drainages (Wilkins 1977; Wall 1981), and Dalton-like projectile points have been recorded in Braxton County (Fitzgibbons et al. 1980:194). Regardless of the actual number of Paleo-Indian points, the evidence indicates human occupation within the Appalachian Plateau and Appalachian Mountains was not as intensive as Paleo-Indian occupations in southeastern United States or the Middle Atlantic region.

Research in western Pennsylvania corroborates the lack of a Paleo-Indian presence in the uplands. Of a total of 210 Paleo-Indian loci in 23 counties, only 12 were found in upland locations. Paleo-Indian sites in the uplands of Washington and Allegheny counties were found on benches above springs, suggesting these sites were utilized as temporary bivouac or habitation loci (Lantz 1984).

4.1.2 THE ARCHAIC PERIOD (8,000 TO 1,000 B.C.)

The Archaic period in West Virginia, as in the eastern United States in general, lasts from approximately 8,000 to 1,000 B.C. This cultural period is commonly divided into three subdivisions: the Early Archaic (8,000 to 6,000 B.C.), the Middle Archaic (6,000 to 3,000 B.C.), and the Late Archaic (3,000 to 1,000 B.C.). Some researchers suggest, however, that the Late Archaic is further subdivided by the presence of a Transitional or Terminal Archaic period, which lasted from approximately 2,000 to 1,000 B.C., or later in some instances (Turnbaugh 1975).

Cultural developments during the Early Archaic period represent, in part, responses to dramatic climatic changes associated with the retreat of glacial ice at the end of the Pleistocene, the extinctions of a variety of Pleistocene floral and faunal species, and the subsequent emergency of new species. Hunters and gatherers demonstrated their ability to adapt to these changes as witnessed by the emergence of a more broad-based subsistence economy and the development of new tool and projectile point technologies. Evolving settlement-subsistence patterns reflect the exploitation of seasonally available resources. Stylistic changes and shared technological innovations may also indicate emerging territoriality and concomitant interaction between various aboriginal groups.

The St. Albans Site, located along the Kanawha River in Kanawha County, West Virginia, has produced a stratified series of Archaic projectile points, tools, and a radiocarbon sequence ranging from approximately 8,000 B.C. to 6,000 B.C. Early Archaic point types recovered from St. Albans include Kessell Site-Notched; Charleston Corner-Notched; Kirk Corner-Notched, including the small variety of Palmer corner-notched type (Justice 1987); MacCorkle Stemmed, St., Albans Side-Notched; LeCroy Bifurcate; and Kanawha Stemmed. In addition to the projectile points, the artifact inventory includes drills, knives, scrapers, blades, hoes, gouges, worked fling fragments, hammerstones, and hematite (Broyles 1971). Early Archaic occupations were also recorded on ridge tops and knolls, adjacent to springs or heads of streams in Braxton County. Broyles et al. (1975) interpreted these sites to be short term occupations related to hunting and gathering activities.

Although significant quantities of Archaic artifacts have been recovered from the uplands of West Virginia, no stratified sites have been recorded or excavated in the area (Brashler et al. 1987). With the exception of the Dennison Site (46 LG 16), a mountaintop site located in Logan County (Moxley 1982), few upland sites have produced diagnostic artifacts that span the Early Archaic period. In southeastern West Virginia, the Mill Pond site near Greenville in Monroe County produced a variety of Early Archaic points from a surface collection (Broyles 1964). Point types included specimens that fall within the Kirk Corner Notched Cluster and the LeCroy Cluster. Broyles (1964) also reported artifacts similar to the Mill Pond assemblage were collected from two surface sites in Summers County by an avocational archeologist. Elsewhere, Kirk, MacCorkle-like, and bifurcate points (LeCroy) have occasionally been reported from upland settings within the Monongahela National Forest (Brashler 1984).

The Middle Archaic in West Virginia is generally placed between about 6,000 and 3,000 B.C. On the basis of available evidence, it is generally agreed that social, economic, and technological adaptations initiated during the Early Archaic continued and intensified during the Middle Archaic period. For example, the Middle Archaic period is characterized by a more intensive exploitation of diverse habitats (uplands, valleys, rivers, etc.) which is accompanied by the utilization of a wider variety of raw materials for tool production. The toolkit is also characterized by a dramatic increase in woodworking and plant processing tools. These tools include axes,

adzes, celts, choppers, nutting stones, mortars, and pestles. The archaeological record of the Ohio Valley, and the eastern United States in general, indicates that this period witnessed the emergence of regional differences which may have developed in response to the significant changes in the environment that were associated with the warm, moist climatic "optimum" which occurs at this time.

The Hansford Site (46FA104), located on the Kanawha River in Fayette County, West Virginia, produced a series of projectile points that are considered typical of the Middle Archaic in the region (Wilkins 1977). This inventory includes Stanly points (5,700-5,000 B.C.); Morrow Mountain points 5,000-4,000 B .C.); and Guilford Lanceolate points (5,000 and 4,000 B.C.) (Coe 1964). Wilkins (1977:123) has noted that the frequency of Middle Archaic points on upland sites in Boone County is significantly less than those reported from the Early and Late Archaic. Similar low frequencies of Middle Archaic point types were reported by Broyles et al. (1975:91) and Fitzgibbons et al. (1980) in the Burnsville Reservoir area of Braxton County.

More recent work at the Hansford Site yielded evidence of a Middle Archaic notched point tradition for the Kanawha Valley (Wilkins 1985). Based on the suggested placement of these points at ca. 4,600 B.C., Wilkins suggests that these points are affiliated with the Midcontinent Tradition of the Ohio Valley rather than the Morrow Mountain-Guilford Tradition of the Carolina Piedmont, as defined by Coe (1964). Differing cultural traditions may therefore occur in the upland areas of West Virginia during the Middle and Late Archaic (Wilkins 1985:22).

The suggested range for the Late Archaic in West Virginia extends from approximately 3,000 to 1,000 B.C. Hunting and gathering strategies similar to those of the Early and Middle Archaic continue to be employed through this period, but evidence suggests a shift toward more intensive exploitation of certain wild floral species. This emphasis on plant foods is suggested by (1) the increased incidence of mortars, pestles, and plant processing tools on Late Archaic sites, (2) the increased number of sites in riverine settings, and (3) the increased number of hearth and pit features at sites from this period. In southeastern West Virginia, Wilkins (1978) has documented a number of Late Archaic sites in rockshelters as well as bottomland sites. The variety of site types, in conjunction with their extent and quantity, suggests a possible increase in population and/or functional specialization of sites. It is also during this period that more sedentary lifestyles begin to emerge and population increases. These changes, accompanied by the development of more pronounced regional differences, may be indicative of the social evolution from band level to tribal level social organizations.

Diagnostic artifacts identified with the Late Archaic in West Virginia include a wide variety of notched and stemmed points. Archeological surveys and excavations in the Kanawha Basin have produced Brewerton Side-Notched, Brewerton Eared-Notched, Hansford Corner-Notched, Hansford Concave Base, and an assortment of stemmed projectile points. The Hansford Site has produced several of these point types in association with hearths that yielded radiocarbon dates of 3,700-3,600 B.C. (Wilkins 1977). The Burnsville Reservoir surveys produced a substantial quantity of Late Archaic stemmed points. Other point types recorded in the course of these surveys included Brewerton and Lamoka-like forms. Late Archaic projectile points recovered from the Burnsville survey area include Buffalo Straight and Expanded Stemmed types and Steubenville Stemmed forms which may date toward the end of this period (Fitzgibbons et al. 1980). Savannah River points are relatively common in southeastern West Virginia, and Fitzgibbons et al. (1980) suggest that their presence indicates a possible affinity with the Savannah River Phase of the Carolina Piedmont.

The Transitional Archaic period is not well defined for West Virginia. With the exception of new point styles and the addition of sandstone and soapstone vessels to the artifact inventory, the lifestyle of Transitional period groups seems to have been an extension of an essentially Late Archaic system. Among the point types considered to be diagnostic of the Transitional Archaic period are Orient Fishtail-like points, Perkiomen points, Susquehanna Broad points, Snook Kill points, Lehigh Broad points, and Dry Brook points. Evidence for a shift to an extensive reliance on cultigens is lacking although riverine resources were intensively exploited by these groups.

Wilkins (1977) suggested the appearance of stone bowls at these loci indicated a greater degree of stability and permanence (Wilkins 1977). More recently, Klein has suggested that the use of steatite vessels during the terminal Late Archaic was primarily for ceremonial or ritualistic events and that the use of these vessels served to solidify social relationships across regional boundaries and perpetuate group identity. Fitzgibbons et al. (1980) and Wilkins (1977) have both noted that artifact frequency for the Transitional Archaic period shows a marked decline relative to the incidence of artifacts associated with the Early and Late Archaic periods. Wilkins (1977) asserts that this apparent decline is related to the strict focus on exploiting riverine environments, to the virtual exclusion of others, at this time. As a result, many sites from this time period remain undetected as they lie buried beneath one or more feet of alluvial sediment.

4.1.3 THE WOODLAND PERIOD (1,000 B.C. TO A.D. 1000)

The Woodland period in West Virginia is placed between 1,000 B.C. and A.D. 1000. Distinguished from the Archaic period by the appearance of ceramics and by an economy increasingly dependent on the exploitation of cultivated plants, the Woodland period represents a dramatic change from the broad spectrum hunter/gatherer populations of the preceding period. The increasing role of cultigens in the subsistence base fostered a greater economic stability. The declining dependency on seasonal residential movements in combination with a more stable subsistence base encouraged population growth, which in turn produced larger and more permanent settlements. The emergence of these new economies was accompanied by the appearance of distinct social hierarchies and class stratification, elaborate mortuary rituals, pubic works, and the development of extensive trade networks.

The Early Woodland period in West Virginia, dated between 1,000 B.C. and A.D. 100, is distinguished by the emergence of the Adena complex, which was centered in the Middle Ohio Valley and extended into the Kanawha River Valley of West Virginia. The Adena complex is characterized by the appearance of Fayette Thick and Marion Thick pottery, stemmed point types, large earthen burial mounds, blocked-end tubular pipes, and variously shaped stone and copper gorgets. These people lived in small villages and hamlets that were dispersed on floodplains, river terraces, and uplands in proximity to major drainages. Although domesticated squash is present by ca. 800 B.C. and domesticated corn by ca. 400 B.C. (Carlisle and Adovasio 1982), the relative importance of these cultigens in the economic system of these people remains a question.

No Early Woodland mounds or sites are reported from the immediate vicinity, but Solecki (1949) reports on several mound sites and rockshelters in the New and Greenbrier valleys. Sites reported by Solecki (1949) in Summers County along the New Rive include Hinton Mound, Hinton Bridge Mound, Richmond Mound, and the Buffalo Rockshelter. Also in southeastern West Virginia, Fayette Thick pottery has been reported from the Pence Springs site (O'Malley 1985). Brashler et al. (1987) suggest that the absence of Early Woodland inhabitants in this area may a result of their more conservative nature. That is, people in this part of the state remained hunter/gatherers and were only marginally affected by the socio-economic and technological developments to the

west. Concomitantly, the absence of these diagnostic artifacts potentially renders Late Archaic and Early Woodland occupations virtually indistinguishable from one another.

The Middle Woodland period lasts from approximately 100 B.C. to A.D. 600, while the Late Woodland period persists between A.D. 600 to A.D. 1200. The Middle Woodland period is best known for the Hopewell Culture which evolved from and superseded the Adena Culture. Hopewell influences can be traced across a large portion of the eastern United States and are identified with the construction of extensive earthworks, large burial mounds, and elaborate mortuary practices. Hopewell groups also possessed a sophisticated level of technology and art as expressed in the quality of their tools and grave goods. The distribution of these goods indicates the presence of a sophisticated trade network and widespread stylistic influences. These characteristics are generally considered to represent evidence of a ranked social organization, but Ford (1979) asserts that the notion of ranked societies during the Hopewell period is not universally accepted.

In West Virginia, the Upper Ohio Valley has the best documented cultural sequence during these time periods. Two related complexes, Fairchance and Watson, have been incorporated by Hemmings (1984) into the "Watson Tradition," a ceramic complex which spans the Middle and Late Woodland periods. The earlier Fairchance Phase is radiocarbon-dated between A.D. 120 and A.D. 420 and may persist as late as A.D. 660, based on the dated Watson component at the Hughes Farm site (Maslowski 1985). Hopewellian influences are evidenced in the form of small but significant quantities of exotic flint, copper, and marine shell ornaments, and mound burial. The physical type at the Fairchance Mound and Village Site is said to be Hopewellian as well (Hemmings 1984). Subsistence needs were met chiefly by hunting and gathering, with settlements consisting of large hamlets located along small streams and small camps, hamlets, and rock shelter occupations on terraces and in the uplands (Maslowski 1985). The Watson Phase appears to date between about A.D. 500 and A.D. 1000. Mound building and burial ceremonialism appears to decrease. There appears to be a gradual shift to larger, more densely occupied sites located on high terraces adjacent to major waterways such as the Ohio River. Watson Phase sites also include hamlets which are located on both bottomlands and uplands (Maslowski 1985). An increasing reliance on cultivated plant foods may characterize the subsistence regime at this time.

In southeastern West Virginia, a comparable sequence occurs in the Kanawha Valley and extends into southern and central West Virginia (see Fitzgibbons et al. 1980). The Middle Woodland manifestation has been termed the Armstrong Phase (McMichael 1968) and demonstrates a mix of Adena and Hopewell characteristics. Shale-tempered Armstrong pottery appears quite early and is contemporary with Adena, lending ambiguity to the nature and extent of this phase (Hemmings 1985). Unfortunately, no village sites have been found, although numerous small open sites and rock shelters have minor Armstrong components. The Hokes Mill site on Second Creek in Greenbrier County has been identified as Middle Woodland (Wall 1989), and excavations by Ison et al. (1985) at the Spring site in Summers County produced a radiocarbon date of A.D. 310 in association with Armstrong ceramics and Snyders and Jack's Reef points.

The succeeding Buck Garden Phase, which spans the late Middle Woodland and the early Late Woodland, has been dated between ca. A.D. 700 and A.D. 1200 (Maslowski 1985:27; Wilkins 1979; Railey and Henderson 1986). McMichael (1968:26-27) suggests that the preceding Armstrong Phase gradually changed into the Buck Garden Phase. More recently, Fuerst (1988) has divided the Late Woodland in southeastern West Virginia into an early Schoolyard Phase (A.D. 500-800) and a late Buck Garden Phase (A.D. 800-1200). McMichael (1968:27) reports that Buck Garden pottery is tempered with crushed rock (generally chert or sandstone). However,

Buck Garden pottery from the Green Sulphur Spring site is predominantly limestone tempered (Henderson 1986). Diagnostic lithic artifacts include Chesser Notched, Lowe Flared, and Levanna, Madison, and Hamilton triangular points. Hamlets and camps appear along the Kanawha and other major rivers, but no large, nucleated settlements with which these sites can be associated have been discovered. McMichael (1968) believes that people associated with the Buck Garden phase were driven out of the Kanawha Valley, probably by Fort Ancient people, by A.D. 1200.

4.1.4 THE LATE PREHISTORIC AND CONTACT PERIOD (A.D. 1000 TO A.D. 1780)

The Late Prehistoric period is characterized by the emergence of a fully horticultural subsistence system, augmented by seasonal hunting and gathering, the manufacture of shell-tempered pottery and the utilization of small triangular arrow points. The developmental trend to a nucleated settlement pattern is manifested in permanently occupied villages, which demonstrate a tendency to be fortified through time. However, the dominant Late Prehistoric groups of this region, the Monongahela and Fort Ancient cultures, lack the complex settlement hierarchy that is characteristic of more culturally complex Mississippian populations to the south and west. In fact McMichael (1968) points out that in more remote parts of central and eastern West Virginia a Woodland lifestyle persisted for several centuries. Fort Ancient cultures are generally defined by three important traits: (1) increased reliance on agriculture, (2) increased sedentism, and (3) a rise in socio-political complexity (Orr 2002). However, within West Virginia, Fort Ancient (and Monongahela) cultures lacked the attendant socio-religious hierarchy associated with Mississippian temple-mound communities to the south and west. Instead, Fort Ancient and Monongahela villages appear to be more self-sufficient, with social interaction more characteristic of tribal level societies.

As noted above, two distinct Late Prehistoric cultural expressions occur in West Virginia, namely Monongahela and Fort Ancient. In the Upper Ohio Valley (i.e., the panhandle of northern West Virginia, southeastern Pennsylvania, and the Upper Monongahela drainage in West Virginia), the local Watson Phase groups gradually develop into Monongahela. Their large, circular, nucleated villages are located on high bottomlands near major rivers or on saddles and hilltops, often at a great distance from water. Smaller hamlet-like and special purpose sites have rarely been documented, much less excavated, leaving a gap in our present knowledge. Several phases have been proposed for southwestern Pennsylvania, with the earliest components recognizable as Monongahela beginning as early as A.D. 900 (George 1983).

Fort Ancient sites tend to be located south and west of the Monongahela "Core" on portions of the Ohio and Kanawha rivers in West Virginia. Several alternative models to account for the Fort Ancient presence in West Virginia have been advanced. One model suggests that Fort Ancient was derived from local Late Woodland antecedents at a relatively early date (Graybill 1980). Based on a lack of evidence for early intrusions and the resemblance of early Monongahela and Fort Ancient pottery, it has been argued that terminal Middle Woodland/early Late Woodland groups in both the Middle and Upper Ohio Valleys participated in a common ceramic tradition with its center in the Middle Ohio Valley around the mouth of the Kanawha. Each area or phase developed elements of this stylistic tradition in a uniquely local fashion (Johnson 1990). More recently, it has been suggested that the Feurt-Clover continuum can be derived from the Buck Garden Phase centered in the Upper Kanawha drainage (Graybill 1984). However, the prevailing view is that Fort Ancient represents a late intrusion into West Virginia (Mayer-Oakes 1955) which began in the Lower Ohio and gradually moved upstream to the Kanawha River (Maslowski

1985). Mississippian influences are consistently stronger among Fort Ancient groups than Monongahela groups.

Graybill (1988) has identified three interrelated Fort Ancient complexes in the Plateau Area of West Virginia. These complexes are Mount Carbon (A.D. 1050-1700?), Bluestone (A.D. 1200-1500), and Woodside (A.D. 1500-1630). Graybill (1988) argues that the Bluestone complex and other early Fort Ancient sites in the area developed from local Late Woodland populations such as Buck Garden. Conversely, others suggest that the Bluestone complex represents a mixing of traits from the Roseberry Phase (A.D. 1050-1250) of the lower Kanawha Valley and Virginian-Siouan traits. Within the Plateau area, Fort Ancient ceramics are both shell tempered and limestone tempered, and projectile points are triangular for the most part. Available evidence suggests that habitation loci were concentrated in the river valleys, while the uplands were exploited primarily for hunting and the procurement of other special resources. Rock shelters and hunting camps that were heavily used as hunting and gathering stations during the Middle and Late Woodland appear to be used less frequently or for a more limited suite of activities, perhaps primarily as hunting camps. Given a consistent lack of ceramics from upland sites, definitive cultural associations may be difficult, it not impossible, to make.

The Contact Period is marked by the presence of trade goods at Late Prehistoric archaeological sites. The presence of trade goods often only indicates limited, if not indirect, contact with European populations. Sites from this period reflect a continuation of Fort Ancient village patterns (i.e., fortified villages along major rivers) and a subsistence based on plant domesticates such as maize, squash, beans, and other cultigens, supplemented by hunting, fishing, and gathering. Principal trade items included glass beads, iron axes and ploughs, knives, and copper and metal ornaments. The first attempts to explore and settle the wilderness of the trans-Allegheny region of Virginia occurred in the late seventeenth century. These efforts were, for a time, successfully resisted by Native American groups like the Susquehannock. Between 1763 and 1780, representatives of the British and American governments negotiated a series of treaties with the Cherokee and Iroquois Confederacy that gave Euro-Americans right of access to increasingly larger portions of the trans-Allegheny frontier. By 1780, Native American groups had forfeited all legal claims to the region which would become West Virginia (Rice 1986).

4.2 HISTORIC CONTEXT

4.2.1 EARLY SETTLEMENT AND FRONTIER FORTS (1700–1783)

The earliest European explorers to reach Greenbrier County included an expedition organized by Colonel Abraham Wood, a fur trader, and led by Captain Thomas Batts and Robert Fallum in 1671 (Rice 1986). The Batts-Fallum expedition reached present-day Alderson via a series of Indian trails and proceeded to cross the New River. Rice (1986) reports that two major Indian trails traversed Greenbrier County in the late seventeenth and early eighteenth centuries. The Seneca Trail, which linked the Cherokee and the Iroquois League of Nations, traversed the state in a north/south route and more or less followed US 219 through the county. The Kanawha Trail or Buffalo Trail traversed the state in an east/west direction and connected the Ohio Valley and the Great Valley of Virginia. These two historic trails crossed in Greenbrier County near Lewisburg. At this time, most of West Virginia served as a buffer zone between the Iroquois Confederacy and the Cherokee, Mingo, and Shawnee tribes, and the land was used as common ground for hunting, trading, and the like.

European settlement of what is now Greenbrier County began in the 1720s and 1730s as immigrants from Pennsylvania and Virginia were encouraged by the British government and the Virginia Assembly to settle in the fertile valleys west of the Allegheny Mountains. The British government wished to strengthen the colonies' western defenses and offered up to 100,000 acres in land grants as long as one non-Virginia family settled every 1,000 acres (McBride et al. 2003). Ironically the first application for a land grant in the area was denied because the Virginia Assembly believed the land was too isolated and the risk of Indian attack too great. However, in 1745 portions of present-day Greenbrier, Monroe, and Pocahontas counties were opened for settlement by the Greenbrier Land Company, which received a land grant for 100,000 acres. Settlers quickly moved westward, including Henry Baughman, namesake of Baughman's Fort, who received a grant for 780 acres south and west of Alderson, near the mouth of Muddy Creek (Dixon 1967). Stephen Sewell (namesake of Sewell Creek and Sewell Mountain) and Jacob Marlin founded Marlinton along the Greenbrier River in what is now Pocahontas County in 1749, and settlers moved into the Meadow River valley as early as 1758 (Anonymous 1972). Sewell and Marlin's partnership dissolved and Marlin returned to Virginia, while Sewell relocated in the vicinity of Sewell Creek and the Meadow River (near present day Rainelle). Sewell later encountered hostile Indians along the New River and was killed in a skirmish.

Between 1750 and the end of the Revolutionary War, western Virginia was marked by unceasing hostilities between the Euro-American settlers and various Indian tribes, that more often than not were either supported or encouraged by the French. In order to secure their western defenses and continue to encourage settlement in the area, the Colonial government constructed a series of forts along major drainages (McBride and McBride 1991, 1993; McBride et al. 2003). Three short periods of fort construction are identified by McBride et al. (2003). They are as follows: (1) 1755-1756, the French and Indian War; (2) 1774-1782, Lord Dunmore's War and the American Revolution; (3) 1786-1791, US efforts to claim and dominate lands north of the Ohio River (McBride et al. 2003). The forts were part of a defensive system that included a military presence, offensive campaigns, and government-sponsored peace negotiations. This system, established during the French and Indian War, was fine-tuned over time and allowed for the colonization and conquest of a rugged and disputed territory that eventually became the State of West Virginia.

Only two forts were constructed in the vicinity of Greenbrier County during the French and Indian War. Baughman's Fort (or stockade), constructed near Alderson in Summers County at the mouth of Muddy Creek, was attacked by Indians during the summer of 1755. The other fort constructed at this time was Marlin's Fort, in present-day Marlinton (Pocahontas County), near the confluence of Knapp Creek and Greenbrier River. Between 1770 and 1782, many forts were constructed in what is now West Virginia (McBride and McBride 1991). The list includes forts on the Potomac, Monongahela, Greenbrier, New, Tygart, Kanawha, and Upper Ohio rivers. Several forts were built within Greenbrier County, including Arbuckle's Fort (Keeny Fort) built in 1774 at the confluence of Muddy Creek and Mill Creek, Donnally's Fort, McClanahan's Fort, McCoy's Fort, Fort Savannah (Fort Charles) built perhaps as early as 1755 near Lewisburg, Renick's Fort, and Stuart's Fort, built in 1774 near Fort Spring (GAI 2000; McBride et al. 2003). No forts were constructed before or after the Revolutionary War in what is now Nicholas County.

Archeological investigations by McBride et al. (2003) have demonstrated that residential forts, such as Donnally's Fort, produced more artifacts and a higher percentage of ceramics, especially compared to architectural artifacts, than the non-residential forts such as Arbuckle's Fort, Fort Savannah, and Stuart's Fort, which historical and archeological data indicate were occupied on a more intermittent basis (McBride et al. 2003). Arbuckle's Fort was built by Captain Matthew Arbuckle in the spring of 1774, and later that year Captain Arbuckle and his men directed

Colonel Andrew Lewis and his troops to Point Pleasant at the mouth of the Kanawha River, where they defeated the Indian Confederacy in the climatic battle of Lord Dunmore's War.

The earliest person to set foot in Nicholas County was Major William Morris in 1776. Major Morris claimed land within the county and offered it to his son William Jr. He refused the land and it was offered to his brother Henry. Henry settled in an area along Peter Creek, near present day Lockwood in 1791 (Carpenter 1992). Morris was soon joined by other families such as Conrad Young and Edward McClug. The Morris homesite was later the site of the Morris Massacre of 1792 (Carpenter 1992:2). Simon Girty, who had spent the winter at the Morris cabin, was wanted for several crimes. After he was escorted off the property at rifle point, he returned with two Indians and killed two of Morris' daughters, Betsy and Margaret. For the most part, settlement in Nicholas County did not occur until the first quarter of the nineteenth century.

4.2.2 GREENBRIER AND NICHOLAS COUNTIES: FORMATION AND PROSPERITY (1778–1860)

Greenbrier County was formed from Botetourt County in 1778. Initially, Greenbrier County extended from the current Virginia-West Virginia state line on the east to the Ohio River on the west, and included all or parts of Greenbrier, Monroe, Summers, Pocahontas, Fayette, Nicholas, Webster, Clay, Kanawha, Putnam, Roane, Jackson, and Mason counties. As settlement continued and population increased, other counties were formed from the original county. Fort Donnally was attacked by a group of Wyandot and Mingo warriors in 1778, but as the war continued, the British were forced to withdraw their troops from the area and their support of Indian raids on the western frontier. After 1782 no British attacks occurred within the Greenbrier Valley (CRI 2002). The first courthouse was erected in Lewisburg in 1782, and it remains the county seat today.

By 1790, at least a dozen gristmills were operating within the county (CRI 2002). During the late eighteenth and early nineteenth century, Virginia, including what was to become West Virginia, experienced an agrarian transformation from a tobacco-based plantation economy to a more diversified grain-based economy. The grain-based economy (and later a secondary dairy industry) characterized the area for the next 100 or more years. Between 1790 and 1820 as many as 250,000 Virginians (and perhaps as many as 150,000 slaves) moved from the older settled parts of the state to the newly opened western and southwestern frontier. During this time, Greenbrier County became the home of both high-status planters and small subsistence farmers. Despite the increased number of settlers, the county retained its agrarian character.

Nicholas County was created by an act of the Virginia General Assembly on January 30, 1818. The county was formed from parts of Greenbrier, Kanawha, and Randolph counties. The boundary lines were disputed and the county was reformed to its present configuration in 1820. The county was named in honor of Wilson Cary Nicholas (1761-1820), who served as a commander under General Washington and later served as a U.S. Senator from Virginia (1799-1804), the U.S. House of Representatives (1807-1809), and the Governor of Virginia from 1814-1816. He owned land in Nicholas County, and upon his retirement from public service, he assisted in the formation of the county. The first meeting of Nicholas County took place on land donated by Judge Lewis Summers. Although Judge Summers donated 30 acres for the establishment of the county seat in present day Summersville on January 19, 1820, the town did not become incorporated until 1860. In 1820 the county had a population of 3,338 people, with 373 tithable households.

Improved transportation routes were critical in order to move the county's agricultural products to markets in the east. In 1821 construction began on the James River and Kanawha Turnpike and

the route between Lewisburg and Charleston was completed by 1824 (Figure 3). Today, US 60 closely follows the route of the old turnpike. The James River and Kanawha Turnpike helped to promote commerce and Thompson's Tavern (Inn) was built in the 1830s just west of Rainelle (Anonymous 1972). The development of steam locomotion and the construction of railroads, beginning in the 1840s, proved to be the demise of overland turnpikes and canals. The fertile valleys of the area were conducive to the growth of corn and other grain crops, and along with dairy cattle, sheep, and horses, the region quickly became an important source of food to support the ever-increasing industrial population along the east coast. In 1855 Virginia authorized the construction of the Covington and Ohio Railroad across the Allegheny Mountains. It was decided that the railroad would be routed through Greenbrier County in order to serve White Sulphur Springs. Railroad construction was halted during the Civil War.

4.2.3 CIVIL WAR YEARS (1861–1865)

Few, if any, significant events occurred or were recorded in Nicholas County during the Civil War. Consequently, this section of the historic context will focus on events that occurred in Greenbrier County. At the outbreak of the Civil War, Greenbrier County immediately raised troops for the defense of Virginia and the Confederacy. Although small skirmishes occurred in the eastern valleys, the whole of the county was largely untouched. However, by the winter of 1861 and 1862, more than 1,500 wounded Confederate soldiers were hospitalized at White Sulphur Springs. Between the spring of 1862 and late summer of 1863, Greenbrier County was the site of three battles. The first battle, the Battle of Lewisburg, occurred in May, 1862. The Federal Mountain Department, under the command of General John C. Fremont, was tasked with protecting Federal rail lines and destroying the Confederate rail lines. To that end, Colonel George Crook and 1,400 Ohio troops passed through Lewisburg on their way to cut the Confederate Virginia Central Railroad near Covington. Upon hearing that Confederate troops were massing on his rear to attack, Crook quickly retreated to Lewisburg. Confederate forces attacked his position, but under the Federal counter-attack, the untested Confederates broke rank and fled. Throughout 1862 Federal troops maintained control over most of the western counties of Virginia. Although forces loyal to the Confederate cause continued to control Greenbrier County, most of the western counties maintained allegiance to the Union.

Although Federal forces assumed control of the western counties, Greenbrier County continued to contribute men, materials, and animals to the Confederates. The county also provided General Robert E. Lee with his famous mount, "Traveler"; the horse was presented to General Lee as a gift while he visited the White Sulphur Springs area. The second major engagement in Greenbrier County occurred in the spring of 1863 at Tuckwillers Hill, two miles north of Lewisburg (Orr 2002). During this battle, Federal troops were forced to withdraw. However, by June of 1863, Greenbrier County and the western counties of Virginia succeeded from the Commonwealth of Virginia and formed the State of West Virginia, which maintained allegiance to the United States. The final battle within Greenbrier County is known as the Battle of White Sulphur Springs, or the Battle of Dry Creek, and occurred in August, 1863. Federal forces, under the direction of General Averell, attacked the Confederate troops that consisted of infantry, light cavalry, and some artillery. Averell's forces attacked the Confederate lines four times over a two day period but were unsuccessful in moving the Confederate troops. With no reinforcements coming to his aid, Averell ordered his men to retreat and the Confederates refused to pursue. Wounded soldiers of both the Union and Confederate troops were hospitalized at White Sulphur Springs during and after the battle. Although this was the last major battle in the county, the entire countryside felt the affects of the war for years to come. The constant troop movement and occupation throughout the region and the ravages of war took a heavy toll on agricultural crops and fields, livestock,

horses, draft animals, and forests. In addition, the loss of manpower and the destruction of the infrastructure (railroads and roads) coupled with high property taxes that most families could not pay served to pave the way for the reconstruction era.

4.2.4 RECONSTRUCTION YEARS (1865–1880S)

The years following the Civil War were difficult times throughout the South, and West Virginia, despite siding with the Union, was no exception. The loss of manpower, neglect of agricultural fields, loss of livestock and draft animals, disruption (or in some cases destruction) of transportation networks, plummeting property values, and the emancipation of slaves combined to have a deleterious effect on the economic and social landscape in post-War West Virginia. Gradually, the economy improved as fields were cleared and planted, livestock were replaced, and infrastructure was rebuilt. By 1873 the Chesapeake and Ohio Railroad had been constructed through Greenbrier County and other roads were rebuilt. During the first half of the reconstruction era, the county remained largely agrarian, and various organizations (e.g., Grange or Patrons of Husbandry) were formed to assist farmers to restore their land and curb erosion. Farmers continued to change crops and crop rotation cycles as new methods of agriculture were introduced to the area. Many farmers began the transition from grain crops to dairy farming and market gardening, in part as a response to infrastructural improvements. By 1880 the population in the county had grown to 15,000 (CRI 2002). Despite efforts to rebuild the infrastructure of the region, the economic recovery was slow to develop. The farmers in Greenbrier County and elsewhere in the region sought alternative methods of income. The solution for many was to sell off their timber or their land to timber moguls. The timber industry began on a large scale as early as 1882 in some parts of the county, but within the project area the timber industry did not begin until the first decade of the twentieth century. Despite these new endeavors, Greenbrier County was still more than 80% agrarian into the 1890s.

Events in Nicholas County were similar to those that occurred in Greenbrier. However, Nicholas County did not take as long to recover economically nor suffer as deeply as several West Virginia counties did to the north and east. That is, owing in part to its remote location and access, and thus its lower population, the period of recovery for Nicholas County following the Civil War was less difficult and arduous compared to nearby counties. Nonetheless, Nicholas County was suffered through the reconstruction period.

4.2.5 THE ECONOMIC BOOM YEARS (1880S–1930S)

The industrial period from the late 1880s to the early 1910s saw a major transformation not only across the eastern United States and Great Lakes region, but also within West Virginia. The initial transformation in West Virginia was triggered by the increase of railroads into the remote mountainous areas of the state and an increased demand for timber resources. The increased demand for West Virginia timber resources led to a change in the lumber industry from small-scale local or portable saw mills that selected only the finest timber for cutting to a huge factory-based industry that consumed entire forests within a few years and employed as much as 100 people or more. According to one source, in 1835 there were 15 steam operated circular sawmills in the state, but by 1880 there were 472 lumbering establishments within the state, the majority of which were steam powered (Hiltz n.d.). The development of steam operated single-band sawmills coupled with the expansion of the railroad industry provided the precipitance. The first band sawmill in West Virginia was erected in 1881. In order to produce a steady flow of logs, a single-band sawmill required 17 acres of virgin timber per day (Hiltz n.d.). In 1909, there were 83 band

mills and 1,441 other lumbering establishments operating in the state. Collectively, these operations produced nearly 1.5 billion board feet (bf) of lumber in 1909 (Hiltz n.d.).

Of particular importance in the development and expansion of the lumber industry was the invention of the Shay-geared locomotive engine. In the 1870s, logging railroads were limited to one rod locomotive engines. Because of their rigidity, the track had to be well graded and curves could not be too steep or too sharp. The Shay engine used reducing gears instead of side rods, which enabled the engine more freedom of movement on rough, mountainous terrain with sharp curves and steep inclines. The Lima Locomotive Works in Lima, Ohio produced 2,761 Shay engines between 1880 and 1945, and over 200 were used in West Virginia for the logging and coal industry (Hiltz n.d.). It has been estimated that in the 1870s and 1880s, West Virginia was blessed with between 10 to 12 million acres of virgin hardwood forests (Brashler 1991[4]:25). By 1910 the amount of uncut virgin timber had been reduced to slightly over 1.5 million acres, and by the 1920s only a few isolated areas with small landholdings supported original hardwood forests (Hiltz n.d.). This same source estimates that from 1880 to 1912, the total amount of cut timber in West Virginia amounted to more than 20 billion bf, representing nearly 8.5 million acres. The most valuable logging tree in the state was the red spruce, which occurred over vast regions of the state on mountain tops and plateaus. A typical red spruce averaged 60 to 90 feet (ft.) in length with a diameter of 2 to 4 ft. Hemlock, white oak, yellow poplar, and yellow pine were equally important tree species. White oak, the largest tree in the original forest, often attained heights greater than 100 feet and a diameter of more than 6 ft. White oaks were prominent on ridges and slopes with dry, thin soils formed in sandstone or shale. Yellow poplar was perhaps the most important tree in the forest. These trees were typically between 120 to 140 ft. in height and 7 to 9 ft. in diameter with a distance to the first limb of 80 ft.

Another factor that contributed to the economic boom of this period was the rise of the steel industry, which fueled the industrial revolution in America. As the steel industry continued to grow rapidly in cities like Pittsburgh, Detroit, and Chicago, the demand for lumber and coal also increased, and as coal fields in Ohio and Pennsylvania were exhausted, new mines opened in West Virginia and Kentucky. In order to tap these new, high-quality coal reserves, it was necessary to expand the railroad network throughout the area. Consequently, numerous railroad and/or coal companies began to lay rail lines into West Virginia. This in turn allowed the timber industry to exploit the vast stands of yellow pine and mixed hardwoods that covered most of the Appalachian Plateau and the Allegheny Mountains. Many logging companies established their own railroad subsidiaries and once the timber had been clear-cut, the companies turned to the mining of coal.

The Chesapeake and Ohio Railroad (C&ORR) was the first company to construct new lines in the county. In 1896 and 1897, the C&ORR began surveying possible rail lines up the Greenbrier Valley, and construction began in the summer of 1899 for a line running from Caldwell in Greenbrier County to Marlinton in Pocahontas County. Rail service began in October of 1900 and by May of 1902 the line extended all the way to Durbin at the north end of the valley. The C&ORR also extended a line through Ronceverte, west of Caldwell by 1902. With the railroad infrastructure in place, the timing was right for the timber industry to take advantage of the virgin forests that covered much of the county. As noted previously, this area was dominated by a mixed mesophytic forest that included a variety of hardwood species in addition to yellow pine. Prominent tree species included hemlock, various oak, chestnut, yellow or tulip popular, ash, and spruce. After the trees had been removed (essentially clear-cut) in one area, the cutters moved to harvest the trees in another area. The West Virginia timber industry boom (ca. 1880-1930) preceded the coal industry boom, which flourished between 1900 and 1930. Today both industries continue to be important to the West Virginia economy. Within Greenbrier, Nicholas,

and Fayette counties, coal was not exploited on a widespread basis until the 1920s and early 1930s. For the most part, the coal fields, like the forests, were exploited, exhausted, and abandoned within 20 to 30 years. Population figures for Nicholas County reflect the boom years with population increasing from 11,400 in 1900 to 20,700 in 1920. Population figures have remained relatively steady between 1950 and 2000, with a low of 22,500 in 1970 and a high of 28,100 in 1980.

4.2.6 LOGGING COMPANIES AND LOGGING CAMPS (1880-1930)

The coming of the railroad allowed the hardwood lumber industry to emerge as one of the largest and most important industries of Appalachia by the beginning of the twentieth century. Three distinct periods of development can be identified in the industrialization of Appalachia. Stage 1 (pre 1880) is characterized by rural, settlements where the families are the primary production and consumption unit; Stage 2 (1880 – 1900) is characterized by the transition from kin-based subsistence economy to a wage earning economy dominated by corporations. During Stage 2 workers maintained family farms and worked for wages on a seasonal basis. Stage 3 (1900 – 1930) is characterized by a greater reliance on wage labor and includes the formation of company communities of families participating in a consumer economy to harvest lumber and coal (Brashler 1991[4]:59). The economic boom of the lumber industry in Appalachia, especially during Stage 3, was the result of five things: (1) Appalachia contained tens of millions of acres of hardwood forests, (2) the railroad boom reached West Virginia between 1880 and 1920, (3) rapidly rising demand for hardwood timber throughout the United States and abroad, (4) depletion of the forest resources in the Northeast and Great Lakes, and (5) the vast forests of the Pacific Northwest were primarily dominated by softwoods (such as pines, spruce, fir) (ETSU 2006).

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One of the unique aspects of the Southern Appalachian logging industry was the logging camp (ETSU 2006). That is, unlike the coal mining industry where the coal mines and coal towns were more or less permanent fixtures on the landscape, the logging camps tended to be more ephemeral. Logging camps, which often consisted of 75 to 100 (male?) workers, constantly had to be moved to the resource. That is, in order to efficiently and effectively harvest their timber resources, the lumber companies had to move the workers (i.e., the loggers) to the resource. Thus, as the lumber company completed clear cutting one area, they would lay railroad tracks into another area of virgin timber. Logging camps, which often consisted of one to four or five shanty houses, were moved from one camp location to another by train (ETSU 2006). The shanty houses were actually modified train cars that often times were not removed from the tracks. Rather, the workers established temporary walkways that they would place outside the buildings alongside the tracks. When it became time to move to another area, the people simply packed up the sidewalks and other furniture and moved to the next forest tract. The shanty cars could hold entire families, or several bachelors, depending on work camp composition. In addition to the shanty houses, some of the larger and more stable communities might have a school car, church car, company store, dining car, and doctor's office (ETSU 2006). The mobile logging camps generally moved once or twice per year although sometimes the camp could stay in the same location for two or three years.

At some logging camps, the shanty houses were brought to the camp location by railroad and then the houses/cars were moved to the side of the tracks with a large crane (Brahsler 1991[4]61). Brashler (1991) reports that in the Monongahela National Forest shanty house locations were identified and recorded on the basis of cleared land that measured roughly 12 ft. x 25 ft. (4m x 8m) and oriented in a linear pattern along the abandoned narrow-gauge railroad bed.

Based on historical research, oral history, and archeological data from 10 logging sites in southeastern Webster County within the Monongahela National Forest, Brashler (1991) has proposed a settlement model that includes three or possibly four site types. Brashler suggests that logging sites in Appalachia consisted of the following types: mill towns (e.g., Richwood, Rainelle, Curtin), family company camps (Dogway), single-gender shanty camps (i.e., male only logger camps), and temporary family shanty camps. Brashler has suggested that family company camps were considerably larger in size (perhaps 30-60 or more shanty houses) than the single-gender shanty camps (or temporary family shanty camps) which more often than not consisted of between one to five shanty houses (Brashler 1991[4]:63-65). Archeological data from the Dogway family camp suggests artifacts from these sites exhibit greater gender diversity (e.g., finer ceramic tablewares, pressed glass, and decorative items) than those recovered from the single gender camps (Brashler 1991[4]:64). Brashler concludes that variables such as site size, amount of occupied space, artifact types, and organization of space may indicate whether or not a logging camp was a "family community camp" such as Dogway or a "single-gender shanty camp". She argues that the observed variability in these site types can be attributed to site function, gender composition, duration of occupation, and socioeconomic status (Brashler 1991[4]:64). Through historical research and oral histories, Brashler (1991) was able to demonstrate that many women were active participants in the wage labor economy. Women were employed in a number of areas in the labor force, including, cooks (loggers were provided three meals per day), store clerks, teachers, secretaries, or even as "teamsters" for "skidding" the logs to the company railroad tracks or caring for the horses and mules in the camp when they were not working with the loggers.

4.2.7 RAINELLE AND THE MEADOW RIVER LUMBER COMPANY (1906–1970)

The early histories of Rainelle and the Meadow River Lumber Company (MRL) are intertwined with the lives of Tom and John Raine. Tom Raine (1851-1933) and John Raine (1863-1940), both born in southern Ohio, had experience in both logging and railroads prior to starting the MRL and the Meadow River Coal and Land Company (MRC&L) in 1906. The Raine's purchased 32,000 acres of virgin hardwood forest (the Beury Tract) on Meadow River. The land was available for sale because the former owners believed the timber was inaccessible and did not envision any railroads extending service to the area for many years.

The MRL and the MRC&L were chartered on June 6, 1906. The Raine brothers selected the site for the new mill and the town at the confluence of Wolfpen Creek and Sewell Creek, just upstream from the mouth of Sewell Creek and the Meadow River. Their first order of business was to build a railroad feeder line to connect the mill to the existing C&ORR in Summers County. The feeder line, which extended ca. 21 miles, was initially known as the Sewell Valley Railroad (SVRR). The feeder line ran from Meadow Creek Station, to Springdale, over Wallow Hole Mountain, and down Sewell Creek to Rainelle. Tom Raine undertook the construction of the railroad, while John worked a tract of land near Hillsboro Academy in Pocahontas County (Collins 1999; Bagdon 2002). Tom Raine also began work on the construction of the mill and the town. The Sewell Valley railroad was completed to Rainelle in 1910. The railroad and many of the subsequent rail lines constructed by the MRC&L was built by Italian laborers that had worked for the Raine and Andrews Company elsewhere in West Virginia.

Construction of the town began in 1908 with the utilization of hemlock trees cut in proximity to the town site (Bagdon 2002), and construction of the mill began in 1909 (MRF n.d.). The company soon entered the railroad business, and they purchased Sewell Valley No. 1 (a Shay-

geared engine, Class 50-2) in June, 1909 (Bagdon 2002). The company discarded the first Sewell Valley No. 1 and purchased a second Sewell Valley No. 1 (a two-truck, Shay geared engine, Class 42-2) in the winter of 1910. The second Sewell Valley No. 1 began hauling logs to Rainelle in the winter and spring of 1910, and later in 1910 the company purchased another two-truck, Shay-geared engine (Class 42-2), known as Meadow River No. 1, along with 20 cars. The mill, which had three six-foot bandsaws, was completed in 1910, and the first logs were cut on September 10, 1910 (Bagdon 2002). The principal tree species on company tracts included red and white oak, chestnut, hickory, poplar, maple, hemlock, bass, beech, cherry, and ash (Larson 1916). Initially, the principal stock was rough lumber, but with time the mill expanded to accommodate stock of ties, flooring, siding, lath, and chair stock (Larson 1916).

L.C. Dyer, one of the founding charter members, became President of the MRL and John Raine moved to Rainelle to become the General Manager. Because of the profits generated from other Raine and Andrews businesses, John Raine was able to purchase 14,000 acres in 1914 from the Gauley Coal and Land Company as well as an additional few thousand acres from several smaller purchases (Collins 1999). In 1928 an additional 30,000 acres was purchased from the Gauley Company on Big and Little Clear Creeks, bringing the company's land holdings to nearly 80,000 acres. Eventually the MRC&L land holdings grew to more than 125,000 acres or nearly 200 square miles. Tom Raine later formed the Raine Lumber Company in 1916 and built a sawmill at Honeydew in Fayette County which operated until 1923 under the supervision of his son J. W. Raine. Raine Lumber Company also purchased an operation in Pocahontas County that operated between 1923 and 1928 on what is now Seneca State Park (Collins 1999). During the 1920s Tom Raine also became interested in the developing coal industry, and in 1921 he bought the Loop and Lookout railroad (L&LRR) and the SVRR form MRL. He then proceeded to extend the SVRR to Glencoe, Duo, and Rupert, and later extended lines to Nallen to meet the New York Central (NYC). When Tom Raine sold the SVRR to NYC in 1924, he realized a profit of $3.75 million. The SVRR totaled more than 100 miles in length and eventually this rail line was operated as the Nicholas, Fayette, and Greenbrier railroad (NF&GRR).

John Raine, along with assistance from his nephew, Howard L. Gray, continued to oversee the rapid growth and expansion of the MRL, the MRC&L, and the town of Rainelle. The town of Rainelle, which was incorporated in 1913, quickly earned a reputation for being one of the best hardwood mill towns in the United States (Collins 1999). John Raine studied George Pullman's efforts to create a "model town" and reportedly built some of the finest company housing in the state (Collins 1999; Larson 1916). At the time the first houses were built, beginning around 1908-1910, each house was built with an eye toward comfort and sanitation. All the residences were two-story, frame houses with clapboard siding, a front porch and an enclosed rear porch/storage room. The houses were plastered and papered on the interior and painted white on the exterior. The houses contained a living room, dining room, and kitchen downstairs, and two bedrooms and a bathroom upstairs**.** Each house had running water and most of the houses also had modern bathrooms, steam heat, and electricity. Each house had a lawn and garden, including a fruit tree, and in later years each was provided with a garage (Collins 1999).

John Raine was elected President of MRL in 1917 and he named his nephew as plant foreman. John Raine was concerned about worked motivation, as he desired to place the worker in a position that "… he will be interested in the accomplishment of a good piece of work, and where he will feel that it is all a part of his honest toil and effort" (Lumber World Review 1920). To that end, the MRL instituted a pay scale that included various incentives for all laborers rather than a scale that was based strictly on an hourly wage. Because of the success of the MRL, the New York State College of Forestry began sending students to Rainelle in 1916 to study various aspects of the logging industry and the MRL operations. On of the more comprehensive studies

was presented by Andrew Larson in his "Report on the Meadow River Lumber Company of Rainelle, West Virginia" (Larson 1916). Students from the New York State College of Forestry continued to study at MRL for the next two decades (Bagdon 2002).

In 1924, disaster struck Rainelle as the mill was burned. Fortunately, the company carried extensive fire insurance, and the net loss was minimal. Construction began immediately and a new mill opened in March of 1925, less than seven months after the fire. The new mill contained three nine-foot band mills and was able to cut more than 110,000 board feet (bf) per day (Collins 1999; Bagdon 2002). In addition to cross-cut saws, band saws, and thinning saws, the plant consisted of a dimension mill, a flooring mill, a planing mill, a lumber-grade warehouse, a door and window warehouse, drying kilns, a glue room, train repair shop, boiler house/power plant, fire pump house, furniture room, laminated wood room, a shoe heel room, various sorting and loading sheds, numerous storage docks, and a refuse burner. By the end of the decade, MRL employed nearly 500 workers, and production had increased from about 3 million bf in 1910 to an average of over 30 million bf in the late 1920s, or the equivalent of cutting nearly 3,000 acres of virgin forest every year (Collins 1999; WV Review 1929). By 1929, the MRL shipped products to 26 states and several foreign countries and was renowned as the "largest hardwood lumber mill" in the world (WV Review 1929).

Between 1910 and the mid-1950s, the MRL owned and operated well over 100 miles of track between the SVRR and the L&LRR and their various logging spurs. The SVRR and the L&LRR became the NF&G RR during the 1920s and continued to operate into the 1960s. They also owned at least 7 Shay engines and as many as 600 cars. After a successful run of nearly 50 years, the Shay engines of the MRL were replaced by diesel-electric locomotives by 1957. During the last years, the MRL operated with two 70-ton diesel-electric engines. Mismanagement, inattention to shrinking markets, the lack of technological updates, and two labor strikes (1963 and 1969) proved too much for the company to overcome. The end of the era came in 1970 when MRL was sold to Georgia-Pacific (GP). GP operated the plant for about one year before it closed the mill and the last lumber was shipped out of town in 1971. At the time the mill was sold, the number of board feet cut per year had dropped to 18,000 bf per year. The mill was razed by 1975, and HAER documentation was completed in 1984.

4.2.8 PARDEE & CURTIN LUMBER CO. AND NICHOLAS COUNTY (1889-1928)

The Pardee & Curtin Lumber Company (P&CL) was founded in 1873 in Pennsylvania as a partnership between George W. Curtin and Ariovistus Pardee Jr. George Curtin, who was the son of the governor of Pennsylvania during the Civil War, was born in Clinton County, Pennsylvania in 1834. He served in the 7th Pennsylvania Reserves and was assigned to the Army of the Potomac during the Civil War. He was in the Battle of Antietam and in 1864 was captured and taken prisoner at the Battle of the Wilderness. Curtin eventually was taken to the infamous Andersonville Prison in Georgia where he spent several months until his release in a prisoner exchange. Curtin was married in the fall of 1865, and his only child, Harry (who later took over the P&CL upon his father's death), was born in 1866. Following the War, Curtin maintained his service with the Pennsylvania Militia, and he eventually attained the rank of Brigadier General. In 1873, Curtin moved to West Virginia with his family and initially settled in Grafton where he built a sawmill along the Tygart River (www.familytreemaker.genealogy.com).

Ario Pardee Jr. was born in Pennsylvania in 1839. After graduating from Rensselaer Polytechnic Institute in New York, he went to work for his father, a noted "Coal Baron" in Pennsylvania. At the outbreak of the Civil War, he joined the 28th Pennsylvania Infantry as a captain in June of

1861 and was promoted to major in November of 1861. He distinguished himself in service, and by October 1862 he was named Lieutenant Colonel of the 147th Pennsylvania Regiment. He fought at the Battle of Antietam Creek in Maryland, and he later served as a Brigade Commander during the Battle of Gettysburg, where he was awarded the Order of Battle Merit. It is likely that during these times he met and struck up a friendship with George W. Curtin. Pardee's troops were under the command of General Sherman during his march across Georgia where he again distinguished himself during combat. Following the war, he entered into several partnerships related to coal mining with his father and brother (Calvin). He also entered into a partnership with George W. Curtin, and together they formed the P&CL.

As noted, the first P&CL sawmill was located in Grafton along the Tygart River. The mill, which was a single band, steam operated mill, closed in 1890. At that time P&CL moved their operations to Sutton (Braxton County) on the Elk River. In the early 1890s a spur of the Baltimore & Ohio Railroad (B&O) was completed to Sutton. The P&CL mill in Sutton was very successful, and the mill operated for 14 years (1904). The P&CL also acquired a nearby mill, just upstream from Sutton (east) in Palmer, West Virginia in 1901 which they operated for six years. During the early years of operation, log skidding in the vicinity of Sutton was done by horses or oxen, and the logs were floated down the river through a series of splash dams (www.familytreemaker.genealogy.com). In 1900, the company acquired a 25-year timber contract on several large tracts of land in Nicholas County, and shortly thereafter, P&CL expanded their operations and opened four mills in Nicholas County. The mills were located at Curtin, Coal Siding, Hominy Falls, and an unnamed location at the mouth of Deer Creek. Curtin, the largest of the four mills, and Coal Siding were located on the Cherry River upstream from its confluence with the Gauley River, and Hominy Falls was located on Hominy Creek, several miles upstream from the Gauley River (www.familytreemaker.genealogy.com). In addition to the P&CL and the MRL, other large-scale logging companies in Nicholas County and/or the surrounding region between 1905 and 1925 included the Cherry River Boom and Lumber Company (200,000 acres) (Brashler 1991) and the W.M. Ritter Lumber Company, which owned over two billion feet of hardwoods in West Virginia, Virginia, Tennessee, North Carolina, and South Carolina (ETSU 2006).

The lumber mill at Curtin was the largest of the P&CL operations in Nicholas County. The mill at Curtin utilized a large double band saw, whereas the other P&CL mills in Nicholas County used a single band saw. All the mills were steam operated, and sawdust and wood chips from the band saw helped to fuel the steam engines. Although the logging was done by horses or oxen, the logs were brought to the mill towns by the Pardee and Curtin Lumber Company Railroad (PCLRR) (www.familytreemaker.genealogy.com). The narrow-gauge railroads and the Shay locomotive engines were able to negotiate the steep and rugged terrain. The company also owned the Cherry River and Southern RR, and together the company owned over 85 miles of track in the area. With the expiration of the timber contract and the exhaustion of timber resources as a result of their clear cutting practices, the four mills in Nicholas County closed in 1928. During the 1920s, the P&CL was under the leadership of Harry Curtin, George's son, as Harry had taken over control of the company in 1917 after his father's death. Harry Curtin died in the fall of 1928, but by that time P&CL was in the process of moving their operations to Bergoo (Webster County). By most accounts, the four P&CL mill towns in the county were ghost towns by 1926 (Berry n.d.). The P&CL mill at Bergoo operated until 1944 when it burned. Review of Figures 6 and 8 shows the presence and subsequent disappearance of the community of Hominy Mill between 1920 and 1935. It is possible that Hominy Mill served as a shanty town community for workers at Hominy Mills as well as loggers that worked for P&CL.

Curtin, much like Rainelle, was a model company town for its time. Much of the town was built by George Curtin, who was affectionately called the "General" for his rank in the Pennsylvania Militia following the Civil War. The town was self-sustaining and included a school, church, hotel, company store, post office, ice cream parlor, and theatre. Curtin provided his employees with fine company houses and constructed boardwalk streets and sidewalks. The town also had a ferry for crossing the Cherry River since the bridges were only constructed for use by trains. The year 1918 was a particularly bad year for Curtin. Not only did the town lose young men to military service during World War I, but on March 13, 1918 a devastating flood swept through the town destroying the hotel and several residences. Later in that same year, the infamous 1918 flu epidemic swept through town and killed numerous individuals including whole families. As reported by (Berry n.d.), the town of Curtin is all but abandoned.

> "The wooden buildings have long since gone, although careful inspection of the hillsides revealed old home sites and a few artifacts… The stone walls of the old mill rose above the tangle of berries… The mill and dry kiln were constructed of large sandstone blocks, locally quarried. Portions of the wall still stood, and the kiln side of the mill showed double-wall construction… Trees sometimes a foot in diameter had grown up inside the mill walls… Two massive stone blocks, split by a narrow passageway, show where the band mill once stood… On the lower side of the mill are the remains of four furnaces, apparently used to kiln dry the lumber…the (collapsed furnaces) suggest the fire boxes could probably hold up to a ton of coal each… Close by the mill and furnaces is a large depression, which had been the mill pond…" (Berry n.d.).

4.2.9 GROWTH OF THE "SMOKELESS" COAL INDUSTRY (1920–1960S)

Beginning in the 1920s, interest in the coal industry reached Greenbrier and Nicholas counties as well as the surrounding region. As noted previously, Tom Raine became interested in the coal industry at this time and purchased the SVRR and the L&LRR. Tom Raine extended the NF&G to his property on Big Clear Creek, north of Rupert, in 1929, but the onset of the depression precluded mining the coal reserves in this area until 1932. In 1932 he formed the Raine Coal Company, and the company, under family ownership and supervision, continued to operate until 1959 when the company and property was sold to the Gauley Coal and Land Company.

The community of East Rainelle, which was founded in the 1910s and incorporated in 1921, was developed to accommodate the growing population of Rainelle. In the early years, East Rainelle, also referred to as "Slabtown" because the first houses were temporarily sided with "slabs" from a portable sawmill, was located east and south of Sewell Creek, primarily along US 60 (Whitman 1977). During this time East Rainelle served as the business and commercial center for Rainelle and the surrounding area. Beginning in 1921, the Greenbrier and Eastern Railroad (G&ERR) extended rail service the Meadow River Valley area in order to exploit the low volatile, or 'smokeless,' coal supplies in the region. Many mines were opened in the Meadow River region after construction of this railroad, and additional mines were opened in the vicinity of Charmco, Quinwood, Duo, Clearco, and Anjean after the railroad was extended to the Big Clear Creek area in 1928-1929. East Rainelle benefited from the development of the coal industry in the 1920s and 1930s, and the town's population eventually surpassed Rainelle. Between 1921 and 1950, the population of East Rainelle more than tripled from nearly 450 people in 1921 to nearly 1,700 people in 1950, whereas the population of Rainelle in 1950 was about half at 850 people (Whitman 1977). In 1969, Rainelle and East Rainelle were joined under the name of Rainelle.

Today East Rainelle contains a mix of historic and modern homes, as does the well-defined commercial district (also a blend of old and new buildings) along Route 60, Main Street.

The P&CL, like the Raine brothers, ventured into the coal mining industry in part because of their large landholdings in the area and also because they owned the railroads into the coal regions. In Webster County, the company started and owned a railroad company, Greenbrier, Cheat, & Elk (GC&E). The GC&E was not only used for hauling logs to the mill in Bergoo, but was also used for hauling coal from the P&CL coal mines. The coal mining operation, which started in Bergoo in 1928 along with the P&CL sawmill, continued to produce coal until 1958. During this 30-year period, the company produced 23 million tons of "smokeless" coal from its nine mines. The peak period of production was the late 1940s when the company employed over 2,000 men (www.familytreemaker.genealogy.com).

4.2.10 END OF AN ERA (1971–PRESENT)

The Meadow River Lumber Company was sold to the Georgia-Pacific Company in December of 1970, and the plant was closed completely by 1972. Prior to the sale to G&P, MRL had sold many of their assets such as the railroads, the power plant and the Pioneer Hotel. When G&P purchased the remaining assets from MRL, they also purchased the company housing. G&P immediately turned around and allowed the families to purchase their home rather than continuing to pay rent. Reportedly, over 80 homes were sold in this manner in the first year (MRF n.d.). G&P sold over 200 acres of land on the fringes of town to prospective home owners and developers, and they also sold many of the outdated businesses such as the company bank, company store, and post office (MRF n.d.). Thus, the purchase of the MRL by G&P turned a "lumber company town" into just a "plain town" (MRF n.d.). Eventually, the lumber mill was razed, the mill pond was filled, and the railroad tracks serving the mill were removed. All this was accomplished by 1975. Except for the company housing that still dominates the residential area west of Route 20 and on either side of US 60 west of the Route 20/US 60 interchange, only a few buildings remain from the original company town. Extant buildings include the former Fire Pump House (Greenbrier County Public Service District #2), the abandoned railroad depot, the former company bank (APCO offices), the former high school (currently the elementary school), the United Methodist Church, and the John Raine house. Within recent years the company store, located next to the bank, has been razed, the Tom Raine house was torn down to build the Rainelle Medical Center, and in 1982 the Pioneer Hotel (former theater) was closed and torn down due to a lack of clientele.

The P&CL mill in Bergoo in Webster County burned in 1944, and the company built a new mill along the Elk River west of Bergoo and east of Webster Springs in a town called Curtin (Note: this is not the same town as the Curtin in Nicholas County), in honor of the company founder. The new single band sawmill, with an annual production capacity of 4-5 million bf, was the first all electric mill in the state, but the company reverted back to steam in 1979 with the addition of a new boiler-dry kiln complex (www.familytreemaker.genealogy.com). In 1981 the mill in Curtin was closed, but in 1984 the sawmill along with a timber contract was leased to the Jim C. Hamer Company. At that time the P&CL owned 58,000 acres of timber resources and 70,000 acres of coal resources in Webster, Randolph, Braxton, and Nicholas counties. At that time, the P&CL also merged with other related companies and reorganized to form and operate the Pardee Resources Company (www.familytreemaker.genealogy.com). Today, rubber-tired skidders have replaced horses for logging operations, and trucks have replaced horses, rivers, and railroads as the preferred mode of transporting logs to sawmills.

5.0 FIELD AND LAB METHODS

Field investigations were conducted from August 1, 2006 through August 18, 2006. The field team consisted of a three-person team: Mr. J. Sanderson Steven (Principal Archeologist), Mr. Brian Corle (Project Archeologist), and Ms. Kerri Holland (Assistant Archeologist). Dr. William Chadwick and Mr. Mat Harris assisted with interpretation of the GIS data.

5.1 PEDESTRIAN SURVEY

The pedestrian survey of the 2.75 mile (50 acre) Segment B corridor was conducted with a three person crew. The crew was spaced at 15-m (50 ft.) interval transects along the 45 m (150 ft.) wide project area. Additional pedestrian survey was conducted along three re-routed portions of Segment C. The first of these areas was approximately 2,438 m (8,000 ft.) in length and traversed the top of Laurel Creek Mountain (Figure 2). Additional realignments included an approximately 460 m (1500 ft.) section paralleling Hominy Creek, and a 1,220 m (4,000 ft.) segment that jogged around the east side of the community of Hominy Falls. The pedestrian survey along Segment C totaled approximately 46 acres. The purpose of the pedestrian survey was to assess what landforms within Segment B and the new alignments along Segment C contained a potential for archeological resource. Following the methods applied by URS, areas defined as having a high or medium potential for archeological resources included well-drained, relatively flat landforms adjacent to permanent water sources. The project area also contains several areas with sandstone over-hangs. These areas could have provided shelter for both prehistoric and historic people. In addition, the WV SHPO archeological site files and historic maps were consulted to help establish an archeological context for known historic and prehistoric site locations in the project vicinity and to identify former historic buildings that may only exist as archeological resources within the project area.

Areas subject to the pedestrian survey were examined for the presence or absence of surface disturbance, the age and composition of the forest cover, and the presence of cultural features such as old fence-lines, road-traces, and building foundations. Surface disturbance along the project area included contour strip mines, log loading deck areas, clear-cut logging areas, road cuts, and two-track dirt roads used for log skidding. If an area was disturbed and displayed an exposed ground surface, then the surface was examined for the presence or absence of artifacts. The presence of different vegetation (such as old orchards and abandoned agricultural fields) can indicate changes in historic land-use practices. The presence of abandoned road traces can help identify the location of historic resources including old home sites, farmsteads, logging camps, and mill locations.

If the area contained relatively undisturbed soils and met the topographical criteria for medium to high archeological sensitivity, then subsurface testing shovel testing was recommended. Areas that underwent subsurface testing were given the two-letter designation WG (Western Greenbrier) followed by a unique number. Five areas (WG 1, WG 2, WG 3, WG 4, WG 5, and WG 12) were identified as requiring some level of subsurface testing during JMA's pedestrian survey. Areas WG 1, WG 2, WG 3, and WG 4 were located along Segment B; Areas WG 5 and WG 12 were located within Segment C on top of Laurel Creek Mountain (Figure 2).

Initially, URS defined approximately 1,830 m (6,000 ft.) in seven locations within the powerline corridor as containing a medium potential for archeological resources (URS 2005). However, several of these previously defined areas were by-passed by the new alignment (e.g., the top of

Laurel Creek Mountain, along Hominy Creek, and near the community of Hominy Falls) (Figure 2). Thus, Areas WG 6 through WG 11, which were located along Segment C within Nicholas County, were either identified for shovel testing by URS or occupied similar or adjacent landforms on the new alignment (Figure 2).

5.2 INTENSIVE SHOVEL TEST SURVEY

In order to determine the presence or absence of subsurface archeological deposits, the JMA field team employed the systematic excavation of STPs and judgmental STPs. JMA excavated 353 STPs within areas WG 1 through WG 12, or the equivalent of almost 20 acres. STPs, which measured approximately 50 centimeters (cm) in diameter, were spaced at 15-m intervals along parallel transects. The shovel test transects were spaced at 15-m (50 ft.) along either side of the proposed corridor centerline. Judgmental STPs were excavated in areas not included in the URS survey, but determined by JMA as having a potential for archeological resources. In addition, one judgmental shovel test was excavated in within a feature. Finally, radial shovel tests were excavated at 7.5 m (25 ft.) intervals in cardinal directions around positive shovel tests. The purpose of radial shovel tests was to obtain additional artifacts and to refine site boundaries. Radial shovel tests were also excavated around isolated find spots to determine if the artifact was part of a site or an isolated artifact location. If a site area contained surface artifacts, these artifacts were collected and their location plotted on the field map.

All STPs measured roughly 50 cm in diameter and were excavated to subsoil, generally 20-30 cm below the ground surface. Excavated soil matrices were screened through ¼-inch hardware cloth to ensure uniform recovery of cultural materials. Information on each shovel test was recorded on standardized forms that include the location, setting, and provenience information; the presence or absence of artifacts; the number and types of artifacts; and, soil color designations and texture according to standard scientific nomenclature. All shovel tests were flagged; the flags were labeled with general provenience information. The location of the shovel tests was plotted on a project map. The beginning and end of each transect was recorded using a hand-held Global Positioning System (GPS) unit.

5.3 LABORATORY METHODS

Artifacts recovered during field investigations were returned to JMA's Alexandria laboratory for cleaning and cataloguing. Artifacts with stable surfaces (such as lithics, ceramics, and glass) were washed in warm water. Other artifacts (such as metal and bone) were dry-brushed to remove the dirt. The cleaned artifacts were placed in re-sealable 4-mil polyethylene zip-lock bags and labeled with provenience information. The bags were stored sequentially in acid-free boxes labeled with provenience information. Artifact bags were labeled using indelible ink with site number (46NI655) and provenience data. Artifacts were boxed in acceptable containers following professional guidelines.

Recovered artifacts were processed in accordance with *Guidelines for Phase I, II, and III Archaeological Investigations and Technical Report: Appendix L. Curatorial Guidelines-Collections Management Facility* (WV SHPO). Artifact analysis focused on determining periods of occupation, site function, artifact distribution, and integrity of cultural deposits. Historical period artifacts were catalogued by count, raw material, typology, and function. Additional artifact attributes were recorded where they contributed to the determination of the artifact function or temporal range. Artifacts were grouped into categories in order to provide a framework for analysis. The categories used (*group* and *class*) are based on a system developed

by South (1977). The artifact categories have been tailored to incorporate nineteenth and twentieth century artifacts. The groups used in the current assemblage include: Architecture (nails, brick, window glass), Kitchen (ceramics, bottle glass, etc.), Clothing (shoe parts), Arms (shotgun shell), and Activities (axe, oil can, etc.). Processed artifacts were placed in archivally stable bags, labeled with provenience data, and boxed for curation. In the event that the landowners request the artifacts, they will be returned to the owners. If the landowners choose to donate the artifacts, JMA will suggest that they be deposited with the WV SHPO. Relevant documentation such as filed notes and maps will also be delivered for permanent curation.

6.0 PHASE I SURVEY RESULTS

6.1 RESULTS OF THE PEDESTRIAN SURVEY

The walkover survey was conducted along the 2.75-mile length of Segment B (Figure 2). As noted previously, Segment 2 parallels the existing powerline west of Rainelle along the Fayette-Greenbrier County line. The first section examined began at the intersection of Snake Island Road and Segment B and continued southwest to the point where the existing powerline intersects US Route 60 (Figure 2). This portion of the project area is approximately 2,620 m (1.6 mile) in length. The walkover was conducted along three transects spaced at 15 m (50 ft.) intervals along the west side of the existing power line corridor.

This section of the project area, which consists of steep slopes southwest of the Meadow River, rises approximately 182 m (600 ft.) in elevation from Snake Island Road to the ridge top. The ridge top portion of the project area is relatively level for approximately 400 m (1300 ft.). At this point the steep slope drops approximately 213 m 700 ft. to US Route 60 at the south end of the project area. Segment B south of US Route 60 was previously surveyed by JMA in 2004 (Stevens and Chadwick 2004:51).

The ridge slope south of Meadow River contains a northern exposure and supports a secondary forest dominated by hemlock and birch trees with a under story of rhododendron (Plate 1). The slope also contains a contour strip mine located approximately 182 m (600 ft.) southwest of Snake Island Road. The strip mine is approximately 121 m (400 ft.) wide and dates to the mid-twentieth-century. The natural ground surface on the slope is composed of sandstone talus covered by humus.

The walkover survey determined that the section of Segment B along the ridge slope southwest of Meadow River contains little potential for cultural resources. The hillside within the project corridor is extremely steep and does not contain ridge spurs or saddles that would provide a suitable location for human occupation. In addition the ground surface within the project area is primarily sandstone talus covered in a thin humic soil horizon. The only cultural feature identified along this section of the project area is a contour strip mine dating to the last half of the twentieth-century. Strip mines are a common feature and are not considered a potential archeological resource. Therefore no further work is warranted along this section.

The ridge top portion of the project area along this section is forested in mature 50+ year old hardwoods dominated by oak and yellow (tulip) poplar with an under story of mountain maple. An intermittent spring is located in a draw approximately 100 m (328 ft.) northeast of the southwestern edge of the ridge top. The ground surface in this section of the project area is covered in leaf litter and humus with occasional outcrops of sandstone bedrock or sandstone talus. The southern edge of the ridge contains sandstone outcrops and overhangs (Plate 2).

The walkover survey resulted in the determination that this section of the project area could potentially contain archeological resources. The sandstone outcrops along the southern edge of the ridge could have provided shelter, and the intermittent spring could have served as a source of potable water for historic and prehistoric people. The ground surface along the landform does not contain obvious signs of ground disturbance. Based on these observances the area was selected to undergo additional Phase I shovel testing. The area was designated WG 1 and the results of the shovel testing will be presented in Section 6.2 of this report.



Plate 1. Overview of Area WG 1 showing proposed powerline corridor to the right of the existing transmission line, facing southwest.



Plate 2. Overview of Area WG 1 showing large sandstone outcrops along the edge of the mountain, facing northeast.

The southwest slope of the project area leading to US Route 60 is forested in a mature mix of oak and poplar interspersed with occasional hickory trees. The understory is composed of green briar and mountain maple. The ground surface along this section is primarily sandstone talus covered in places by a thin humic horizon. Two gravel logging roads cross this section of the project area. These roads are maintained and are currently in use.

The walkover survey determined that this section of the project area contains little potential for archeological resources. The topography is steep and no landforms that would have provided locations for human occupation were identified. In addition, the ground surface is primarily composed of sandstone talus and contains very little soil development. Therefore, no further investigations are warranted along this section of the project area.

The second section of Segment B consists of a small parcel of land 76 m (250 ft.) long x 45 m (150 ft. wide located between the south bank of the Meadow River and Snake Island Road. The project area parallels the west side of the existing power line. The topography along this section is composed of a steep hill side approximately 25 m (80 ft.) above the river. The hill drops in elevation approximately 10 m (30 ft.) from the road to railroad tracks. From the tracks, the land drops approximately 15 m (50 ft.) to the river. The project area at this location is forested in a mix of hemlock and birch trees with an under story of rhododendron. The ground surface is covered in sandstone talus capped by a thin humic horizon.

Aside from the railroad tracks and Snake Island Road, only one cultural feature was identified in this section. The feature is located on the slope approximately 15 m northeast of Snake Island Road, 20 m (65 ft.) southeast of the railroad tracks and 5 m (16 ft. northwest of the existing power line. The feature was located within WG 2. The feature is composed of a 9-by-17 m (30-by-55 ft.) bench cut into the hillside and oriented northwest-southeast along the slope. Within the bench are four poured concrete 30-by-30 cm (1-by-1 ft.) posts composed of Portland cement. Within the center of the post is galvanized steel pipe. The posts are located at the four corners of the feature. Surrounding the feature was the remains of a chain link fence.

Phase I investigation of the feature included mapping, subsurface testing, and a surface reconnaissance of the area surrounding the feature. Subsurface testing included excavation of one STP, designated WG 2.1. This STP was excavated within the footprint of the feature. The stratigraphy within the shovel test consisted of a disturbed 11 cm (0.4 ft.) thick silt loam stratum containing 30 percent course limestone gravel. This stratum capped another disturbed layer of silty clay loam (Figure 9a). Several fragments of non-electrical wire and a wire clamp were recovered from the shovel test. These artifacts were noted in the field but not retained for collection. The reconnaissance survey in the vicinity of the feature identified numerous surface artifacts, including galvanized metal buckets, ceramic electrical insulators, and modern trash.

Based on the walkover survey, surface artifacts, and subsurface testing, this feature appears to be modern (circa 1970s) and is most likely associated with the existing power line. The feature may have been the former location of a transformer station that was abandoned when the power line was last upgraded. Supporting this interpretation is the numerous fragments of ceramic insulators surrounding the feature; the poured concrete fence posts and remnants of chain link fence indicate that the feature was enclosed by a fence. Artifacts generally associated with domestic occupation were not recovered in the area or within the shovel test. These artifacts would have included domestic items such as kitchen ceramics or bottle glass or architectural materials including nails or window glass. No further archeological investigation is warranted and no further works is recommended in this area.

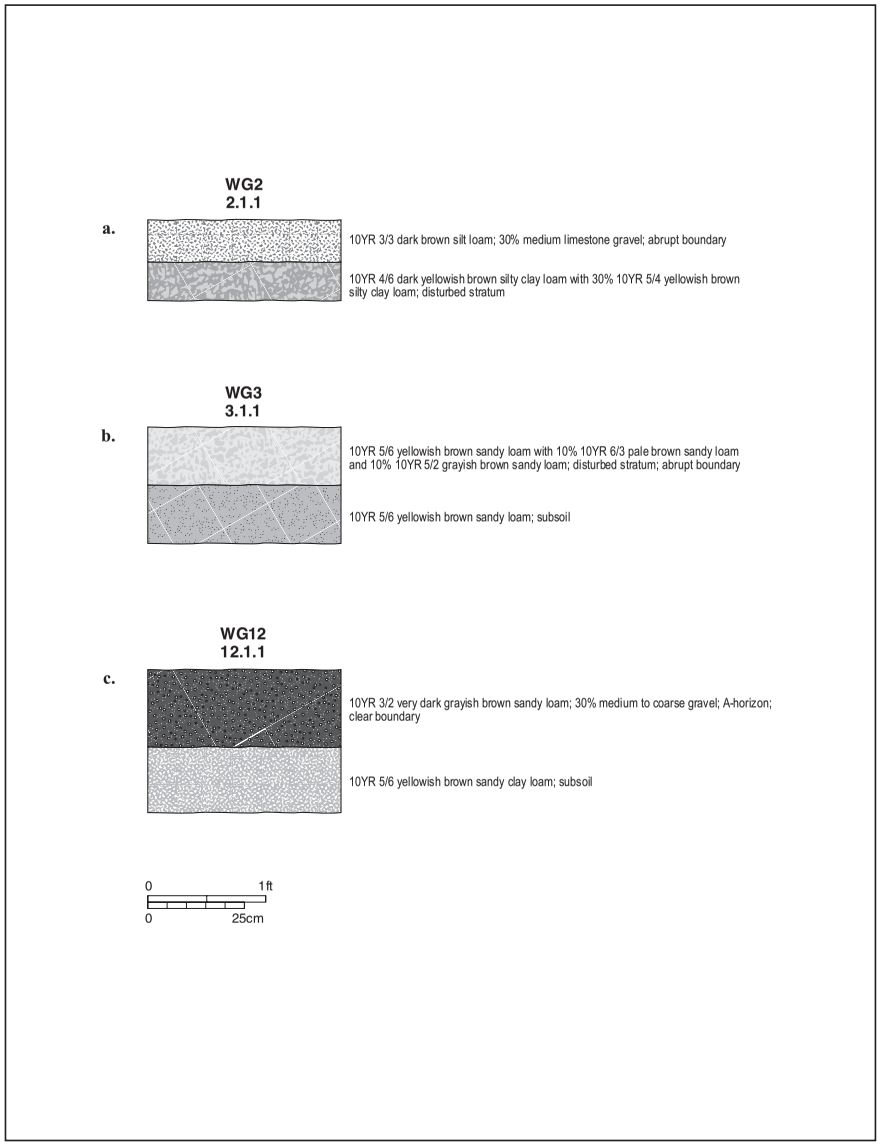


Figure 9. Representative shovel test pits in Areas WG 2, WG 3, and WG 12.

The remaining portion of Segment B (i.e., between the railroad track and the river) is a steep slope that drops into Meadow River. That is, there is no terrace or floodplain at this location and therefore, no area available for human occupation. Rather, the river is entrenched in a steep bank and would not have been suitable location for occupation. Therefore no further work is recommended at this location.

The walkover survey of Segment B on the north side of the Meadow River was also conducted in two sections. The first section extended southwest from an existing logging access road to the north bank of the Meadow River (Plate 3). This section of the corridor parallels the west side of the existing power line and is approximately 150 m long (500 ft.) and 45 m (150 ft.) wide. The second section of the corridor began at the logging road and continued to the top of Laurel Creek Mountain. This section then continues along the top of Laurel Creek Mountain for approximately 1,220 m (4,000 ft.). Segment B terminates at the point where Segment C separates from the existing powerline (Figures 1 and 2).

The project area between the railroad tracks and the logging road is within a select-cut timber stand that has been recently logged. Uncut trees within this stand consist primarily of oak and hickory interspersed with yellow poplar. Between the railroad tracks and the river, the project corridor is forested in cherry and beech with a thick under story of thorn apple, green briar and blackberry bushes (Plate 3). The ground surface on the terrace south of the railroad tracks displayed signs of past disturbance associated with the construction of the railroad tracks. These disturbances included push piles, and graded areas that are the result of creating a bed for the tracks. Much of the ground surface on the north side of the railroad tracks is covered in sandstone talus capped by a thin humic horizon. Recent logging activities have resulted in surface disturbance within the project corridor. This disturbance is the result of machinery associated with log skidding that has removed the overlying humus and/or subjected the thin rocky soils to erosion and exposed the underlying talus.

Although the terrace south of the tracks did contain surface disturbance, one incidental shovel test (WG 3.1) was excavated at this location. Plate 3 illustrates the excavation of a judgmental STP (WG 3.1) on the narrow terrace above Meadow River. In addition to the shovel test a series split-spoon soil probes were conducted along the southern edge of the terrace. The stratigraphy within STP WG 3.1 (and the soil probes) consisted of a 15 cm (0.5 ft.) thick sandy loam disturbed zone that capped the compact sandy loam subsoil (Figure 9b). No artifacts were recovered from the shovel test. The project corridor north of the railroad tracks (i.e., between the railroad tracks and the logging road) is characterized by thin soils that cap the underlying talus. This area has been heavily disturbed by logging operations. Therefore, this area contains little potential for archeological resources and no further work is recommended.

The second section of Segment B north of Meadow River is approximately 1,220 m (4,000 ft.) long and 45 m (150 ft.) wide. This section parallels the west side of the existing power line and begins at the logging access road on the north side of the river and continues up the slope of Laurel Creek Mountain. The topographic rise between the logging road and the top of Laurel Creek Mountain is approximately 160 m (520 ft.). The southern 305 m (1,000 ft.) of the project area is located within a select-cut timber stand that has recently been logged. The remaining uncut trees are primarily oak and hickory. To the north of the select-cut area is a contour strip mine dating from the last half of the twentieth-century. The strip mine is approximately 60 m (200 ft.) wide. At the north edge of the strip mine is a gravel logging road. Beyond the road the project area continues upslope for a distance of approximately 305 m (1,000 ft.) until it reaches the summit of Laurel Creek Mountain. The summit at this location is characterized by massive

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Plate 3. Overview of Area WG 3 showing excavation of STP 3.1.1 on terrace of Meadow River, facing southwest.

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sandstone outcrops. The walkover survey of the steep section of the project corridor did not identify any cultural resources or landforms that would require further Phase I sub-surface testing. Therefore, the area is considered to have low potential for archeological resources and no further work is recommended for this portion of the project corridor.

On top of the mountain, the project area continues along the west side of the existing power line in a northeasterly direction for approximately 610 m (2,000 ft.) (Plate 4). At this point the project corridor (Segment C) angles to the north-northwest from the existing power line and continues for a short distance before angling back to the northeast across Laurel Creek Mountain (Plate 5 and Figures 1 and 2). The project corridor along the summit of Laurel Creek Mountain is gently sloping and is characterized by sandstone ridges separated by several small intermittent, unnamed drainages. The project area has recently undergone select-cut logging. The remaining trees are primarily black cherry and oak with an understory of seedling poplar, mountain maple, blackberry bushes, and green briar (Plate 6).

The ground surface along this section contains occasional outcrops of sandstone and exposed rock fragments however, in general, the surface is undisturbed. The project area on the summit contained several springs flanked by well-drained landforms, suggesting that it may potentially contain archeological resources. The presence of relatively intact soils and minimal ground disturbance resulted in the determination that this area required further subsurface testing. The area was designated WG 5 (see Figure 2); the results of the subsurface testing will be discussed in the Phase I shovel testing results within Section 6.2 of this report.

The section of the new power line that splits from the existing line is labeled Section C. Originally Segment C was to traverse the west slope of Laurel Creek Mountain. However, due to landowner considerations the proposed line was rerouted approximately 1,676 m (5,500 ft.) north across a ridge-spine and then shifted to the northwest for approximately 762 m (2,500 ft.) across a northwest trending ridge on top of Laurel Creek Mountain. The powerline corridor then drops down the northwest slope of the mountain into the Meadow Creek stream valley where it rejoins the original powerline corridor (Figure 2). Based on the URS walkover survey of the original powerline, the corridor measured 2,133 m (7,000 ft.) long and would have crossed approximately 580 m (1,900 ft.) of areas considered to contain a moderate potential for containing archeological resources. The new alignment is approximately 2,440 m (8,000 ft.) long and crosses approximately 800 m (2,625 ft.) considered to have a medium potential for archeological resources. These areas include relatively flat landforms near sources of potable water.

Some of the ground surface along the top of the ridge contains areas that have been disturbed by recent logging. These disturbances include rutted two-track roads used for overland log skidding and uprooted trees stumps. The ground surface surrounding these areas has been eroded resulting in exposed subsoil. Because the disturbed portions of the ridge top were not extensive, the majority of the ridge top was selected to undergo intensive Phase I subsurface testing. Typical setting in area WG 5 is illustrated in Plate 7. The ridge saddle at the northeast end of the ridge is severely disturbed as a result of it use as a loading area. These disturbances include graded areas, push-piles, and areas of stripped tree bark that have been pushed into the ground surface by machinery (Plate 8). As a result of the extensive disturbance this area was not chosen for subsurface testing and no further work is recommended.

The new alignment continues northeast across the top of Laurel Creek Mountain for a distance of approximately 1,160 m (3,800 ft.). This portion of the project corridor crosses several narrow ridge tops that are separated by steep-sided draws. This portion of the project corridor has been



Plate 4. Overview of Area WG 4 showing proposed powerline corridor to the left of the existing transmission line, facing northeast.



Plate 5. Overview of Area WG 4 near the conjunction of Segments B and C, facing northeast.



Plate 6. Overview of Area WG 4 on top of Laurel Creek Mountain showing Segment C, facing southwest.



Plate 7. Overview of Area WG 5 showing proposed new alignment on Laurel Creek Mountain, facing northeast.



Plate 8. Area WG 5 showing log loading area in select-cut timber stand, facing northeast.



Plate 9. Area WG 5 showing clear cut area on the top of Laurel Creek Mountain, facing northeast.

recently clear-cut across its entire length (Plate 9). As a result of the clear-cutting, the ground surface has been disturbed. These disturbances include eroded and deflated soils, areas of exposed subsoil, and areas containing exposed bedrock (Plate 10).

Areas containing exposed soil were visually examined for the presence or absence of artifacts. One area, designated WG 12, produced one prehistoric isolated find (IF-1). The isolated find, an interior chert flake, was located at the head of a draw approximately 275 m (900 ft.) southwest of the point where the new alignment shifts to the northwest (Plate 11). The single chert flake was recovered from a logging road within the project area. The ground surface surrounding the isolate find was intensively examined for additional artifacts, but no other artifacts were observed. Three judgmental shovel tests (WG 12.1.1, 12.1.2, and 12.1.3) were excavated in the vicinity of the surface collection.

Shovel test 12.1.1 was excavated 2.5 m (8 ft.) west of the surface collection. The stratigraphy within the shovel test consisted of a 20 cm (0.6 ft.) thick sandy loam A horizon containing 30 percent medium to coarse, angular pebbles and cobbles. The A horizon displayed a clear boundary into the underlying sandy clay loam subsoil (Figure 9c). No artifacts were recovered from this shovel test. Shovel test 12.1.2 was placed 7.5 m (25 ft.) east of the surface collection and shovel test 12.1.3 was 15 m (50 ft.) east. The stratigraphy within these shovel tests consisted of an 11-to-12 cm (0.36-to-0.4 ft.) thick sandy loam A horizon with 40-to-50 percent medium, angular pebbles and cobbles. The A horizon displayed an abrupt boundary onto the underlying sandy clay loam subsoil. No artifacts were recovered from these shovel tests.

The identification of a prehistoric isolate on top of Laurel Creek Mountain indicates that prehistoric peoples occasionally used the project vicinity. The nature of the isolate is a low-density upland prehistoric campsite. The location of the site at the head of a draw may indicate that the draw contained a lesser gradient leading to the Meadow River valley and was perhaps used as a point of access to the mountain top. The results of the subsurface testing and the surface collection confirm that the site was not intensively used. The stratigraphic sequence revealed by the shovel tests indicates that the area surrounding the isolate has undergone erosion or deflation as a result of recent and historic clear-cut logging.

At the angle point in the powerline corridor near the isolated flake, the corridor turns to the northwest and traverses the top of Laurel Creek Mountain for approximately 762 m (2,500 ft.) before it drops off the northwest slope (Plate 12), and then continues for approximately 180 m (600 ft.) into the Meadow Creek stream valley. As discussed below, part of the corridor above the creek was not tested due to extensive ground disturbances and bedrock outcrops. The new corridor alignment rejoins the original alignment just before crossing Meadow Creek and continues to the northeast.

The aforementioned section of the new alignment is also within the recent clear-cut area. The ground surface in this area has been disturbed by overland log skidding and numerous road cuts. These activities have resulted in eroded and deflated soils. This part of the project area also contains large areas where subsoil and the underlying sandstone bedrock have been exposed. During the walkover survey these areas were examined for the presence of artifacts or surface features. No archeological materials were identified. Given the disturbed and eroded nature of the soils within this part of the corridor, the area was determined to have a low potential for archeological resources, and therefore no subsurface testing was conducted in this part of WG 5.



Plate 10. Area WG 5 showing large areas of exposed bedrock on top of Laurel Creek Mountain, facing southwest.



Plate 11. Overview of Area WG 12 near angle point in Segment C; note IF-1 located in dirt road near survey crew, facing northwest (note end of clear cut area in background).



Plate 12. Overview of new alignment at the northwest edge of Laurel Creek Mountain, overlooking Meadow Creek valley, facing northwest.

6.2 RESULTS OF THE INTENSIVE SHOVEL TEST SURVEY

Nine areas (WG 1, WG4, WG 5, WG 6, WG 7, WG 8, WG 9, WG 10, and WG 11) within the project corridor underwent systematic subsurface Phase I testing, and three areas discussed above (WG 2, WG 3, WG 12) were subjected to the excavation of judgmental STPs. Areas WG 1 and WG 4 were within Segment B, which was not previously surveyed by URS. Areas WG 5, WG 8, and WG 9 were identified and tested based on field observances by JMA personnel during the fieldwork. These areas were selected for testing using several criteria. Criteria included the presence of relatively undisturbed soil, proximity to a source of fresh water, and level to gently sloping landforms such as ridge tops stream terraces, and well-drained floodplains that would have provided an attractive place for both prehistoric and historic occupations.

Areas WG 6, WG 7, WG 10, and WG 11 were located in areas identified previously as containing a medium potential for archeological resources. The location of several of medium probability areas, including WG 5, WG 6, WG 7, WG8, WG 10, and WG 11 had to be shifted as a result of proposed re-alignments after the URS walkover survey was completed. However, in most cases, the re-alignment did not substantially diverge from the topographic settings considered by the previous study to contain a medium probability for archeological resources. As warranted, JMA conducted subsurface testing within the new alignment in these areas. JMA excavated a total of 353 shovel tests, including seven judgmental STPs and 10 radial STPs. Table 3 lists the areas tested, the number of shovel tests per area, and results.

Table 3. Summary of shovel test areas (WG), number of STPs, and survey results.

WG Area	Number of Transects	Number of STPs	STP Results	Comments
1	2	43 + 2 judg.	All Negative	2 judgmental STPs in rockshelter
4	6	44	All Negative	
5	2	15	All Negative	
6	2	41	All Negative	
7	4	65	All Negative	
8	NA	4	All Negative	4 judgmental STPs
9	NA	4	All Negative	4 judgmental STPs
10	4	102	All Negative	6 STPs not excavated due to Hominy Cr.
11	2	18 + 10 rad.	4 Positive	Historic artifacts (46NI655) Hominy Mill
2	NA	1	All Negative	1 judgmental w/in 1970s industrial feature
3	NA	1	All Negative	1 judgmental on terrace above Meadow R.
12	NA	3	All Negative	3 judgmental STPs around isolated flake
Total STPs		353		

6.2.1 AREA WG 1

This area is located along Segment B on a ridge top, northeast of US Route 60 and southwest of Snake Island Road. Area WG 1 was recommended for additional subsurface testing based on the results of the walkover survey (Plates 1 and 2). Forty-three shovel tests were excavated along two 390-m (1,280 ft.) long transects that parallel the west side of the existing power line (Figure 10). In addition, two judgmental shovel tests (1.1.1 and 1.2.1) were excavated along the southern edge of the mountain in order to investigate the area surrounding a potential rock shelter.

STPs (1.1.1, and 1.2.1) were excavated at the edge of a small sandstone rock overhang along the south edge of the ridge. Shovel test 1.1.1 was placed 7.5 m (24.6 ft.) south of the overhang (Figure 10). The stratigraphy consisted of a 24 cm (0.8 ft.) thick sandy loam A horizon. The A horizon displayed a clear boundary onto a sandy loam subsoil. Medium and coarse sandstone fragment comprised approximately 25 percent of the matrix within the A horizon and subsoil. Shovel test 1.2.1 was excavated directly beneath the overhang. The stratigraphy within this shovel test consists of a 20 cm (0.65 ft.) thick, sandy loam A horizon, overlying sandstone bedrock (Figure 11a). No artifacts were recovered from the subsurface testing at this location.

Shovel test transects 1.3 and 1.4 were excavated paralleling the west side of the existing power line (Figure 10). Transect 1.3 was 15 m (50 ft.) west of the power line and Transect 1.4 was placed 30 m (100 ft.) west of the power line. Shovel test profiles along the transect produced similar stratigraphy, which consisted of a 12-to-25 cm (0.4-to-0.8 ft.) thick sandy loam A horizon resting on a sandy loam subsoil (Figure 11b). Both soil horizons contained 10-to-15 percent medium-sized sandstone cobbles. The boundary between the soil horizons was clear and no evidence of historic plowing was identified in the soil profile. No artifacts were recovered from subsurface testing at Area WG 1.

6.2.2 AREA WG 4

Area WG 4 was identified as requiring additional subsurface testing as a result of the pedestrian survey along Segment B. The area is located on top of Laurel Creek Mountain beginning at the intersection of the proposed power line (Segment C) and the existing power line (Segment B) and continuing south along the west side of the existing power line where it then drops off the south side of Laurel Creek Mountain. The project area in this location contains several ridge tops separated by small drainages (Plate 4). These locations are considered to have a medium potential for archeological resources.

Area WG 4, which measured 330 m (1,083 ft.) in length, underwent subsurface testing through the excavation of 44 shovel tests along six transects (4.1, 4.2, 4.3, 4.4, 4.5, and 4.6) (Figure 12). Transects 4.1 and 4.2 began at the intersection of Segments B and C and continued for 105 m (345 ft.) along the west side of the existing power line. Eight shovel tests were excavated along each transect. Transect 4.1 was located 15 m (50 ft.) west of the edge of the power line and Transect 4.2 was located 30 m (100 ft.) west of the power line. A typical shovel test profile along the transects 4.1 and 4.2 consisted of a 2 cm (0.06 ft.) thick sandy loam O horizon capping a 13-to-26 cm (0.4-to-0.85 ft.) thick sandy loam A horizon that in turn rested on the sandy loam subsoil (Figure 11c). Transects 4.1 and 4.2 ended at a disturbed area associated with a logging staging area approximately 110 m (360 ft.) south of the intersection of Segments B and C. No artifacts were recovered from the subsurface testing.

Transect 4.3 and 4.4, excavated on the south side of the disturbed log staging area, paralleled the existing power line for 150 m (492 ft.), where the transect ended at the south edge of the landform above a small unnamed drainage. Twenty-one shovel tests were excavated along the two transects (Figure 12). Eleven shovel tests were excavated along Transect 4.3 and ten shovel tests were excavated along Transect 4.4. Transect 4.3 was located 15 m (50 ft.) from the edge of the existing power line and Transect 4.4 was 30 m (100 ft.) from the power line. Shovel test stratigraphy mirrored Transect 4.1 and 4.2 containing a 2 cm (0.06 ft.) thick sandy loam O horizon capping the 8-to-25 cm (0.26-to-0.8 ft.) thick sandy loam A horizon that in turn caps the sandy loam subsoil (Figure 11c). No artifact were recovered from subsurface testing on these two transects.

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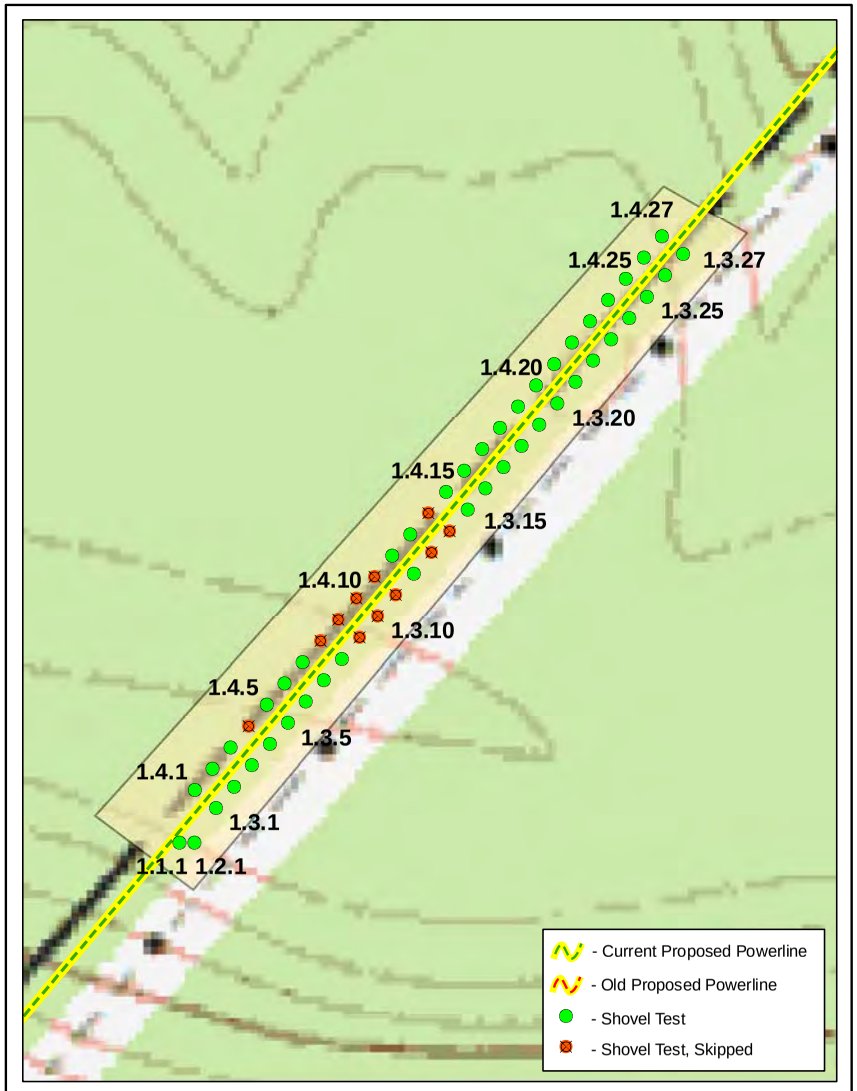


Figure 10. Plan map of Area WG 1, showing powerline corridor and STP locations.

Appendix G3

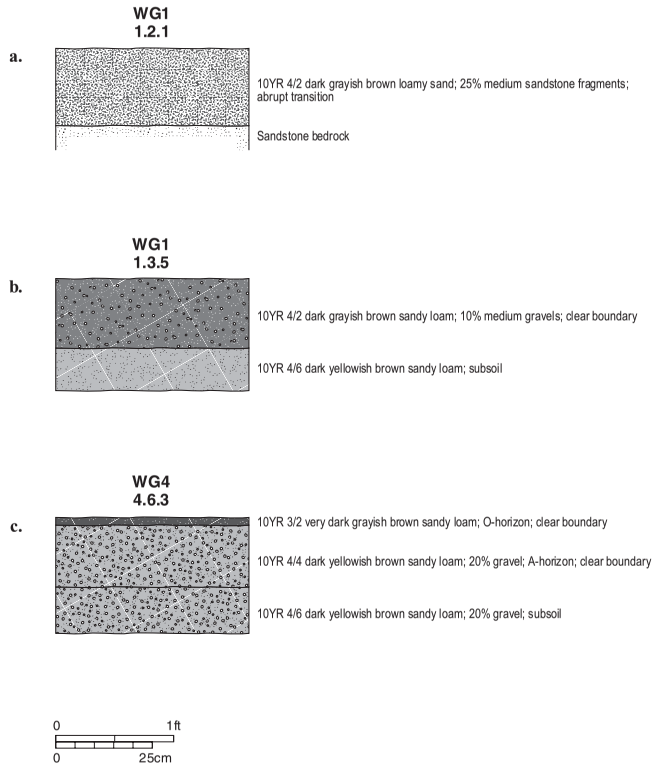


Figure 11. Representative shovel test pits in Areas WG 1 and WG 4.

Appendix G3

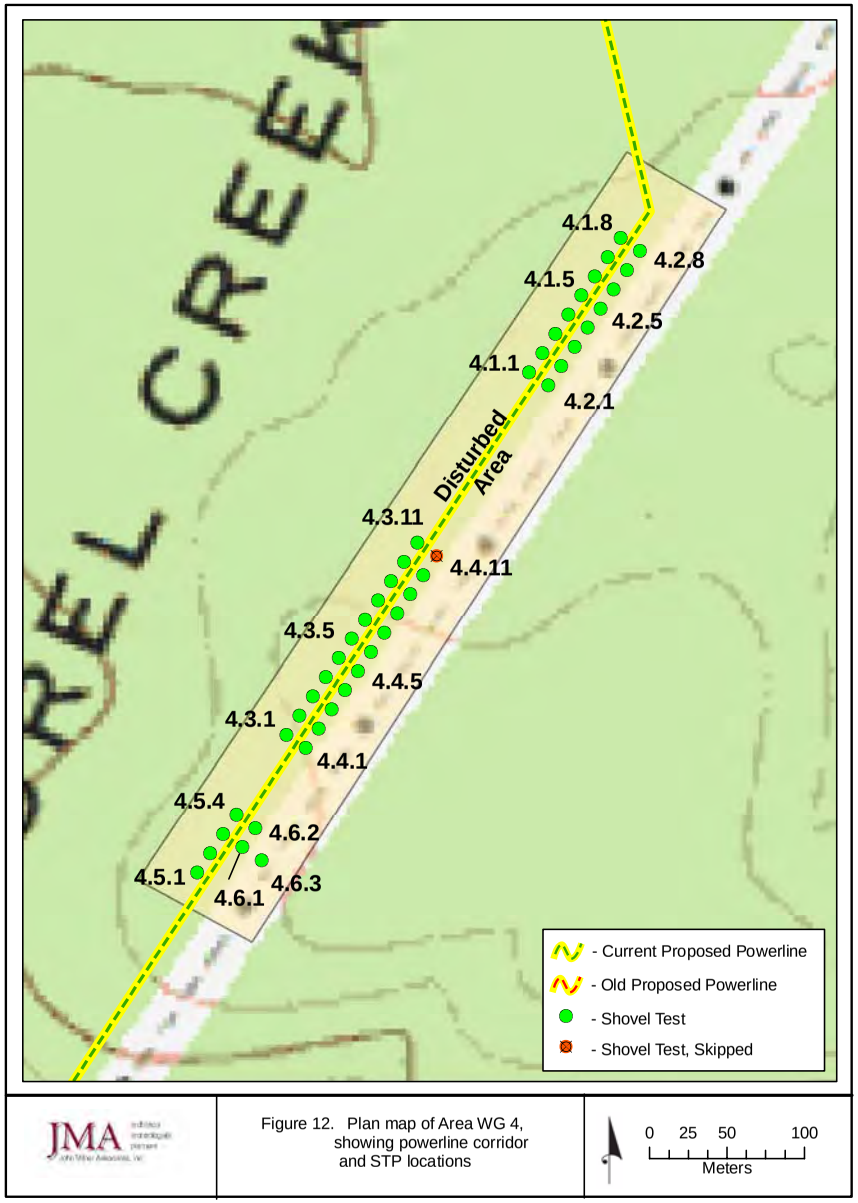


Figure 12. Plan map of Area WG 4, showing powerline corridor and STP locations

Appendix G3

Transect 4.5 and 4.6 were excavated along a flat area at the southern edge of Laurel Creek Mountain before the project corridor drops into the Meadow River valley. Four shovel tests were excavated along Transect 4.5 and three shovel tests were excavated along Transect 4.6. The stratigraphy within the shovel tests was similar to soils described in the other transects. A typical soil profile consisted of a 2 cm (0.06 ft.) thick sandy loam O horizon capping a 11-to-26 cm (0.36-to-0.85 ft.) thick sandy loam A horizon that overlay the sandy loam subsoil (Figure 11c).

In summary, subsurface testing did not identify archeological resources within this section of the project area. The shovel test transects crossed several landforms that contained a moderate potential for archeological resources. Past events, including modern and historic logging events, have triggered erosion and deflated the soils. The soil profiles within the shovel tests did not display a plow zone indicating that the area was not used historically for agriculture. The WG 4 portion of the project area did contain several sources of fresh water and landforms that could have provided relatively level ground for prehistoric or historic occupation.

6.2.3 AREA WG 5

This portion of the project area is located on a ridge at the southern end of Segment C (Plate 7). The area is approximately 150 m (500 ft.) northeast of the intersection with Segment B (Figure 2). Area WG 5 is located within the new alignment and was identified as an area that required additional subsurface testing during the pedestrian survey of the new alignment. Two transects, 5.1 and 5.2, were placed at this area. Transect 5.1 paralleled the western side of the ridge, and Transect 5.2 was located 15 m (50 ft.) east along the top of the ridge (Figure 13).

Subsurface testing included the excavation of 15 shovel tests along the two transects. Eight shovel tests were excavated along Transect 5.1, and seven shovel tests were excavated along Transect 5.2. Shovel test stratigraphy varied across the landform. Shovel tests along Transect 5.1 contained a 6-to-13 cm (0.2-to-0.4 ft.) thick sandy loam A horizon that alternatively capped the bedrock or subsoil depending on the location of the shovel test. The subsoil in these shovel tests was composed of a sandy loam (Figure 14a). Shovel test profiles along Transect 5.2 consisted of a 2 cm (0.06 ft.) thick sandy loam O horizon overlying a 4-to-13 cm (0.1-to-0.4 ft.) thick sandy loam A horizon. The A horizon in turn capped the sandy loam subsoil (Figure 14b). No artifacts were recovered from the subsurface testing at area WG 5. The stratigraphic sequence identified in the shovel test indicates that the landform has been subjected to extensive erosion resulting in a deflated A horizon overlying subsoil or sandstone bedrock. The shovel tests along Transect 5.1 are more severely eroded as a result of their topographic location on the landform.

6.2.4 AREA WG 6

This section was identified as a sensitive area by the archeological assessment and walkover survey conducted by URS (URS 2005). Area WG 6, located in Nicholas County, is 120 m (400 ft.) south of the intersection of Segment C and Nicholas County Road 17. Area WG 6 measures approximately 300 m (984 ft.) beginning at the foot of a small knob and continuing along the upland flat to the northern edge of the landform. The project corridor at this location is within former agricultural fields or pastures. The northern 150 m (490 ft.) of the project area has been select-cut timbered. The southern portion is in old fields that were most likely abandoned in the mid twentieth century. The fields are interspersed with locust trees, volunteer apple trees and wild rose thickets. Evidence of Area WG 6 being used for farming is present in the form of a split-rail

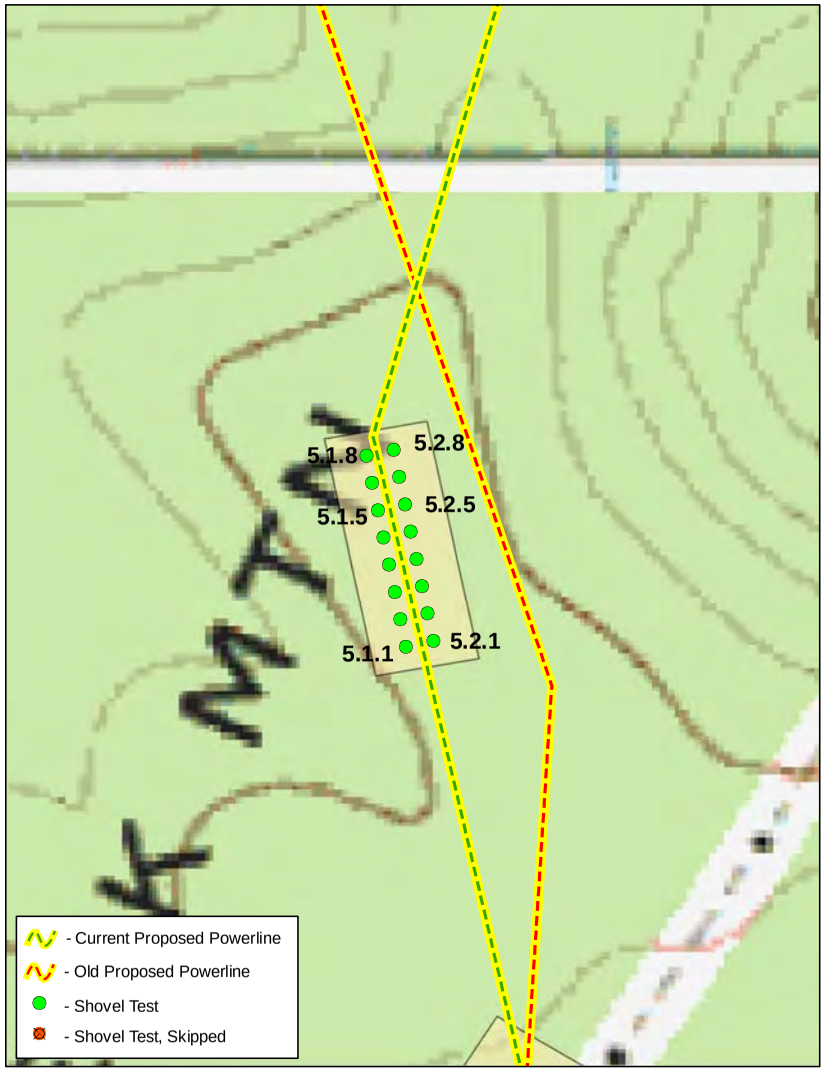


Figure 13. Plan map of Area WG 5, showing powerline corridor and STP locations.

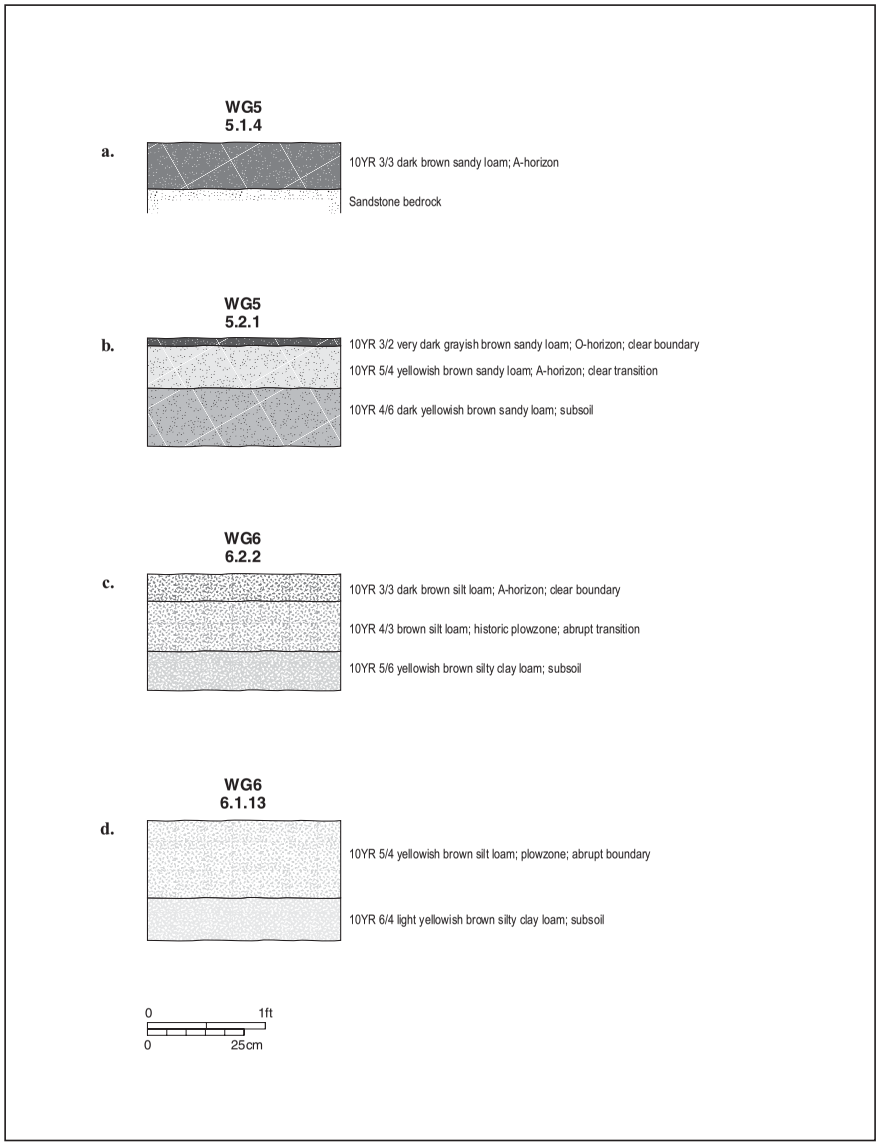


Figure 14. Representative shovel test pits in Areas WG 5 and WG 6.

fence that is located approximately 20 m (65 ft.) south of the northern edge of the landform (Plate 13). The remains of the fence consist of piles of deteriorated wood identified at two locations within the project area.

Subsurface testing in Area WG 6 consisted of the excavation of 41 shovel tests along two transects (6.1 and 6.2). Twenty shovel tests were excavated along each transect (Figure 15). A typical shovel test profile in the southern 150 m (490 ft.) consisted of a 5-to-7 cm (0.16-to-0.2 ft.) thick silt loam A horizon overlying a 17-to-26 cm (0.55-to-0.85 ft.) thick silt loam historic plow zone. The historic plow zone overlies the silty clay loam subsoil (Figure 14c). Shovel test stratigraphy in the northern 300 m (490 ft.) of the project area alternated between soil profiles similar to those described above (Figure 14c) and profiles that exhibited a 15-to-20 cm (0.5-to-0.65 ft.) thick silt loam plow zone capping the silty clay loam subsoil (Figure 14d). No artifacts were recovered from the subsurface testing within area WG 6.

In summary, soil profiles in Area WG 6 demonstrate land-use practices related to agriculture. The evidence for past agricultural use of this area includes the presence of a plow zone (indicating the land was used for crop production), several apple trees, and the remains of a split-rail fence. The split rail fence most likely functioned as a boundary for a filed or pasture. These features do not have research potential.

6.2.5 AREA WG 7

This portion of the project corridor parallels Hominy Creek (Figure 2). The area was defined as containing a medium probability for cultural resources. The landforms that were subjected to subsurface testing in Area WG 7 traverse the terrace and floodplain along the west bank of Hominy Creek for approximately 350 m (1,148 ft.), and then cross Hominy Creek and continue for approximately 30 m (100 ft.) along the terrace on the east side of the creek before ending abruptly at the foot of a steep ridge slope. The project corridor on the west side of Hominy Creek is a mixed deciduous forest dominated by beech and birch trees, with an occasional eastern hemlock (Plate 14). The terrace and slope on the east side of the creek is covered in a dense growth of eastern hemlock. The trees in this area are estimated to be at least 50 years old. Hominy Creek in this area is entrenched within a relatively broad valley that exhibits a low stream gradient. The floodplain is approximately 1 m (3 ft.) above the stream channel. The stream channel is strewn with logs from historic logging activities (Plate 15).

Sixty-five shovel tests were excavated along Transects 7.1, 7.2, 7.3, and 7.4 (Figure 16). Transects 7.1 and 7.2 were along the west side of Hominy Creek, and Transects 7.3 and 7.4 were excavated on the terrace along the east side of Hominy Creek. Twenty-eight shovel tests were excavated along Transect 7.1, and 31 shovel tests were excavated along Transect 7.2. Transect 7.1, the more eastern transect, traversed the east edge of the stream terrace as well as the active floodplain. Transect 7.2 was 15 m (50 ft.) west of Transect 7.1 and was located primarily on the terrace. A typical shovel test profile from the terrace consisted of a 10-to-30 cm (0.3-to-1 ft.) thick sandy loam A horizon overlying either an impenetrable stratum of sandstone talus (Figure 17a) or the silt loam subsoil (Figure 17b). Shovel tests excavated on the active flood plain of Hominy Creek contained a stratigraphic sequence consisting of a 40 cm (1.3 ft.) thick stratum of loamy sand containing approximately 20 percent coal sands and coal chunks. At 40 cm (1.3 ft.) the seasonal water table was encountered prohibiting further excavations (Figure 17c). No artifacts were encountered during subsurface testing on the west side of Hominy Creek.

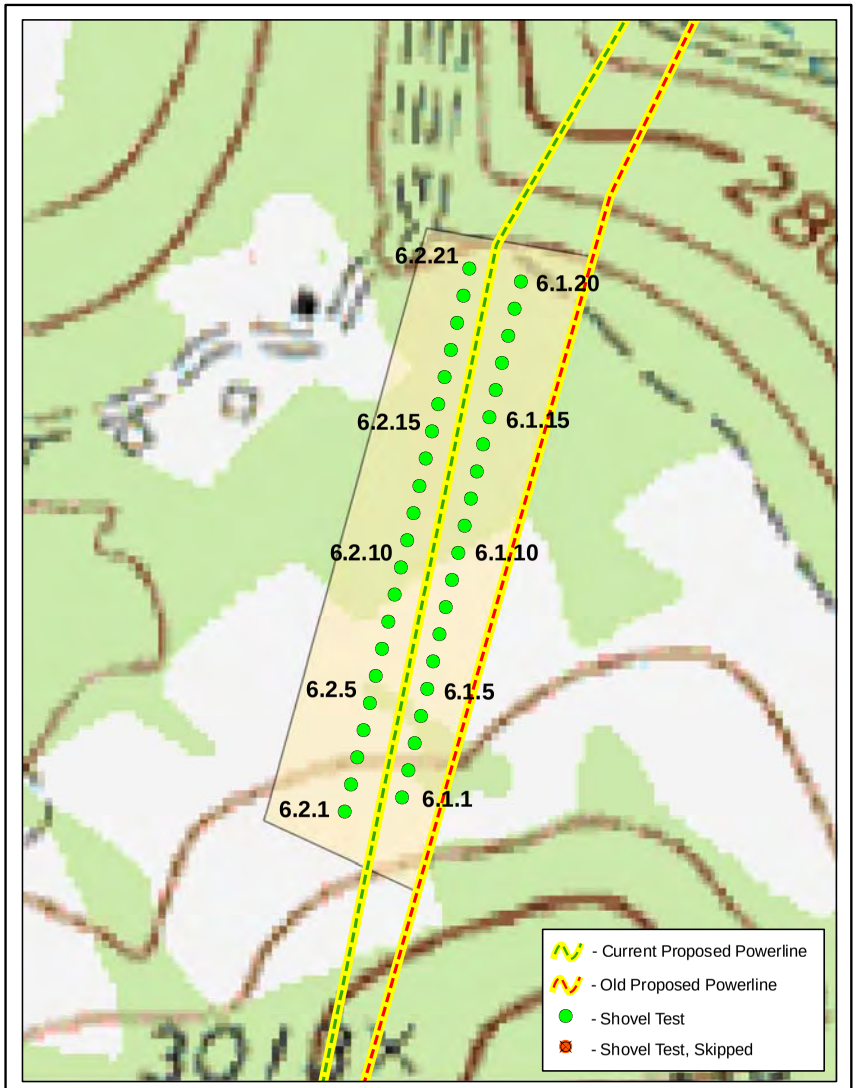


Figure 15. Plan map of Area WG 6, showing powerline corridor and STP locations.

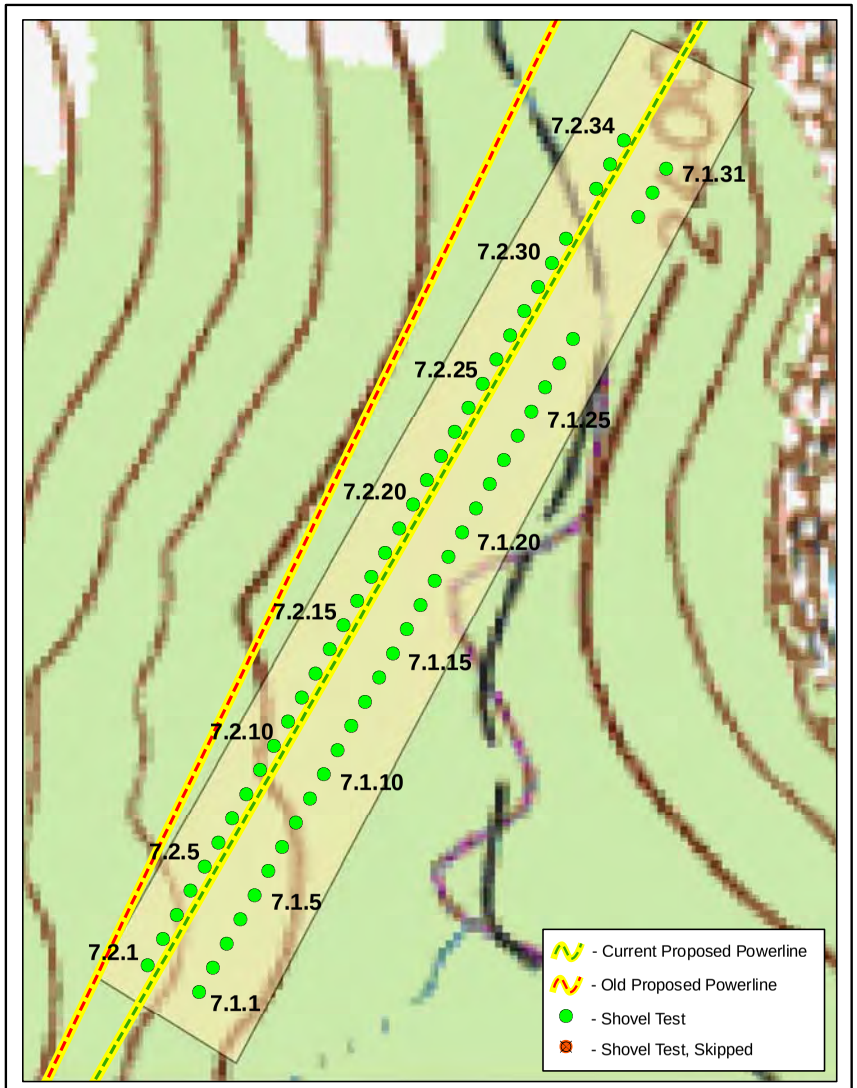


Figure 16. Plan map of Area WG 7, showing powerline corridor and STP locations.

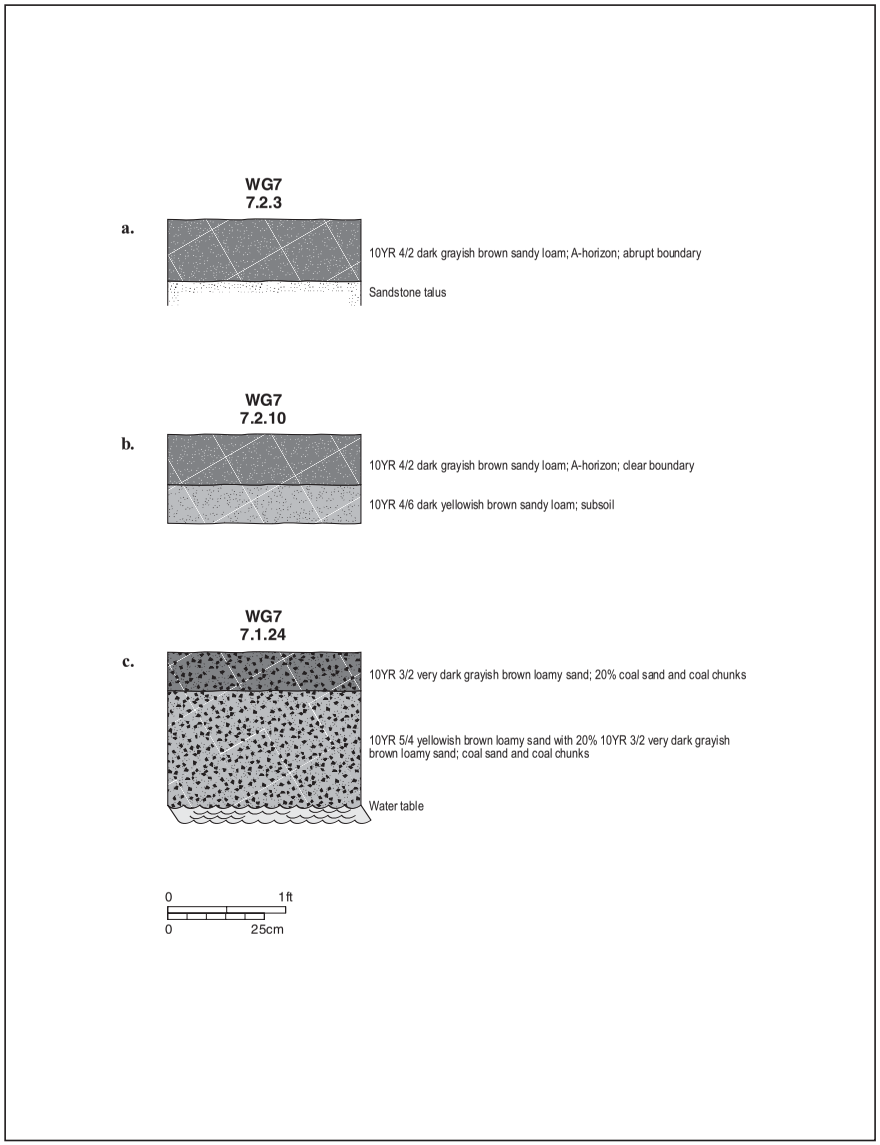


Figure 17. Representative shovel test pits in Area WG 7.



Plate 13. Overview of Area WG 6 showing remnants of split-rail fence along the north end of the O'Dell property, facing west.



Plate 14. Overview of Area WG 7 showing typical vegetation along the west side of Hominy Creek, facing southwest.



Plate 15. Area WG 7 showing evidence of historic logging activities along Hominy Creek, facing north.

Three shovel tests were excavated along Transects 7.3 and 7.4. The stratigraphic sequence within the shovel tests was composed of a 10-to-16 cm (0.3-to-0.5 ft.) thick sandy loam A horizon overlying an impenetrable stratum of sandstone talus (see Figure 17a). No artifacts were recovered from the subsurface testing. Subsurface testing along the terrace of Hominy Creek identified stratigraphy consisting of a thin soil horizon capping talus rock or subsoil. The stratigraphy within the shovel tests excavated on the floodplain identified a modern alluvium containing a high degree of coal sand and coal.

6.2.6 AREA WG 8

This small area was investigated due to a shift in the proposed alignment along Segment C (Figure 2). Area WG 8, which is located approximately 610 m (2000 ft.) northeast of Area WG 7, is situated on the edge of a terrace on the east side of Hominy Creek. The original alignment followed the ridge slope above the stream. However, due to a 60 m (200 ft.) shift in the alignment, the new corridor traverses the western edge of the terrace. A brief reconnaissance survey determined that this area was unaffected by a contour strip mine that formed the southern boundary of WG 7. Although the area contained several massive sandstone boulders, these rocks did not provide any overhangs suitable for human occupation or use (Plate 16). The ground surface in the area did not contain evidence of any recent disturbance. The area is forested and dominated by a dense story of eastern hemlock. Four judgmental shovel tests (8.1.1, 8.1.2, 8.1.3, and 8.1.4) were excavated at Area WG 8 (Figure 18). A typical shovel test profile consisted of 6-to-8 cm (0.2-to-2.6 ft.) thick silt loam O/A horizon capping the silty clay loam subsoil (Figure 19a). No artifacts were recovered from subsurface testing at Area WG 8.

6.2.7 AREA WG 9

This area is located on a ridge spur or bench associated with Coggins Knob in southern Nicholas County. Area WG 9 is approximately 60 m (200 ft.) northeast of the intersection of County Road 17-3 and the project corridor. Area WG 9 lies within a hardwood forest dominated by beech and oak. The bench is approximately 10 m (33 ft.) wide. Four judgmental shovel tests (9.1.1, 9.1.2, 9.1.3, and 9.1.4) were excavated within the project corridor across the bench (Figure 20). A typical shovel test profile consisted of a 2 cm (0.06 ft.) thick silt loam O horizon capping a 6-to-8 cm (0.2-to-0.3 ft.) thick silt loam A horizon that rested upon the silt loam subsoil (Figure 19b). No artifacts were recovered from the subsurface testing at Area WG 9.

6.2.8 AREA WG 10

This area is located on a 760 m (2,500 ft.) section of proposed new alignment. The alignment was shifted to the southeast to avoid the community of Hominy Falls. The new alignment follows the east side of a terrace associated with an unnamed tributary of Roaring Creek for approximately 335 m (1,100 ft.), the alignment then crosses County Road 13-7 and parallels Roaring Creek for approximately 425 m (1400 ft.) to a point where the project corridor crosses County Road 13 and rejoins the former alignment (Figure 2). Most of the project area has been select-cut timbered within the last decade. The recent timbering focused on the removal of larger deciduous hardwood trees. The remaining hemlock was not harvested and is now the dominant tree type, forming a thick canopy across most of the area (Plate 17). Because the select-cut timbering did not substantially impact the natural ground surface, subsurface testing was conducted along the terrace and bottomland adjacent to Roaring Creek.

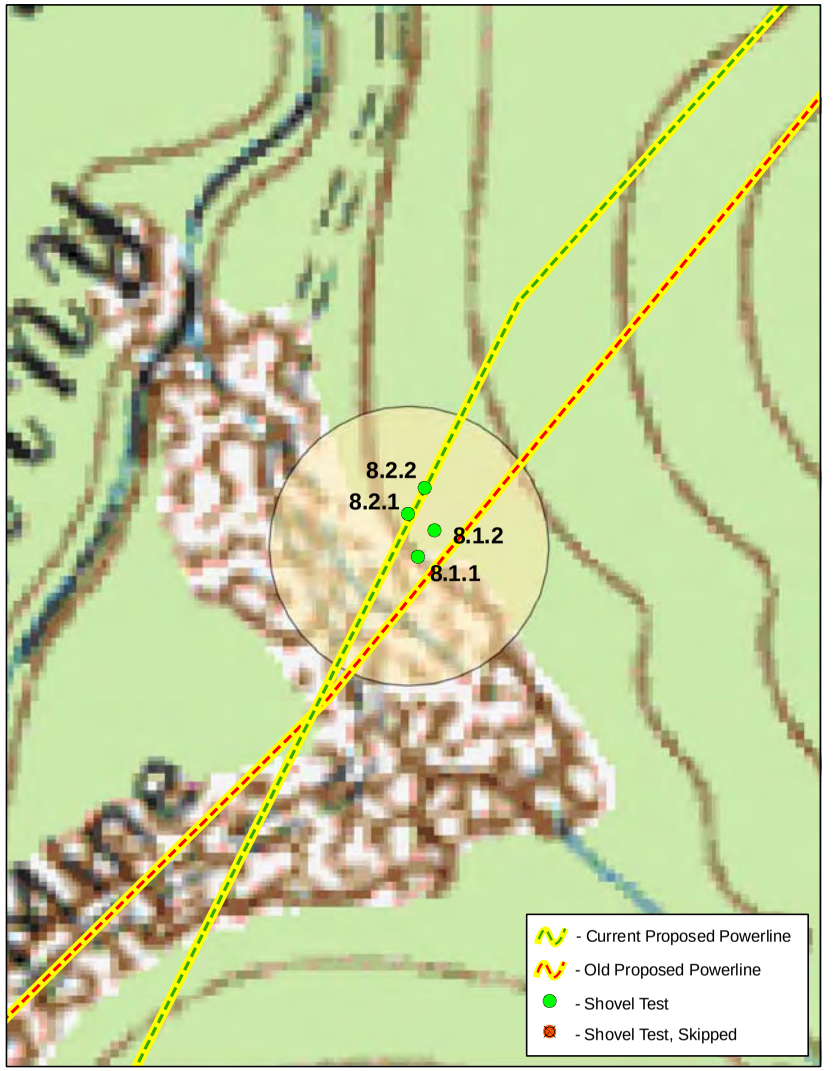


Figure 18. Plan map of Area WG 8, showing powerline corridor and STP locations

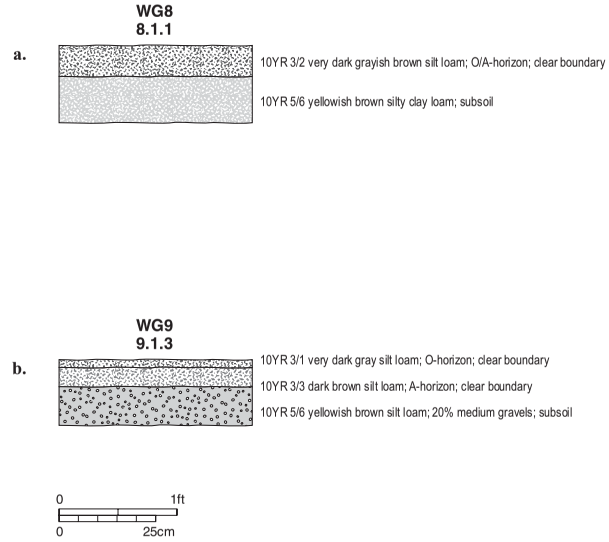


Figure 19. Representative shovel test pits in Areas WG 8 and WG 9.

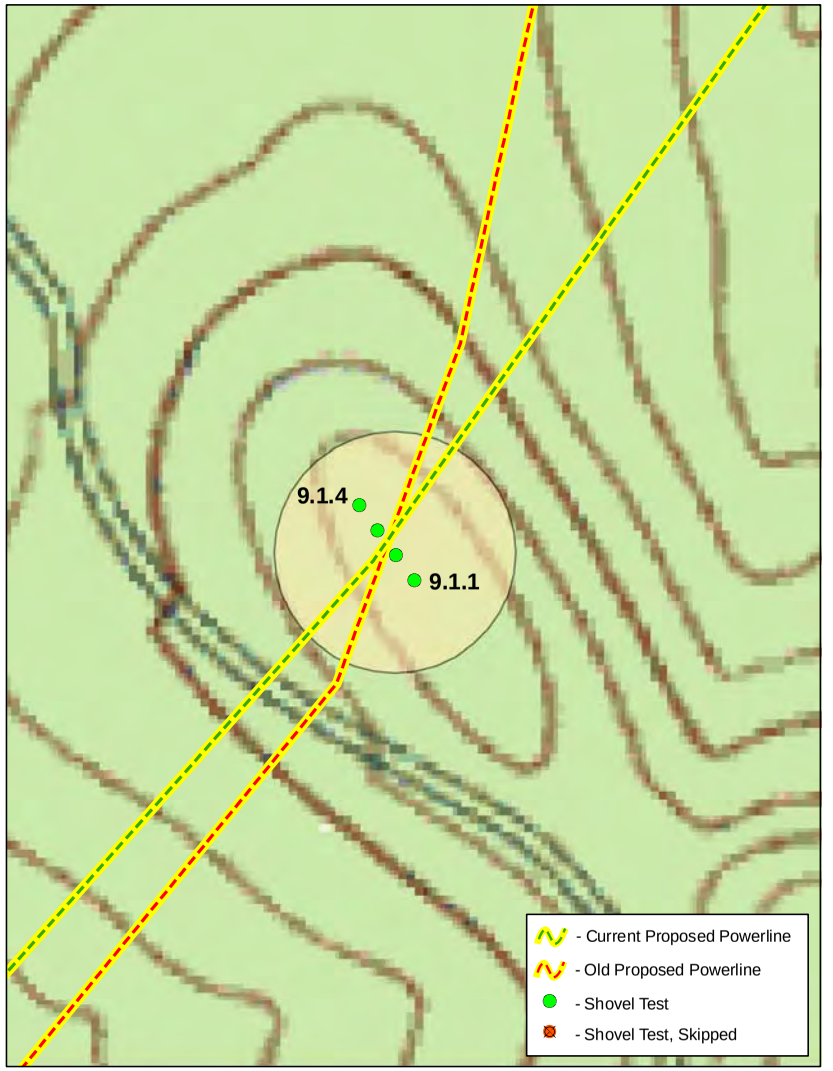


Figure 20. Plan map of Area WG 9, showing powerline corridor and STP locations.



Plate 16. Overview of Area WG 8 showing massive sandstone boulders and outcrops within project corridor, facing northeast.



Plate 17. Overview of Area WG 10 showing forested terrace along Roaring Creek, facing northwest.

JMA placed 102 STPs along four transects (10.1, 10.2, 10.3 and 10.4) within Area WG 10 (Figure 21). Transects 10.1 and 10.2 followed the terrace on the east side of the unnamed tributary to Roaring Creek and ended at County Road 13-7. Transects 10.3 and 10.4 were located on the floodplain along the east side of Roaring Creek. Fifteen shovel tests were excavated along Transects 10.1 and 10.2. Shovel test stratigraphy in this area consisted of a 1-to-3 cm (0.003-to-0.01 ft.) thick loamy sand O horizon. Below the O horizon was the 8-to-16 cm (0.26-to-0.5 ft.) thick silt loam A horizon that rested on the sandy clay loam subsoil (Figure 22a). No artifacts were recovered during subsurface testing.

Subsurface testing was also conducted along approximately 425 m (1, 722 ft.) along the east side of Roaring Creek. Thirty-six shovel tests were excavated along each transect (Figure 21). A typical shovel test profile alternated between areas containing a 1-to-5 cm (0.003-to-0.16 ft.) thick sandy loam O horizon capping a 8-to-20 cm (0.26-to-0.65 ft.) thick sandy loam A horizon overlying a subsoil that fluctuated in texture between a silt loam to a sandy clay loam (Figure 22b). Other shovel tests along transects 10 3 and 10.4 showed a 17-to-22 cm (0.55-to-0.72 ft.) thick silt loam A horizon capping a silt loam subsoil (Figure 22c). No artifacts were recovered from subsurface testing along Roaring Creek.

6.2.9 AREA WG 11

Area WG 11 is located in a steep-sided stream valley along the south side of Grassy Creek. The confluence of Grassy Creek and Hominy Creek is approximately 150 m (500 ft.) to the west, northwest (Figure 2). Within the project corridor, the terraces along Grassy Creek are approximately 100 m (330 ft.) wide. Immediately adjacent to the terrace on the south side of Grassy Creek is a steep forested slope. Although the Grassy Creek terrace is relatively flat, it contains many large boulders. North of the terrace the project corridor bisects a wetland. The dominant forest cover within the project corridor is hemlock and birch interspersed with some yellow poplar and oak. The under story is rhododendron, greenbrier, and wild rose.

Review of Figure 6 shows that a former community known as Hominy Mill was located in the southeast quadrant of the confluence of Hominy Creek and Grassy Creek. The project corridor bisects the eastern end of the community. Survey within the corridor resulted in the identification of archeological remains associated with Hominy Mill. The site is composed of numerous features and surface scatters of historic artifacts including kitchen ceramics, bottle glass, enamelware, and bricks. Features included a series of mounds and depressions and an abandoned narrow-gauge railroad bed that bisects the site in an east-west direction, south of Grassy Creek. The WV SHPO assigned the archeological remains associated with Hominy Mill site number 46NI655. The recorded site lies within the project corridor, but the real site boundaries are larger.

Phase I testing in Area WG 11 included the excavation of 18 STPs along two transect (11.1 and 11.2) (Figure 23). Subsurface testing resulted in 4 positive shovel tests (STPs 11.1.5, 11.2.5, 11.2.6, and 11.3.1). JMA excavated a total of nine radial STPs at 7.5 m (25 ft.) intervals around three positive shovel tests, and one judgmental STP (11.3.1) was excavated within a feature (Figure 23). All radial STPs produced negative results. Within the project corridor, Site 46NI655 measures 30 m (E-W) x 75 m (N-S) (or 100 ft. x 246 ft.). The 0.22-hectare (0.56-acre) site begins at the toe slope adjacent to the southern edge of the stream terrace and extends northward for 75 m (246 ft.) to the north edge of the stream terrace overlooking Grassy Creek (Figure 24). A 4-m (13-ft.) wide railroad bed bisects the southern half of the site. Field observations indicate the railroad bed continues beyond the project corridor to the east and west along Grassy Creek for

Appendix G3

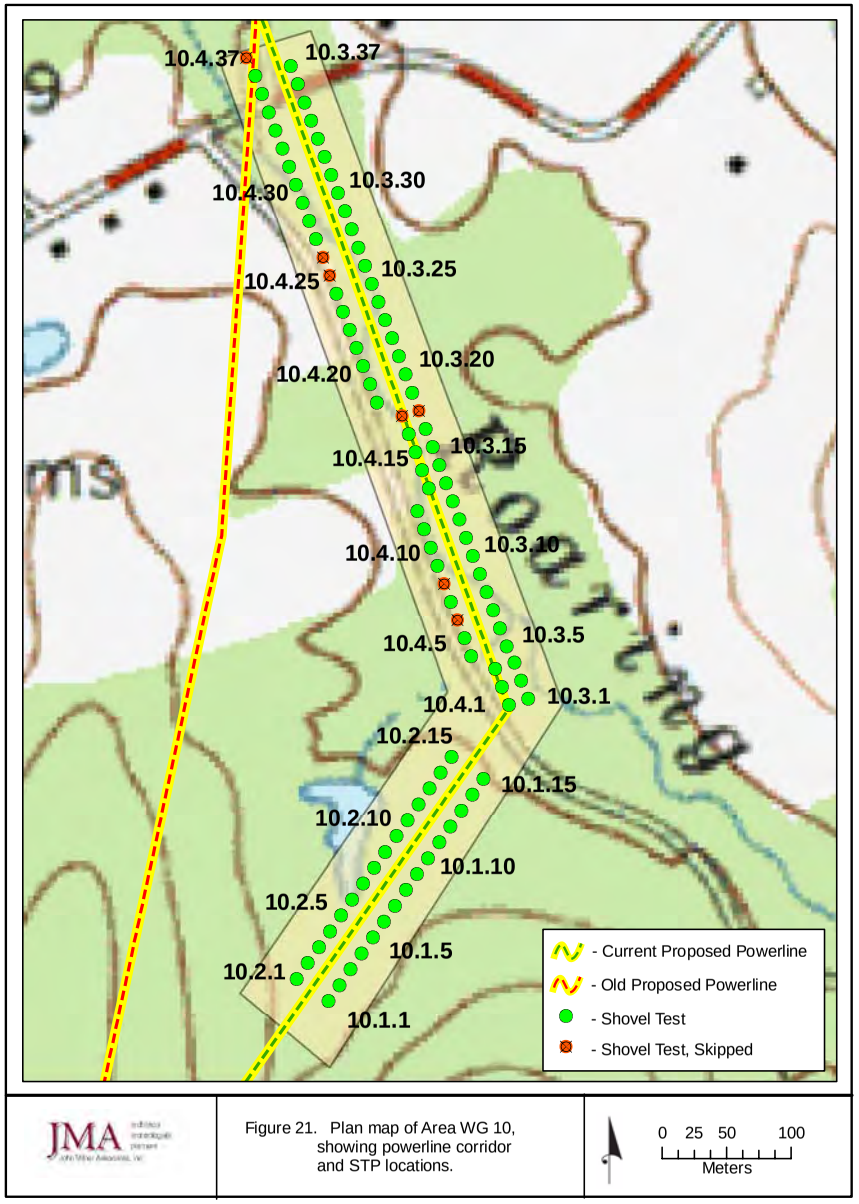


Figure 21. Plan map of Area WG 10, showing powerline corridor and STP locations.

Appendix G3

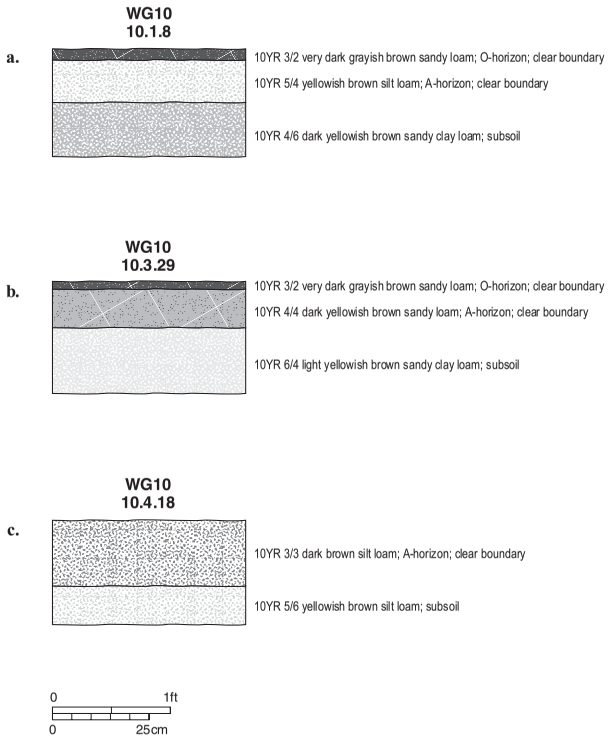


Figure 22. Representative shovel test pits in Area WG 10.

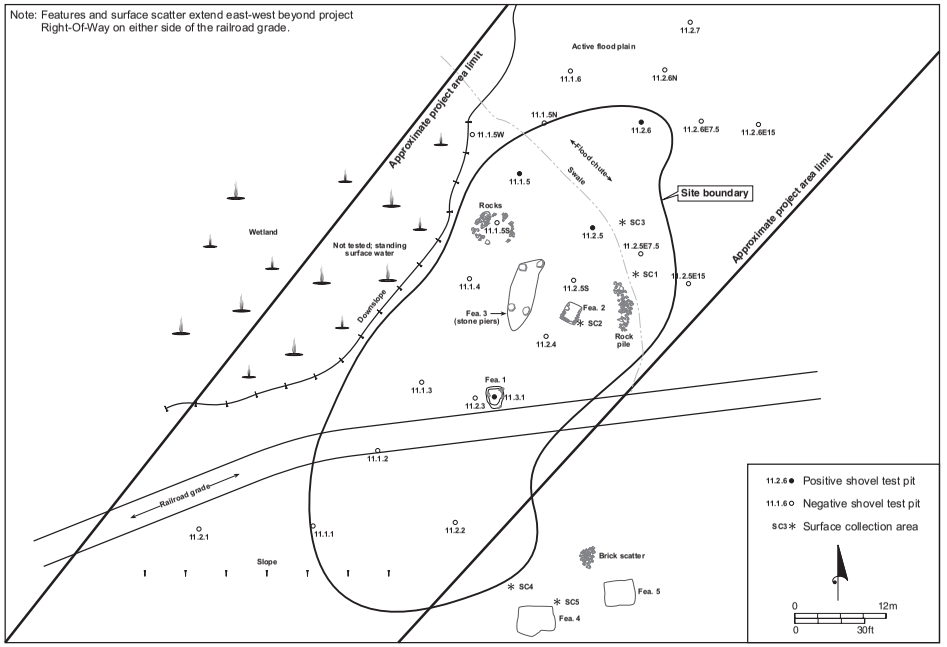


Figure 23. Plan Map of Area 11 and Site 46NI655, showing STPs, features, and surface collection areas.

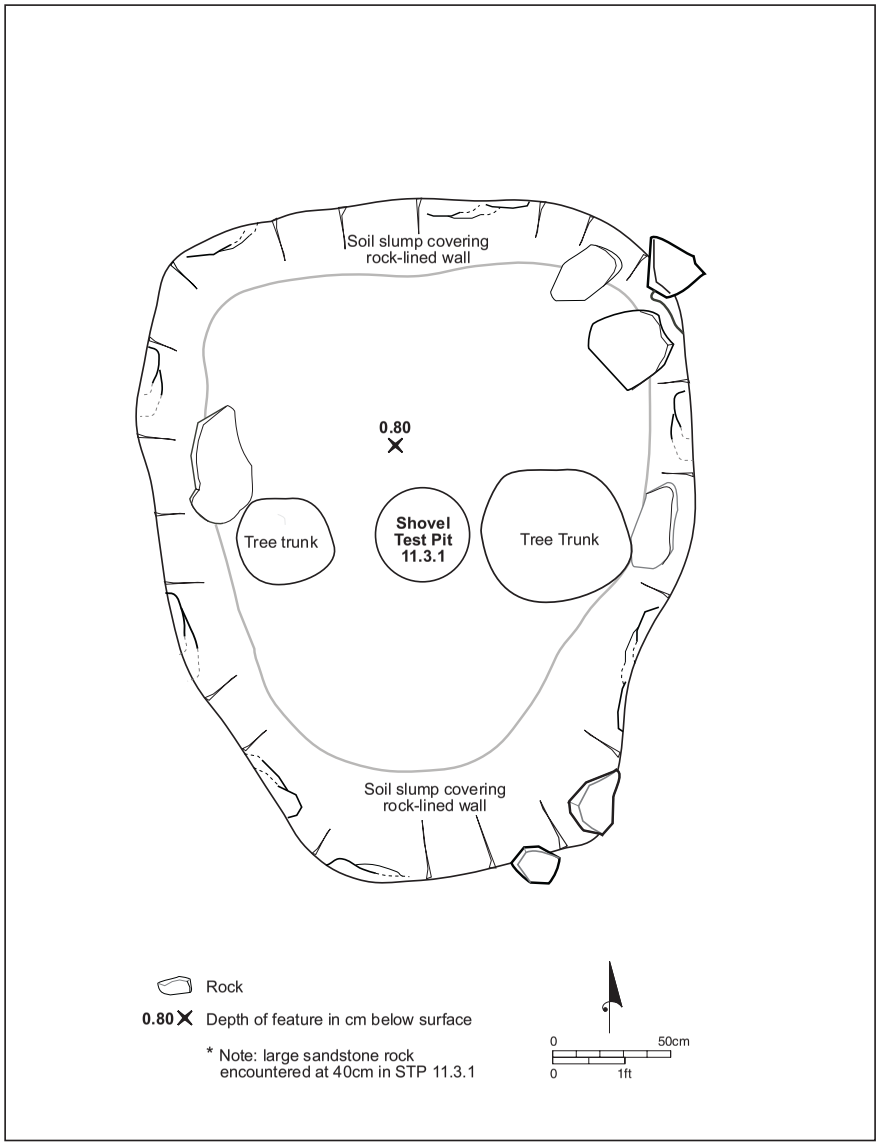


Figure 24. Detail of Feature 1, Site 46NI655.

industrial activities) were identified within the corridor. Also, numerous features (structural features such as mounds as well as depressions and surface artifact clusters) were observed on either side of the railroad bed for several hundred meters east and west of the project corridor.

Five surface features were identified within the defined site area. Feature 1 is a stone-lined, circular depression, 1.5 m (5 ft.) in diameter and at least 1 m (3.3 ft.) in depth. The depression appears to be a stone-lined well shaft (Figure 24). Feature 1 is located near the center of the site, approximately 2 m (6.5 ft.) north of the railroad bed. Judgmental shovel test 11.3.1 was excavated in the bottom of this feature between two trees that have grown inside the well since it was abandoned (Plate 18). The soils within the shovel test included two strata (Figure 25a). The first stratum is a 30 cm (1 ft.) deep silt loam. Artifacts from these strata included one amethyst bottle glass fragment, 2 clear bottle glass fragments, a double-bladed-hand-forged axe head, and one zinc-coated oil can. Below this stratum was a 20 cm (0.65 ft.) thick silty clay loam that terminated on a large rock (perhaps from stone lining). No artifacts were recovered from the lower stratum.

Feature 2, a possible root-cellar or small foundation, is located 11 m (36 ft.) north of the railroad bed and 15 m (50 ft.) northeast of Feature 1 (Figure 23). The feature, which is 2.5 m x 3 m (8-by-10 ft.) in size, is composed of several courses of rough-cut stone (Figure 26). The bottom of the feature is approximately 1 m (3.3 ft.) below the ground surface, and there is an earthen ramp descending to the bottom of the feature on the north wall of the structure. The collapsed stone walls of the foundation filled the bottom of the featured and did not allow for the excavation of a shovel test in the bottom of the feature. Thus, it is likely that the feature is more than 1 m deep.

Feature 3 consists of four rough-cut stone piers located 15 m (50 ft.) north of the railroad grade and 10 m (33 ft.) north of Feature 1 (Figure 23). Feature 2 lies about 5 m (16 ft.) to the southeast of Feature 3. Collectively, the area encompassed by the piers measures 4 m (13 ft.) (E-W) x 6 m (20 ft.) (N-S). The stone piers measured about 25 cm (1 ft.) in height. No shovel tests were excavated within the cluster of stone piers and no concentration of surface artifacts was observed within or adjacent to the stone piers. It is possible that the stone piers functioned as corner foundations for a wooden superstructure, possibly a shanty house or outbuilding.

Features 4 and 5 are located on the south side of the railroad bed at the base of the toe slope of the adjoining ridge (Figure 23). Features 4 and 5 are approximately 10 m (33 ft.) east of the eastern edge of the project corridor. Feature 4 is a mound of stone rubble and earth and measures 3 m x 5 m (10 x 16 ft.). The feature is located 25 m (82 ft.) south of the railroad bed and 30 m (100 ft.) southeast of Feature 1. Feature 5 is a 3.5 m x 4 m (11-by-13 ft.) mound located 7 m (23 ft.) east of Feature 4. A dense scatter of handmade brick debris, measuring 2 m x 4 m (6.5-by-13 ft.), is located 4 m (13 ft.) from the northeast corner of Feature 4. Based on the following evidence, Features 4 and 5 may represent domestic structures: (1) these features are roughly similar to Feature 2 in size; (2) the concentration of brick and brick fragments in close proximity to Features 4 and 5 may represent a chimney-fall (Plate 19); and (3) the majority of artifacts observed on the surface near these features represent kitchen-type artifacts. No subsurface testing was conducted at these locations since they are located just outside of the project corridor. It is possible that these structural mounds served as a foundation for shanty houses, or were foundations for crude temporary housing associated with the logging camp.

Subsurface testing along Transects 11.1 and 11.2 identified a stratigraphic sequence consisting of a 2-to-6 cm (0.06-to-0.02 ft.) silt loam humic or O horizon overlying a silt loam A horizon that was 8-to-35 cm (0.26-to-1.1 ft.) thick. The A horizon in turn capped the silty clay loam subsoil (Figure 25b). Artifacts were recovered from three shovel tests (11.1.5, 11.2.5, and 11.2.6) along

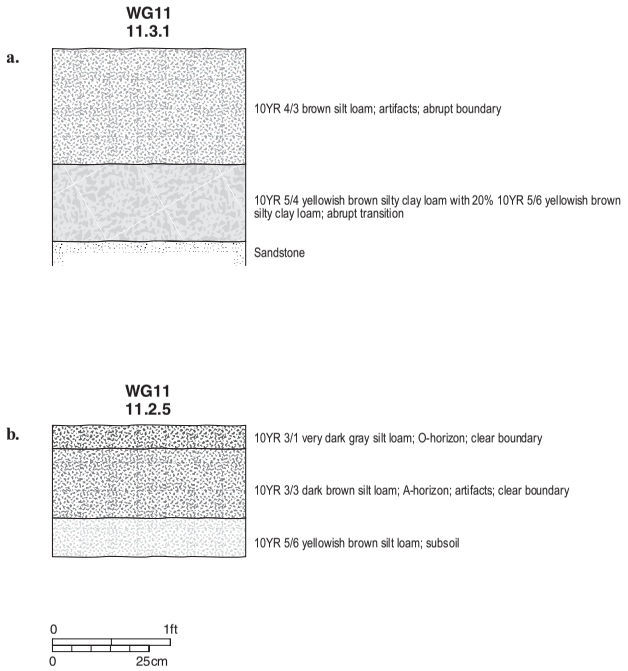


Figure 25. Representative shovel test pits in Area WG 11.

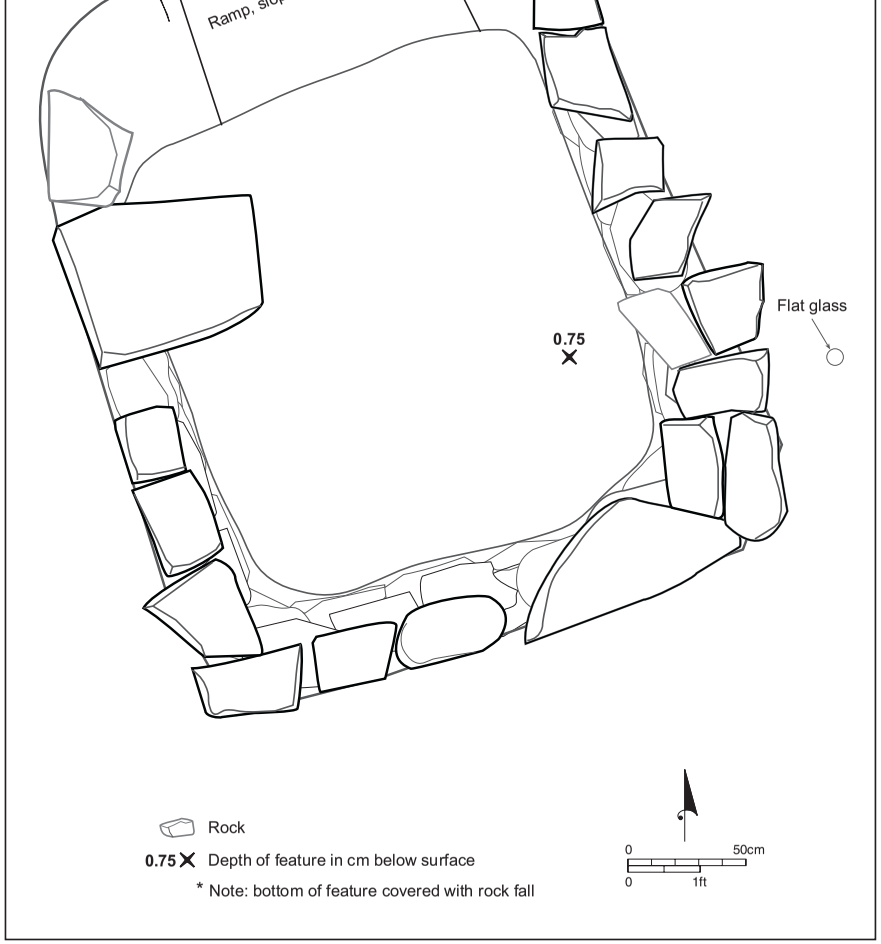


Figure 26. Detail of Feature 2, Site 46NI655.



Plate 18. Interior view of Feature 1, Site 46NI655 showing depression and trees that have grown within the feature, facing south.

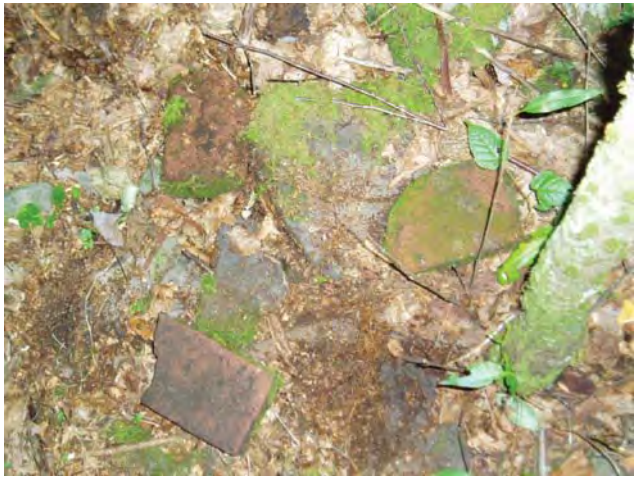


Plate 19. View of large brick concentration northeast of Feature 4 and northwest of Feature 5, facing northeast.

the transects (Figure 23). The three positive shovel tests were clustered along the northeastern edge of the site near the edge of the terrace. Artifacts from these shovel tests were confined to the 11-to-16 cm (0.36-to-0.5 ft.) thick A horizon. Artifacts collected from the various shovel tests and the surface collection areas are presented in below Table 4. The table lists the artifacts by provenience.

Table 4. Artifacts collected from Site 46NI655, by provenience.

Site	Lot	Provenience	Feature	Artifact No.	TYPE NAME	DESCRIPTION	Count	Comments
1	1	ST 1.5		1	Window Glass	All Thicknesses	3	
1	1	ST 1.5		2	Wire Common Nail	Complete	1	burned
1	1	ST 1.5		3	Whiteware	Plain	13	mend
1	1	ST 1.5		4	Machine-Made Bottle Fragment	Amethyst	1	
1	1	ST 1.5		5	Machine-Made Bottle Fragment	Clear	2	
1	1	ST 1.5		6	Unidentified Bottle Fragment	Aqua	1	
1	1	ST 1.5		7	Projectile	Shotgun Shell	1	"UMC NITROCLUB No 12"
1	2	ST 2.5		1	Ironstone	Plain White	2	Sevres China Co mark (1900-08)
1	2	ST 2.5		2	Machine-Made Bottle Fragment	Aqua	2	
1	2	ST 2.5		3	Machine-Made Bottle Fragment	Amethyst	2	
1	2	ST 2.5		4	Machine-Made Bottle Fragment	Clear	2	
1	2	ST 2.5		5	Miscellaneous, Metal	Unidentified	1	flat ferrous, possible stove part
1	3	ST 2.6		1	Whiteware	Plain	1	
1	3	ST 2.6		2	Machine-Made Bottle Fragment	Amber	1	
1	3	ST 2.6		3	Miscellaneous Glass Tableware	Carnival	1	clear glass
1	4	ST 3.1	1	1	Unidentified Bottle Fragment	Amethyst	1	
1	4	ST 3.1	1	2	Unidentified Bottle Fragment	Clear	1	
1	4	ST 3.1	1	3	Tool, Metal	Axe	1	double edged, hand-wrought
1	4	ST 3.1	1	4	Storage, Metal	Can	1	2 pieces
1	5	SC 1		1	Brick	Handmade, Unglazed	1	sample
1	5	SC 1		2	Shoe Part	Leather	1	upper fragments
1	5	SC 1		3	Shoe Part	Rubber	1	sole fragment
1	5	SC 1		4	Hard-Paste Porcelain	Decal Overglaze	1	coffee cup fragment

Site	Lot	Provenience	Feature	Artifact No.	TYPE NAME	DESCRIPTION	Count	Comments
1	5	SC 1		5	Domestic Brown Stoneware	Albany Slip/Bristol Glaze	3	crock fragments
1	5	SC 1		6	Whiteware	Plain	3	
1	5	SC 1		7	Machine-Made Bottle Fragment	Amethyst	1	base
1	5	SC 1		8	Machine-Made Bottle Fragment	Clear	2	paneled bottle fragments
1	5	SC 1		9	Unidentified Bottle Fragment	Olive Green	1	
1	5	SC 1		10	Miscellaneous Kitchen Glass	Canning-Lid Liner	1	milk glass
1	5	SC 1		11	Miscellaneous Kitchen Glass	Canning Jar	9	"MAS[ON]", fragments
1	5	SC 1		12	Miscellaneous Glass Tableware	Carnival	1	cobalt blue glass
1	5	SC 1		13	Storage, Metal	Zinc Canning Lid	9	fragments
1	5	SC 1		14	Appliance, Metal	Cast-Iron Stove Part	1	
1	6	SC 2		1	Whiteware	Plain	3	
1	6	SC 2		2	Miscellaneous Kitchen Glass	Canning Jar	3	fragments
1	7	SC 3	2	1	Window Glass	All Thicknesses	4	
1	7	SC 3	2	2	Whiteware	Plain	3	mend
1	7	SC 3	2	3	Miscellaneous Kitchen Glass	Canning Jar	1	fragment
1	8	SC 4		1	Wire Common Nail	3 - 3.5 Inch Long	1	
1	8	SC 4		2	Machine-Made Bottle Fragment	Aqua	4	"…HOT... [in script]"
1	8	SC 4		3	Machine-Made Bottle Fragment	Amethyst	10	solarized, 1 bottle fragment
1	8	SC 4		4	Machine-Made Bottle Fragment	Clear	3	
1	8	SC 4		5	Pressed-Glass Tableware	Other	1	basket and cherry pattern with stippled background
1	9	SC 5		1	Machine-Made Bottle Fragment	Amethyst	1	solarized
1	9	SC 5		2	Miscellaneous Glass Tableware	Undecorated	1	jelly glass jar
IF-1	1	SC 1		1	Shatter 16-20mm	Chert	1	

Artifacts from STP 11.1.5 included 3 fragments of window glass, 1 wire common nail, 13 shards of plain whiteware, 3 machine-made bottle fragments (1 amethyst glass and 2 clear glass), 1 unidentified aqua-colored bottle fragment, and one brass shotgun cartridge. Artifacts from STP 11.2.5 included 2 plain white, ironstone sherds, 6 fragments of machine-made bottle glass (2 aqua, 2 amethyst and 2 clear glass), and 1piece of unidentified metal that may have been part of a cast iron heating stove. STP 11.2.6 produced 1 sherd of plain whiteware, 1 amber-colored, machine-made bottle fragment, and 1 fragment of clear, carnival, tableware glass.

Surface artifacts were collected from five locations during the Phase I. The surface collections are labeled SC 1 through SC 5 on the site map (Figure 23). SC 1 was located in the vicinity of a large pile of rock and rough-cut stone, approximately 8 m (26 ft.) northeast of Feature 2. The artifacts were recovered from the ground surface and also within the O horizon after the overlying leaf litter had been removed. Artifacts were found within a 3 m x 3 m sq. (10 x 10 ft.) area. Table 4 lists the artifacts collected from SC 1. Artifacts from SC 1 include architectural materials, domestic ceramics, bottle glass, canning lids, pressed glass tableware, and shoe parts.

SC 2 was located 1 m (3.3 ft.) east of the southeast corner of Feature 2 (Figure 23). The artifacts were recovered within a 2 m x 2 m area (21 sq ft. area). Artifacts were found at this location after the surrounding leaf litter had been removed. Artifacts from SC 2 included domestic ceramics and fragments of a canning lid liner. SC 3 is located 12 m (40 ft.) north of Feature 2 and 8 m (28 ft.) north of SC 1 (Figure 23). Artifacts from SC 3 were collected from an approximately 2 m x 2 m area (21 sq ft.) area and included window glass fragments, domestic ceramics, and fragments of a mason-type canning jar.

SC 4 and SC 5 are located south of the railroad bed and north of Feature 4. Given their location, these artifacts may be associated with the use of Feature 4. SC 4 is located 3 m (10 ft.) north of the northwest corner of Feature 4 (Figure 23). Artifacts were recovered from the ground surface within an approximately 1 m sq. area (10 sq ft.). Artifacts included a wire nail, machine-made bottle glass, and pressed glass tableware. SC 5 is located adjacent to the northeast corner of Feature 4. Artifacts were recovered from the surface within a 1 m sq. area (10 ft. sq.). Collected artifacts included machine-made bottle glass and fragments of a pressed glass jelly jar.

The layout of the features within the project corridor suggests the presence of one or more domestic residences with associated outbuildings and a possible well. Feature 3 may represent the remains of a small wood framed house constructed on a wooden sill that rests upon the stone piers. Feature 2 (the stone foundation), located 6 m (20 ft.) east of Feature 3, may have been the location of a root-cellar for storing foodstuffs or another residence. Finally, Feature 1 (stone-lined depression) was located between the house and the railroad bed. It is possible that Feature 1 is the remains of a well that may have provided water for both the residence and Shays steam engines that traveled the railroad. The rubble mounds represented by Features 4 and 5 and their association with domestic artifacts (SC 4 and SC 5) and a large concentration of brick fragments suggests both of these features also represent domestic structures. Figure 6, the 1920 map of Nicholas County, illustrates buildings on both sides of the railroad tracks in the vicinity of Site 46NI655. The map also shows other buildings to the east and west of the site along the railroad tracks as well as to the north and west as railroad tracks divide and merge around the community of Hominy Mill. Other narrow-gauge railroad beds were observed outside of the project corridor during times of accessing or leaving the site area.

6.2.10 AREAS WG 2, WG 3, AND WG 12

Judgmental shovel tests were excavated in areas WG 2, WG 3, and WG 12 during the walkover survey. The location of these shovel tests, the results of the shovel tests, and soil descriptions associated with these shovel tests are discussed in Section 6.1. In summary, the judgmental STP excavated in Area WG 2 was excavated to test a recent (circa 1970s?) feature that may have been an electrical substation The shovel test was negative and the feature was not recorded as a site since it does not meet the National Register of Historic Places (NRHP) 50-year age criterion. The judgmental STP in Area WG 3 was excavated to test the terrace above Meadow River. The soils exposed in the STP indicate the terrace is an unstable surface that is subjected to frequent overbank flooding and would not have been a suitable location for prehistoric or historic occupation. An isolated chert flake was observed on the surface of a logging road on the top of a mountain in Area WG 12. An extensive surface reconnaissance in the vicinity of the flake was conducted, but no additional cultural material was identified. JMA also excavated three judgmental STPs around the isolated flake, but no other artifacts were recovered (Figure 27). The isolated find is does not have research potential and is recommended not eligible to the NRHP.

6.3 DISCUSSION OF SITE 46NI655

Spatially, Site 46NI655 represents a small percentage of the former logging community known as Hominy Mill. The archeological site, which is confined to the proposed powerline corridor (and immediately adjacent area), consists of an abandoned narrow-gauge railroad bed, five structural features, several surface artifact scatters, a surface concentration of brick fragments, and four positive STPs (Figure 23). The features include one depression (a possible well), one cut-stone foundation, a grouping of four stone piers, and two mounds of stone rubble and earth. The latter three features may represent the structural remains of former residences. For example, shanty railroad car houses may have been placed on stone piers or mounds adjacent to the tracks in order to elevate the house floor above the ground surface. The railroad bed bisects the site in an east-west direction. Field observations indicate that numerous structural features (mounds), depressions, and artifact scatters continue along both sides of the railroad bed for several hundred meters both east and west of the designated site area.

Hominy Mill first appears on the 1920 *Map of Nicholas County showing Topography* (Figure 6). The town is not illustrated on the 1935 *Richwood, WV 15 Minute Quad* map (Figure 8), nor does it appear on any subsequent maps. As illustrated in Figure 6, the town of Hominy Mill occupies the southeast quadrant of the confluence of Grassy Creek and Hominy Creek. The town was triangular in plan view with the streetscape aligned along three interconnecting railroads. One railroad was oriented east-west on the south side of Grassy Creek (at the base of the adjoining toe slope). This track connected to a railroad oriented north-south along the east bank of Hominy Creek. These two railroads were also connected by a northwest to southeast railroad spur that ran from the confluence of the two creeks in a southeasterly direction until joining the east-west railroad tracks on the south side of Grassy Creek. The 1920 map indicates Hominy Mill contained 30-35 buildings, with all the buildings located along one of the three railroad tracks. The proposed project corridor bisects the eastern half of the town. Archeological features and artifact scatters occur on either side of the abandoned railroad bed. This, coupled with the observation of additional features to the east and west of the project corridor, strongly suggest that the powerline corridor bisects the eastern half of the town.

Background research for the Phase I study suggests the town of Hominy Mill was most likely a logging camp related to the lumber mill operations at Hominy Falls. Hominy Falls is located

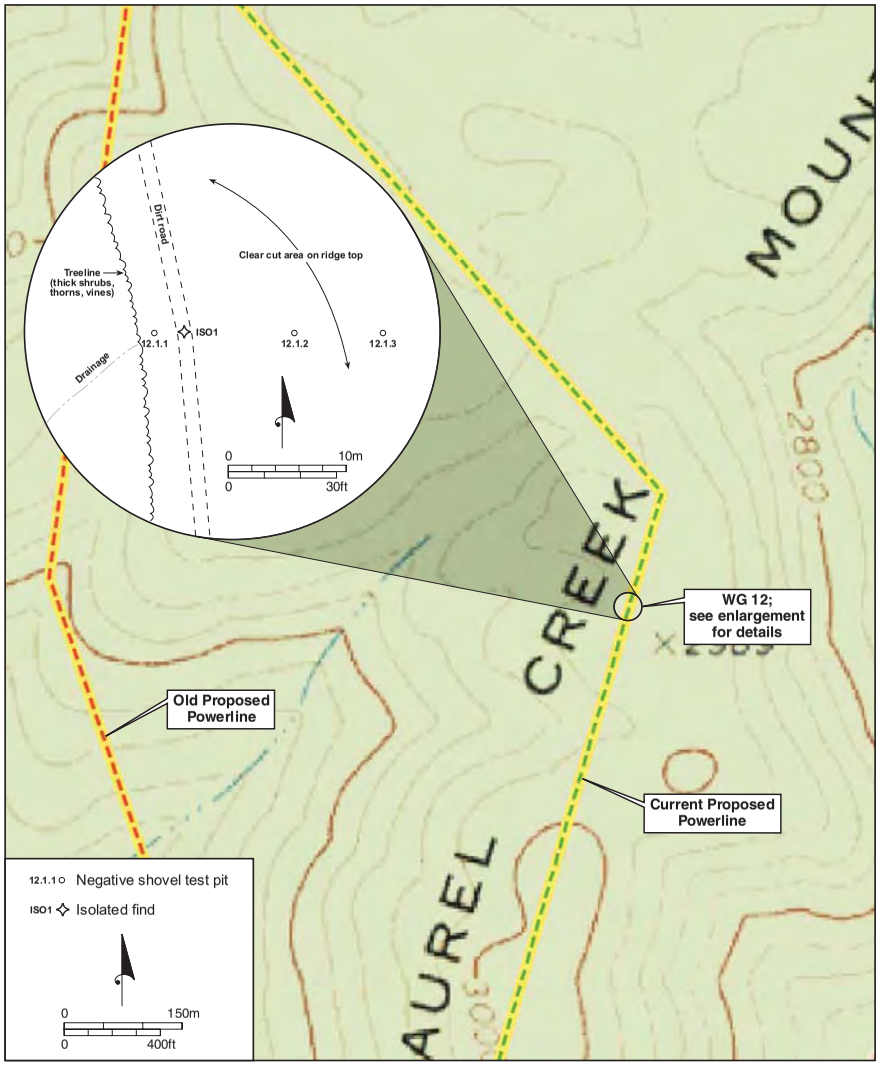


Figure 27. Plan map of Area WG 12, showing powerline corridor, IF-1, and STP locations.

the creek. The town of Hominy Falls and the associated lumber mill operation, including the railroad tracks in the surrounding areas, were owned and operated by the Pardee & Curtin Lumber Company. In 1900 the P&CL purchased a 25-year timber contract on several large tracts in Nicholas County. Sometime between 1900 and 1905, they constructed and opened four lumber mill towns in Nicholas County. The largest and most important mill and town was Curtin, located on the Cherry River near its confluence with the Gauley River. The other mills were opened in Coal Siding (upstream from Curtin), an unnamed location at the mouth of Deer Creek, and Hominy Falls on Hominy Creek. The mill at Hominy Falls was a single band saw, compared to the double band saw at Curtin. Historic records suggest all four of the P & CL mills in Nicholas County closed around 1928.

Based on historical map data and archeological investigations, it appears that Site 46NI655 fits the "company family logging camp" model defined by Brahsler (1991). Brashler has suggested that company family logging camps were distinctly different from single-gender shanty camps in the following ways:

> (1) company family logging camps included women and children, with each nuclear or extended family living in a shanty house, compared to single-gender shanty camps that included 10 to 20 or more bachelors living in a single shanty house;
> (2) company family logging camps were significantly larger in size (30 to 60 or more shanty houses) compared to between one to five shanty houses in a shanty logging camp [the historic map data (Figure 6 this report) suggest Hominy Mill consisted of as many as 30-35 buildings, located along three railroad tracks];
> (3) company family logging camps were somewhat more permanent (one to three years) compared to shanty logging camps (six months or less to one year);
> (4) field observations indicate numerous features (mounds, depressions, foundations, and artifact scatters) were oriented in a linear pattern adjacent and parallel to an abandoned railroad bed [JMA also recorded mounds, depressions, foundations, and artifact scatters along an abandoned railroad bed]; and
> (5) artifacts collected from the Dogway site indicate finer dinnerware and decorative items than would be expected at a single-gender logging camp [the JMA field team recorded hard paste porcelain with a decal overglaze and pressed glass tableware, both items would not be expected at a shanty camp).

Table 5 presents a list of datable artifacts recovered from the site. Although 75 percent (81 of 108) of the artifact assemblage is considered datable, nearly 70 percent of these artifacts have date ranges that extend from the mid-nineteenth century to the present day. The remaining artifacts have terminal date ranges (terminus post quem [tpq] dates) between 1908 and 1920, and of these, several artifacts have initial manufacture dates (ante post quem [apq] dates) between 1900 and 1907. Thus, the artifacts collected from the site suggest a period of occupation during the first quarter of the twentieth century, which corroborates the historic information collected about Hominy Mill and the P&CL operations in Nicholas County.

The features and artifact assemblage collected from Site 46NI655 are similar to the materials reported by Brashler from the Dogway site in southernmost tip of Webster County (1991). Surface features at the Dogway site included several depressions, a stone foundation (root cellar), brick chimney fall, rock piles, shanty house locations, and narrow-gauge railroad beds (Brashler 1991[4]:64). Artifacts from the site included plain and decorative tableware, transfer-print sherds, stove parts, barrel hoops, tin cans, and bottle glass (Brashler 1991[4]:63-64).

Table 5. Date ranges of datable artifacts collected from Site 46NI655.

Artifact Description	Count	Date Range
Wire Common Nail	2	1850-2006
Hard-Paste Porcelain: Decal Overglaze	1	1830-2006
Domestic Brown Stoneware: Albany Slip/Bristol Glaze	3	1810-1920
Whiteware: Plain	23	1810-2006
Ironstone: Plain White, Sevres China Co. Maker's Mark	2	1900-1908
Machine-Made Bottle Fragment: Aqua	6	1903-2006
Machine-Made Bottle Fragment: Amber	1	1903-2006
Machine-Made Bottle Fragment: Clear	9	1903-2006
Machine-Made Bottle Fragment: Amethyst	15	1903-1915
Unidentified Bottle Fragment: Amethyst	1	1880-1915
Miscellaneous Kitchen Glass: Canning-Lid Liner, Milk Glass	1	1869-2006
Miscellaneous Kitchen Glass: Canning Jar, Machine-Made	13	1903-2006
Pressed-Glass Tableware: Basket and Cherry Pattern	1	1825-2006
Miscellaneous Glass Tableware: Carnival Glass	2	1907-2006
Projectile: Shotgun Shell, headstamp:"UMC NITROCLUB No 12"	1	1867-1911
Total Datable Artifacts from Site:	81	

Table 6 presents a summary of the artifacts by “Group” and “Class” following the artifact categories established by Stanly South (South1977). The artifacts from the site can be classified into five groupings, including Kitchen (85%), Architecture (9%), Activities (3%), Clothing (2%), and Armament (1%). The overwhelming majority of artifacts are kitchen-related artifacts (such as various ceramics, bottle glass, container glass, storage glass, etc.) followed by a distant second in architectural artifacts such as window glass of various thickness, nails, and brick. The low frequency of artifacts in the architectural class may be indicative of temporary, movable structures (i.e., shanty houses moved on and off railroad cars as needed). Such structures did not have to be subjected to repairs or demolition on a regular basis. It should be noted that although a large cluster of brick fragments was observed between two of the mound features, only one brick fragment was collected. It is possible that the concentration of bricks represents chimney-fall from one of the nearby structures (Features 4 and 5). All bricks observed at the site appear to be hand-made. Given that 94% of the artifacts from the site are suggestive of residential activities, it is reasonable to conclude that Site 46NI655 represents domestic residences within the community of Hominy Mill. The other artifact groups: Clothing (shoe parts); Armament (1867-1911 shotgun shell); and Activities (one double-bladed, hand forged axe head and one large metal oil can) are indicative of hunting and industrial activities. Collectively the artifact assemblage supports the interpretation that Hominy Mill (Site 46NI655) most likely functioned as a company family logging camp.

Table 6. Artifact counts by Group and Class (South 1977) collected from Site 46NI655.

Group	Class	Count	Percentage of Class	Percentage of Group	Comment
Architectural	Glass	7	6.48	9.26	
Architectural	Metal	2	1.85		
Architectural	Stone/Brick	1	0.93		1 of 100s collected
Clothing	Biological	2	1.85	1.85	
Kitchen	Glass	29	26.85	86.72	
Kitchen	Glass	53	49.07		
Kitchen	Metal	11	10.19		
Armament	Metal	1	0.93	0.93	
Activities	Metal	2	1.85	1.85	
	total:	108	100.00	100.00	

Appendix G3

6.0 PHASE I SURVEY RESULTS

Review of Figure 23 indicates that most of the artifacts recovered from subsurface testing were confined to a 13 m x 15 m area (42 x 50 ft. sq. area) approximately 10 m (33 ft.) north of Features 2 and 3. This location may have been on the periphery of the yard near Grassy Creek and may have been a location where trash was discarded. SC 1 came from the area within the site that was covered in large boulders and was not likely considered usable yard space. Therefore, the residents may have used the stone pile as a convenient place to discard household trash. SC 2 was located adjacent to Feature 2 and the recovery of both canning lid glass and kitchen ceramics supports the interpretation that this feature was either a residence or associated with food storage. SC 3 was located near the north edge of the terrace in the vicinity of the shovel tests that contained artifacts. Artifacts were both kitchen-related and architectural, suggesting a residence was nearby and the area was used for trash disposal. SC 4 and SC 5 were adjacent to Features 4 and 5 and consist almost entirely of kitchen-related artifacts. These artifact scatters in association with the brick scatter and the structural features suggest these areas represent yard scatter by the occupants of the nearby shanty houses, which may be represented by the structural mounds.

Site 46NI655 is recommended eligible for the National Register of Historic Places (NRHP). In order to meet NRHP criteria (36 CFR 60.4), an archeological site must retain integrity and have the potential to contribute significant information. In this case, the significant information contained within the site would be relevant to the history of West Virginia, the development of Nicholas County, and the history of the lumber industry in this part of the state. In terms of internal site integrity, review of Figure 25 indicates that the soils at the site exhibit either an “A-B” soil horizon sequence or an O, A, B sequence. Artifacts are confined to the O and A horizons, i.e., to a depth of approximately 20-30 cm below surface. The site does not appear to have been disturbed since the town was abandoned some 80 years ago. Although structural features and foundations have fallen into disrepair, they are still clearly visible on the surface and foundations remain intact. In addition, the site area is covered by very large trees (hemlock, birch, yellow poplar, oak) that have the appearance of being well over 50-60 years in age. For example, the large tree in Plate 18 is birch tree that has grown up inside of Feature 1, which may be an abandoned well. These data provide indirect evidence that the site retains integrity. The significance of the site and some of the research questions that could be answered through additional research and excavation will be presented in Section 7.0 of this report.

6.4 GREENBRIER COUNTY, COUNTY ROAD 4, HISTORIC BRIDGE #2.49

During the archeological survey of the proposed powerline corridor, the JMA field team observed one historic structure. The historic structure consists of cut-stone boulders used to construct the bridge abutment and stone piers across Meadow Creek for Greenbrier County Road 4, formerly Russelville Road. A number on the bridge guard railing is stamped #2.49. Comparison of the current alignment of CR 4 with various historic maps (Figures 3, 5, and 7) suggests that CR 4 is the same road that is identified as the Russelville Road on the 1887 *Map of Greenbrier County* (Figure 3) and subsequent USGS maps from the early twentieth century. A photo of the current bridge illustrates the massive cut-stone boulders that were used to construct the bridge abutment

(Plate 20). The weathering of the cut-stone boulders, the state of repair of the boulders, and the overall appearance of the boulders suggests the stone piers of the bridge abutment are extremely old and in fact these boulders are probably the original bridge piers. Although the bridge abutment is in a reasonable state of repair, given its probable antiquity, recent repairs have been added to the footers of the bridge abutment in the form of poured concrete slabs (Plate 21). The purpose of the concrete is to provide additional support and stability to the bridge abutment. The bridge superstructure consists of a metal/iron span with large wooden planks perpendicular to the road, and a metal guard rail (Plate 20). The bridge superstructure appears to have been repaired or rebuilt within the last 30-35 years. It is not known if the bridge has been recorded as a historic structure by the state or the county, but because the bridge abutments appear to easily meet the 50-year age consideration, it is recommended that the bridge be recorded on a state of West Virginia Historic Resources Inventory form or a WV DOT Historic Bridge form.



Plate 20. Overview of Greenbrier County Road 4, Historic Bridge #2.49 showing large cut-stone boulders used for bridge abutment construction, facing northeast.



Plate 21. Close-up view of boulder construction for historic bridge abutment showing recent concrete footer support, facing northeast.

7.0 SUMMARY AND MANAGEMENT RECOMMENDATIONS

7.1 SUMMARY OF PHASE I SURVEY

In August of 2006, JMA conducted an intensive Phase I archeological survey of the proposed Western Greenbrier Co-Generation powerline corridor. The survey included a pedestrian survey of 50 acres along Segment B and approximately 46 acres of new alignment along Segment C. Collectively, JMA conducted a pedestrian survey of approximately 96 acres or 8,534 m (28,000 ft.) along a 150 ft. wide right-of-way. The survey of Segment B resulted in the identification of four archeologically sensitive areas (WG 1 through WG 4) that needed to be shovel tested. The survey of Segment C, initially by URS (and later JMA surveyed the new corridor alignments), resulted in the identification of eight archeologically sensitive areas (WG 5 through WG 12) that needed to be shovel tested.

The pedestrian survey resulted in the identification of one isolated find and one historic structure. The isolated find (designated IF-1) is a prehistoric chert flake observed along a logging road in Area WG 12. Radial shovel tests were excavated around the find spot, but no other cultural material was found. IF-1 does not contain integrity or significant information and is not eligible to the National Register. The historic structure consists of large cut-stone piers for the bridge abutment to Greenbrier County, County Road CR 4, Bridge #2.49. The bridge abutment appears to date to the mid nineteenth century although the wooden plank bridge structure appears to date to the last quarter of the twentieth century. Review of historic maps, such as Figures 3 and 5, suggest that the bridge was initially along the Russelville Road and dates to the mid-nineteenth century. JMA recommends that if the bridge has not been previously recorded, then bridge piers and bridge should be recorded on a WV Historic Resources Inventory form or a WV DOT Historic Bridge form, as appropriate. The pedestrian survey also located the remnants of what appear to be a 1970s electrical substation. This area included ceramic insulators and plastic bottles and aluminum cans. The area was not recorded as an archeological site.

In addition to the pedestrian survey, JMA excavated 353 shovel tests in 12 areas. The 12 archeologically sensitive areas were subjected to the systematic excavation of shovel tests. The shovel tests were excavated at 15-m (50 ft.) intervals along parallel transects, spaced 15 m apart. Transects were located on either side of the transmission line centerline in archeologically sensitive areas. STPs measured about 50 cm in diameter and were excavated to sterile soil or bedrock, which was generally 20-30 cm below surface. The intensive survey resulted in the identification of one archeological site, Site 46NI655, also known as Hominy Mill. Site 46NI655 was located in Area WG 11, which was initially surveyed by URS and identified as an area with medium archeological sensitivity.

The site is the location of a former logging-related community known as Hominy Mill. The town and related railroad was under the ownership of the Pardee & Curtin Lumber Company. The P&CL owned four lumber mills in Nicholas County between ca. 1905 and 1928. The town of Hominy Mill does not appear on the 1914 *Winona, W VA* USGS map (Figure 5) or the 1935 *Richwood, W VA* USGS map (Figure 8). However, the town does appear on the 1920 map of *Nicholas County Showing Topography* (Figure 6). The site boundaries were limited to the right-of-way for the powerline corridor, but evidence of the abandoned town and railroad grade extend to both the east and the west of the corridor and along either side of the railroad grade.

Archeologically, the site consists of several features (a depression, possibly a well; stone piers, probably for a house; a stone foundation, possibly for a root cellar; and two rubble mounds that may have supported a residence), several surface artifact scatters, four positive STPs, a concentration of brick fragments (possibly chimney fall) near one of the rubble mounds, at least two rock piles, and a narrow-gauge railroad grade. Artifacts include primarily domestic artifacts such as ceramics and bottle and container glass. Other artifacts include architectural debris (such as nails, window glass, and brick), clothing (shoe parts), industrial activities (oil can and a double-bladed, hand-forged axe head), and armament (shotgun shell cartridge). The few artifacts that are diagnostic suggest a period of occupation during the first quarter of the twentieth century, thus supporting the historic map data for the period of occupation for the town of Hominy Mill.

7.2 MANAGEMENT RECOMMENDATIONS

The following section defines and discusses significance and NRHP eligibility. The section concludes with a series of management recommendations concerning cultural resources identified within the proposed transmission line corridor for the Western Greenbrier Co-Generation project. The term "significance," as it pertains to archeological sites, is defined by the National Register criteria for evaluation (36 CFR 60.4) as follows

> "The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that posses integrity of location, design, setting, materials, workmanship, feeling, and association, and (a) that are associated with events that have made a significant contribution to the broad patterns of history, (b) that are associated with the lives of persons significant in our past, (c) … work of a master …, and (d) that have yielded or may be likely to yield information important in prehistory or history."

Archeological sites are most often considered eligible for inclusion in the National Register under criterion (d) "have yielded or may be likely to yield information important in prehistory or history." Archeological sites may also be eligible to the National Register under criteria (a) associated with significant events or (b) associated with the lives of significant people. Context, integrity, and significance represent three essential elements in any discussion of National Register eligibility. All National Register eligible properties share two defining characteristics: integrity and significance. Possession of only one of these attributes should render a resource "not eligible."

It should be pointed out that all National Register eligible properties are provided the same level or degree of consideration (or treatment or protection) under the law regardless of the significance criteria used to nominate the resource to the NRHP. It is also important to remember that management concerns (i.e., what one proposes to do with the property) should have no bearing on the issue of significance. That is, "… one does not determine a property eligible or ineligible, or eligible under one criterion as opposed to another, because of how one wants to manage the property (King 1996:13)." In a similar vein, NRHP eligibility should not be determined based on the researcher's or the reviewer's personal research interests or agenda, but rather on the ability of the site to produce important information that addresses specific theoretical and substantive issues on a local, regional, or national scale. Thus, significance should not be determined on the basis of achieving or exceeding some *a priori* notion concerning artifact type, density, or diversity, nor should it be determined on the basis of the archeologists or reviewers personal research bias. Rather as Butler (1987) succinctly states importance (or significance) is based on the theoretical

and substantive knowledge of the discipline at the time National Register eligibility is evaluated and determined. Consequently, what is considered important (or significant) is both dynamic and relative and will necessarily vary both spatially and temporally as the discipline evolves.

As discussed above, Site 46NI655, which represents a portion of Hominy Mill, is recommended eligible for the National Register under criterion "d" (information potential). The site retains integrity both spatially (i.e., the features and the artifact scatters appear to be undisturbed [except for years of neglect] on the surface) and temporally (i.e., positive shovel tests confirm that the artifacts are confined to the O and A horizons and that the soils have not been disturbed or truncated since the town was abandoned). The size of the hemlocks, yellow poplars, oaks, and beech trees provide indirect evidence that the site area has been abandoned and generally undisturbed for the last 50-60 years, and probably longer. The presence of structural features (e.g., foundations, stone piers, rubble mounds), associated artifact scatters, and positive shovel tests (both within features and yard areas) demonstrate that the site has the potential to yield significant information about the history of Hominy Mill and its inhabitants. In addition to the archeological record, historical and documentary research at state and county repositories, chain of title research at the Nicholas County Clerk office, and state and local libraries may provide valuable information on the history of the town. A great potential historical research repository is the company archives of the Pardee & Curtin Lumber Company, which is still in operation near Webster Springs. If available, the company archives may include various historical records, photographs, and other documents regarding Hominy Mill (or its residents) that would not be available elsewhere. Finally, there is a possibility that historical research may identify descendants of workers or other family members that lived in Hominy Mill. If such people can be identified and located, oral history interviews could prove to be most useful in acquiring important information on the history of the town and its occupants.

The WV SHPO has identified more than a dozen historic context research themes. Of these, at least seven research themes may be relevant to the archeological site identified as 46NI655 (also known as Hominy Mill). The possible historic context themes and associated research themes are presented below. JMA is prepared to initiate a treatment plan for the site if (1) the WV SHPO and the DOE agree that the site is eligible to the National Register, and (2) if the proposed powerline corridor can not be moved so as to avoid impacts to the site. If the site is determined eligible and if impacts to the site can not be avoided, then JMA is prepared to assist the DOE, WGC, and PHE in preparing a Memorandum of Agreement (MOA) and a data recovery or treatment plan for the site.

At the present time, it appears the site could be adversely affected by ground disturbance activities. That is, ground disturbance within the corridor could disturb the integrity of the features, artifact scatters, and archeological deposits within the site boundaries. Ground disturbing activities (e.g., clearing and uprooting trees along the powerline corridor, dragging trees along the ground in order to remove them from the corridor, and vehicular traffic (logging trucks and other vehicles) that could disturb and adversely effect the integrity of the features, artifact scatters, and archeological deposits. Given the currently proposed alignment, if the site is determined to be eligible, then the powerline corridor will have an adverse effect on Site 46NI655.

7.3 HISTORIC CONTEXT THEMES AND POSSIBLE RESEARCH QUESTIONS

Below are research questions that could be addressed through historic and documentary research, oral history interviews, and archeological investigations. The research questions would guide the formulation of the Data Recovery Plan and the MOA if the site is (1) determined eligible by the

DOE and the WV SHPO, and (2) if the site is adversely affected by construction of the power line (which necessarily includes clearing the right-of-way corridor for the transmission line regardless of whether or not transmission poles are placed within the site boundaries).

Brashler (1991) has presented a series of observations based on research of a logging company that operated in Webster, Pocahontas, Greenbrier, and Nicholas counties during the early twentieth century. The basic research questions presented below draw on her previous research and use her observations to identify questions and aspects of the site that would provide significant information on both the lifeways of the inhabitants and the structure of the temporary town of Hominy Mill. Research in other logging areas has shown that the organization of camps and their provisioning may differ from company to company based on competitive pressures (Franzen 1992). Both historical and archeological methods can be used to address these issues. Additional important information can be obtained by comparing the artifacts from this kind of site to other sites types such as temporary coal mining camps and more permanent mill towns (see Hulse 1989 for an example of the latter).

Community Planning and Development

When was the town of Hominy Mill built and when was it abandoned?
Did the community development follow a preconceived plan or did development occur in an uncontrolled and haphazard manner?
Was the town a family logging camp?
Did its layout differ from other such towns or camps, how does it compare to coal mining camps from the same period?
What types of buildings were constructed and which brought in on railroad cars? What type of sanitary conditions did the inhabitants endure?
Was there a school in town or did the children have to go to another community for their education, or were a majority of the children schooled at home so they could help with chores around the house and work for wages when they became of age?

Social and Cultural

Who were the initial inhabitants of the town? Was the town a company family logging camp or was it a single-gender logging camp?
If the town was a family logging town as the preliminary data suggest, then in what labor activities were women involved? Were the women participating in the wage labor economy? Were women actively in the logging business or was their labor contribution restricted to providing support services such as cooking, laundry, teaching, administrative assistance, etc.?
Did a majority of the people come from a particular ethnic group (e.g., Italian, Irish, local Appalachian residents)?
Were the residents of Hominy Mill all from the same social and economic class or were the people from all walks of life and different income levels?
Were the town inhabitants dependent on the outside world for food, clothing, medicine, etc.?
Did the residents supplement their diet with wild game, fish, and/or garden vegetables?

Economic Development

Why was the town founded at this location and what was the primary function of the town?
Did the majority of the people work together at the lumber mill, or were they loggers or railroad workers?

Based on archeological information, such as type of ceramics, glassware, and bottle glass as well as faunal remains (if present), what can be said about the socio-economic status of the residents?

Transportation

Did construction of the P & CL Railroad precede construction of Hominy Mill?
When did the railroad arrive and when was the railroad abandoned?
How was the community provisioned? Was all the food, medicine, clothing etc. brought via railroad cars, or were there motorized vehicles in town that could be used to transport food, medicine, clothing, etc.?

Domestic Life (and Lifeways)

What were the living conditions for the residents of Hominy Mill?
What was the role of children in the logging towns?
What was the quality of the food and material culture and did they supplement their diet through hunting and fishing?
Was it provided by the company or by individual families?

Industry

What was the primary employer for the residents of the town: nearby lumber mill, railroad workers, lumbermen, or some other occupation?
Did the workers and their families stay in the town during the life of the P&CL lumber mill at Hominy Falls or were the workers transient?

Commerce and Trade

What was the relationship (economically, socially, and politically) between Hominy Falls and Hominy Mill?
Was there competition among logging companies for workers?
Did this result in amenities in the form of better food, ceramics instead of metal plates to attract and keep workers?

Archeological Research Questions

Is this portion of the town primarily residential, or did it have buildings that served the community as well?

Is Feature 1 a well? If not, what function did the feature serve?

Feature 2 is the remains of a foundation. Is the foundation for a residence, an outbuilding, or a building with some other function, perhaps related to the railroad or lumber industry?

Feature 3 consists of four rough-cut stone piers. What function did the piers serve? That is, did they support a building, if so what was the function of the building? Did the piers serve some other function, or are the piers simply piles of stone cleared for housing or some other purpose?

Features 4 and 5 appear to be rubble mounds of earth and rough-cut stone. Are these mounds the result of a collapsed structure built on the site or are they a platform for a building (perhaps a shanty house) brought to the site? What was the function of the building, a community structure

or a residence? How were the mounds constructed and what type of building was on top of the mounds? Does the concentration of brick between the features represent chimney fall or was it used for some other aspect of building construction?

What can we learn about the social, economic, and ethnic status of the site occupants based on the artifact assemblage? Does the artifact assemblage suggest the type of labor with which the residents were engaged? Does this information corroborate the written record about the resident's labor, socio-economic status, and ethnic background? Is there a relationship between surface artifact scatters and subsurface features? Is their any archeological evidence of rebuilding within the community? What types of activities are represented in the artifact assemblage? Was the community home to just laborers or did the workers have their families living with them?

How does the artifact assemblage reflect how the site was provisioned? Did families bring their own material to the site? Did the company provide some or all of it? What evidence is there for the quality of the food in the community? Since the company typically provided the food, how does the quality compare to that found at farmsteads or other industrial towns? Is there evidence that families supplemented the food provided by the company?

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1821b Map of Nicholas County, W.VA. Map on file, West Virginia Division of Archives and History, Charleston, WV.

Appendix I:

West Virginia Archaeological Site Form

WEST VIRGINIA ARCHAEOLOGICAL SITE FORM

(Revised 1999)

Type of Form (Check One): __X__ **New Form** _____ **Revised Form**

1. Site No.: 46NI655 **2. Site Name:** Hominy Mills

3. County: Nicholas **4. 7.5' Quadrangle:** Nettie

5. UTM Zone (circle one): [17] 18 **Northing:** 0525441 **Easting:** 4224632

6. Location Description: Site is located on the south terrace of Grassy Creek and east of Hominy Creek. Site is part of the early twentieth-century community of Hominy Mills

7. Ownership (Name/Address/Tenant): Meade Westvaco Corporation

1 High Ridge Park Stamford CT, 06905

8. Temporal Affiliations: ☐ Prehistoric ☐ Protohistoric ☒ Historic ☐ Prehistoric and Historic

9. Prehistoric Temporal Period(s) Represented: ☐ Unassigned ☐ Paleoindian ☐ Archaic, E M L ☐ Woodland, E M L ☐ Late Prehistoric ☐ Protohistoric

10. Historic Temporal Period(s) Represented: ☐ 1700-1750 ☐ 1751-1800 ☐ 1801-1850 ☒ 1851-1900 ☒ 1901-1950 ☐ 1951-Present ☐ Unassigned

11. Prehistoric Site Type (select as many as appropriate): ☐ Lithic Scatter ☐ Cave/Rockshelter

Habitation: ☐ Camp ☐ Village ☐ Hamlet **Extractive:** ☐ Quarry ☐ Workshop ☐ Earth Mound ☐ Stone Mound ☐ Earthwork ☐ Burial Area ☐ Petroglyph/Pictograph

12. Historic Site Type (select as many as appropriate): ☒ Residential ☐ Farmstead ☒ Commercial ☒ Industrial ☐ Military ☒ Trail/Trace/Road ☐ Other_____

Is site associated with any standing structures? ☐ Yes ☒ No

Has a WV Historic Inventory Form been completed for the structure? ☐ Yes ☐ No

13. Site Condition: ☐ Unknown ☒ Undisturbed ☐ Destroyed ☐ Disturbed (explain): _____

14. Describe current land use: Part of timber tract owned by Meade Westvaco. Timber is at least 70+ years old.

15. Topographical Location: ☒ **Floodplain** ☒ **Terrace** _X__**1** ____**2** ____**3** ☐ **Ridgetop**

☐ **Gap/Saddle** ☐ **Hillside/Bench** ☐ **Bluff** ☐ **Other:**_____

16. Physiographic Province: ☒ **Appalachian Plateau** ☐ **Transitional** ☐ **Ridge and Valley**

17. Soils: Soil Association ___Gilpin-Buchanan_____

Soil Series-Phase/Complex __Buchanan channery fine sandy loam, 8-15% slope, very stony__

18. Vegetation: _____Hemlock and Birch_____ **19. Elevation:** ____2,160 ft./658.37 m____**(ft/m amsl)**

20. Slope %: ___0-8%_____**21. Slope Direction:** _north_____

22. Nearest Water Source (select only one, as appropriate):

Name: _____Hominy Creek_____ ☐ **Spring** ☐ **River** ☒ **Perennial Stream**

☐ **Intermittent Stream** ☐ **Swamp/Bog** ☐ **Other:** _____

Major Drainage (name): __Gauley River_____ **Minor Drainage (name):** _____

23. Distance to water (ft/m) _____150 ft/13.9m_____ **(horizontal)** ____15 ft/4.6 m___ **(vertical)**

24. Site Area (Dimensions in meters): ____4632.96 sq. m_____

Basis for site area estimate: ☐ **Paced** ☒ **Taped** ☐ **Historic Maps** ☐ **Aerial Photograph**

☐ **Transit/Alidade** ☐ **Unrecorded** ☐ **Other** _____

25. Site Description (include description of site, setting, nature and location of artifacts and concentrations, features, and significance of site in a local or regional context. Use Continuation Sheet if necessary:

Site is a series of mounds and depressions with an associated artifact scatter. The site is part of the community of Hominy Mills that dates to the last decade of the nineteenth century and the first quarter of the twentieth century. The site was identified during a walk-over survey. A grid of 21 shovel tests was excavated across the site with in the 150 foot-wide project area. Surface collection recovered artifacts from five (5) locations within the site. The Site is bisected by an abandoned railroad or narrow gauge track that runs east to west. Five surface features were identified within the project are. These include a possible well shaft, a possible root cellar, two stone rubble mounds, and an unidentified surface feature consisting of four stone piers. The site retains integrity, but the presence of stratified deposits could not be determined. The site does have research potential that could provide pertinent information about late nineteenth- and early twentieth- century timber camp life ways. Artifacts include brick; axe head; oil can; wire nails; amethyst, clear, aqua, and amber machine-made bottle glass; canning jars; pressed table glass; Bristol and Albany-slip stoneware; whiteware; ironstone with a Sevres makers mark (1900-1908); and shotgun shell with headstamp: "UMC NITROCLUB No 12" (1867-1911). Enamelware, and other metal, glass, and ceramic vessels were noted, but left in-situ at the site. The community of Hominy Mill was owned by the Pardee and Curtin Lumber Company (P&CL). The P&CL owned four lumber mill operations in Nicholas County between 1905 and 1928. Hominy Mill most likely is a family logging camp associated with the mill town of Hominy Falls.

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26. Investigation Type (select as many as appropriate): ☐ **Examination of Collection**

☐ **Pedestrian Survey** ☒ **Surface Collection** ☒ **Shovel Tests** ☐ **Test Unit(s)**

☐ **Test Trench(es)** ☐ **Deep Test(s)** ☐ **Auger/Soil Corer** ☐ **PZ Removal**

☐ **Mitigation/Block Excavation** ☐ **Aerial Photographs** ☐ **Remote Sensing** _____

☐ **Unknown** ☐ **Other:** _____

27. Surface Collection Strategy (select as many as appropriate):

☐ **Not Applicable** ☒ **Grab Sample** ☐ **Diagnostics** ☐ **Controlled-Total** ☐ **Controlled-Sample**

☐ **Other (specify):** _____

28. Surface Visibility (select only one as appropriate): ☐ **None** ☒ **Less than 10%**

☐ **11-50%** ☐ **51-90%** ☐ **91-100%** ☐ **Unrecorded**

29. Has site been excavated? ☐ **Yes** ☒ **No** **Estimated Percentage of Site Excavated:** less than 1 %

30. Artifacts Collected (estimate percentage of artifacts collected): less than 1 %_____

Prehistoric Artifacts Collected (select as many as appropriate; include frequencies):

Lithics: ☐ **Debitage**_____ ☐ **Tools**_____ ☐ **Projectile Points**_____ ☐ **FCR**_____

Ceramics: ☐ **Rim Sherds**_____ ☐ **Body Sherds**_____ ☐ **Faunal Remains**_____

☐ **Botanical Remains**_____ ☐ **Human Skeletal Remains**_____ ☐ **Other**_____

Historic Artifacts Collected (select as many as appropriate; include frequencies):

Architectural: ☒ **Bricks**__1___ ☒ **Window Glass**___7___ ☒ **Nails**___2___ ☐ **Other**_____

☒ **Ceramics**__29_ ☒ **Bottle Glass**___34_ ☐ **Military**_____ ☒ **Weapons**_____ ☐ **Personal**__2__

☐ **Food Remains**_____ ☐ **Metal**___13___ ☐ **Other:** shotgun shell; 4 pressed glass; canning jar.

Provide a brief description of diagnostic artifacts: wire nails; ironstone with a Sevres makers mark (1900-1908); shotgun shell with UMC headstamp (1867-1911); amethyst, clear, aqua, and amber machine-made bottle glass; canning jar fragments, milk glass canning lid liner, and zinc canning lid fragments

31. Curation Location: Not Determined _____

32. Is Site Eligible to NRHP?: ☐ **Yes** ☐ **No** ☒ **Unevaluated** ☐ **Unknown**

Explain: Site is recommended eligible to the NRHP, evaluation pending DOE and SHPO review.

Appendix G3

33. Form Prepared by: Bryan L. Corle and Sandy Stevens

34. Affiliation: Assistant Project Archeologist, John Milner Associates

35. Address: 5250 Cherokee Ave. Suite 300, Aleandria VA 22321

36. Phone Number: 703-354-9737 **37. E-Mail:** bcorle@johnmilnerassociates.com

38. Date of Fieldwork: 17 August 2006 **39. Date Form Prepared:** 9/11/06, updated 10/06/06

40. References (Please note any bibliographic references):

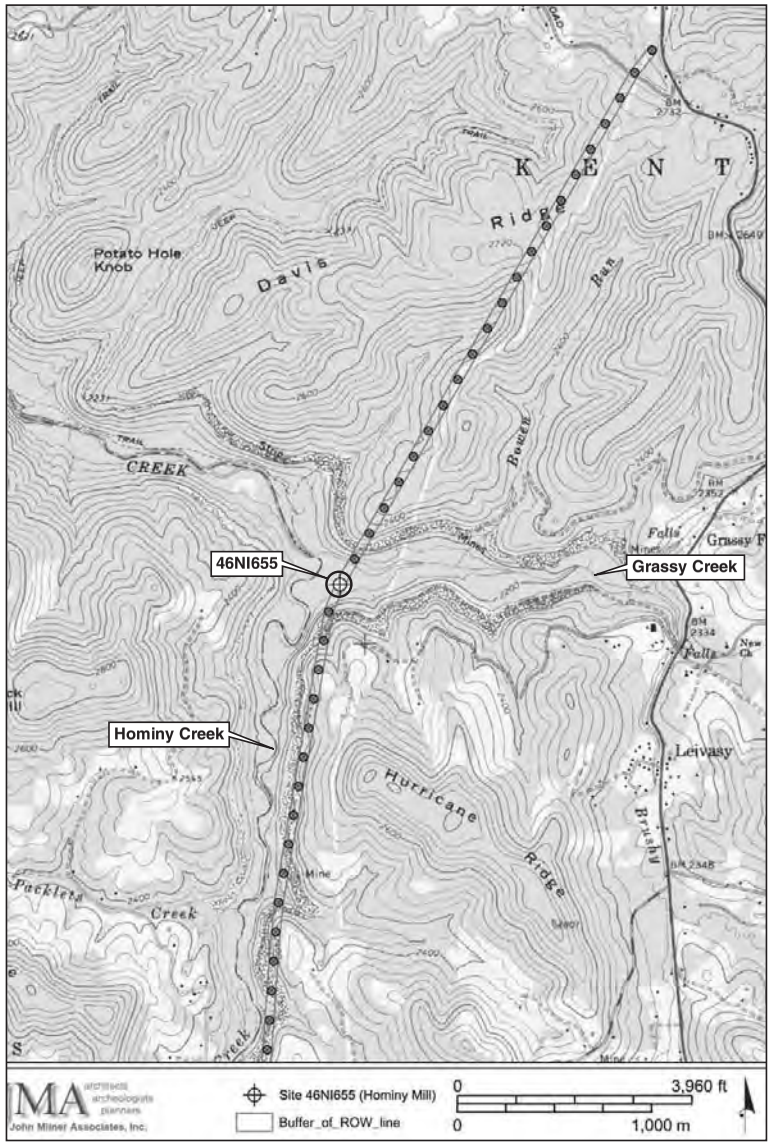
41. Map (Attach portion of USGS quadrangle map and sketch location with nearest landmarks and other recorded sites; include north arrow, key, and scale)

See attached maps

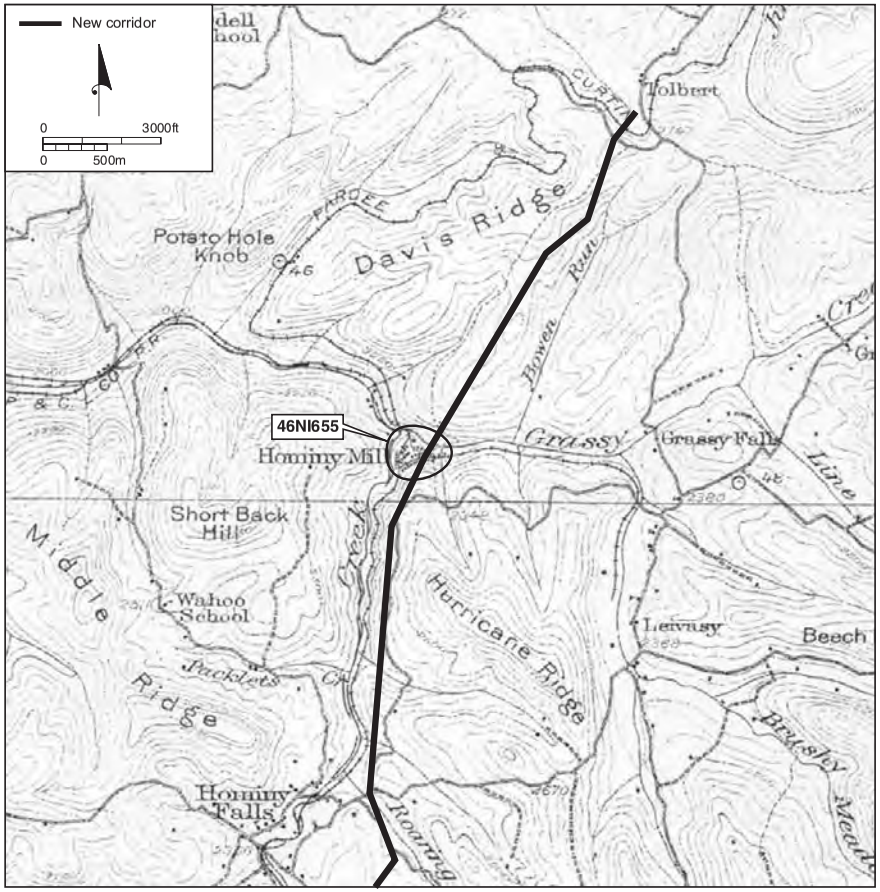
West Virginia Division of Culture and History
State Historic Preservation Office
1900 Kanawha Blvd., East
Charleston, WV 25305
(304) 558-0220

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Appendix G3



Appendix G3



Nicholas County Showing Topography **(White 1920)**

Appendix G3

Appendix II:

Artifact Inventory

Appendix G3

Site	Lot	Provenience	Feature	Artifact No.	TYPENAME	DESCRIPT	Count	Comments
1	1	ST 1.5		1	Window Glass	All Thicknesses	3	
1	1	ST 1.5		2	Wire Common Nail	Complete	1	burned
1	1	ST 1.5		3	Whiteware	Plain	13	mend
1	1	ST 1.5		4	Machine-Made Bottle Fragment	Amethyst	1	
1	1	ST 1.5		5	Machine-Made Bottle Fragment	Clear	2	
1	1	ST 1.5		6	Unidentified Bottle Fragment	Aqua	1	
1	1	ST 1.5		7	Projectile	Shotgun Shell	1	"UMC NITROCLUB No 12"
1	2	ST 2.5		1	Ironstone	Plain White	2	Sevres China Co mark (1900-08)
1	2	ST 2.5		2	Machine-Made Bottle Fragment	Aqua	2	
1	2	ST 2.5		3	Machine-Made Bottle Fragment	Amethyst	2	
1	2	ST 2.5		4	Machine-Made Bottle Fragment	Clear	2	
1	2	ST 2.5		5	Miscellaneous, Metal	Unidentified	1	flat ferrous, possible stove part
1	3	ST 2.6		1	Whiteware	Plain	1	
1	3	ST 2.6		2	Machine-Made Bottle Fragment	Amber	1	
1	3	ST 2.6		3	Miscellaneous Glass Tableware	Carnival	1	clear glass
1	4	ST 3.1	1	1	Unidentified Bottle Fragment	Amethyst	1	
1	4	ST 3.1	1	2	Unidentified Bottle Fragment	Clear	1	
1	4	ST 3.1	1	3	Tool, Metal	Axe	1	double edged, hand-wrought
1	4	ST 3.1	1	4	Storage, Metal	Can	1	2 pieces
1	5	SC 1		1	Brick	Handmade, Unglazed	1	sample
1	5	SC 1		2	Shoe Part	Leather	1	upper fragments
1	5	SC 1		3	Shoe Part	Rubber	1	sole fragment
1	5	SC 1		4	Hard-Paste Porcelain	Decal Overglaze	1	coffee cup fragment
1	5	SC 1		5	Domestic Brown Stoneware	Albany Slip/Bristol Glaze	3	crock fragments
1	5	SC 1		6	Whiteware	Plain	3	
1	5	SC 1		7	Machine-Made Bottle Fragment	Amethyst	1	base
1	5	SC 1		8	Machine-Made Bottle Fragment	Clear	2	paneled bottle fragments
1	5	SC 1		9	Unidentified Bottle Fragment	Olive Green	1	
1	5	SC 1		10	Miscellaneous Kitchen Glass	Canning-Lid Liner	1	milk glass
1	5	SC 1		11	Miscellaneous Kitchen Glass	Canning Jar	9	"MAS[ON]", fragments
1	5	SC 1		12	Miscellaneous Glass Tableware	Carnival	1	cobalt blue glass
1	5	SC 1		13	Storage, Metal	Zinc Canning Lid	9	fragments
1	5	SC 1		14	Appliance, Metal	Cast-Iron Stove Part	1	
1	6	SC 2		1	Whiteware	Plain	3	
1	6	SC 2		2	Miscellaneous Kitchen Glass	Canning Jar	3	fragments

1	7	SC 3	2	1	Window Glass	All Thicknesses	4	
1	7	SC 3	2	2	Whiteware	Plain	3	mend
1	7	SC 3	2	3	Miscellaneous Kitchen Glass	Canning Jar	1	fragment
1	8	SC 4		1	Wire Common Nail	3 - 3.5 Inch Long	1	
1	8	SC 4		2	Machine-Made Bottle Fragment	Aqua	4	"…HOT... [in script]"
1	8	SC 4		3	Machine-Made Bottle Fragment	Amethyst	10	solarized, 1 bottle fragment
1	8	SC 4		4	Machine-Made Bottle Fragment	Clear	3	
1	8	SC 4		5	Pressed-Glass Tableware	Other	1	basket and cherry pattern with stippled background
1	9	SC 5		1	Machine-Made Bottle Fragment	Amethyst	1	solarized
1	9	SC 5		2	Miscellaneous Glass Tableware	Undecorated	1	jelly glass jar
Isolate 1	1	SC 1		1	Shatter 16-20mm	Chert	1	

Appendix III:

Qualifications of the Investigators

J. SANDERSON STEVENS
Cultural Resources Branch Manager
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(502) 587-8800 (phone) (502) 587-8802 (fax)
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EDUCATION

M.A.	University of Iowa, Iowa City	Anthropology	1979
B.A.	University of Colorado, Boulder	Anthropology	1975
B.A.	University of Colorado, Boulder	International Relations	1986

PROFESSIONAL CERTIFICATION

2002&2004	ODOT Section 106 and Section 4(f) Training Workshops
1994-2003	OSHA Annual 8 hr HAZWOPER refresher course
1994-2003	Adult CPR, First Aid, Rescue Diver
1998	National Preservation Institute: Section 106 Update for Contractors
1995/2000	National Preservation Institute: Cultural Resources Management Plans
1994	FERC: Cultural Resources Training Course
1993	OSHA 40-hour Hazardous Waste, Safety and Health Training Course
1990	ACHP & GSA: Section 106 NHPA Training Federal Projects and Historic Preservation Law

EXPERIENCE PROFILE

J. Sanderson Stevens graduated from the University of Iowa in 1979 with a Master's Degree in Anthropology. He has more than 27 years experience as a North American Archeologist with prehistoric and historic archeological experience in the Midwest, Middle Atlantic, Southeast, Northeast, Plains, and Southwest. Mr. Stevens has served as a Principal Investigator and Project Manager for the last 16 years. During that time he has managed and directed numerous projects related to compliance with NEPA and Sections 106/110 of NHPA. Mr. Stevens also has more than six years experience as Cultural Resources Department Manager both with JMA and Parsons, St. Louis. His responsibilities have included, but are not limited to, business development, project management, Section 106/110 and agency coordination as well as management and oversight of all phases of archaeological identification, evaluation, and treatment. Mr. Stevens has prepared more than 120 CRM reports, contributed to numerous EAs and EISs, published 9 professional papers, and presented 16 papers at professional conferences. He has also served as project manager for both underwater archaeology surveys for state DOTs and historic architectural evaluations for DOD and DOT clients. Mr. Stevens has assisted in the preparation of ICRMPs, and NRHP nominations.

KEY PROJECTS (JOHN MILNER ASSOCIATES)

2004-06 Project Manager and Principal Investigator, Badlands National Park, South Dakota, Historic Resources Study. Work performed for BVH Architects, Omaha Nebraska and the Midwest Region, National Park Service, Omaha, Nebraska.

2006 Project Manager and Principal Investigator, Phase I Archeological Survey of the proposed Clearwater Farm Development, Louisville, Kentucky. Work included intensive survey behind NRHP-listed property. Work performed for Keal and Associates, Inc.

2006 Project Manager and Principal Investigator, Phase I Archeological Survey of the proposed Weyerhauser Land Exchange Project, Hawsville, Hancock County, Kentucky. Work performed for RMT Integrated Environmental Solutions and the US Army Corps of Engineers, Louisville District.

2006 Project Manager and Principal Investigator, Phase I Archeological Survey of Proposed Beargrass Creek Trail Improvements, Louisville, Jefferson County, Kentucky. Work performed for Quest Engineers, Inc.

2005 Project Manager and Principal Investigator, Phase I Cultural Resources Inventory of Four Cell Tower Locations across Kentucky (Barren, Boyle, Mason, and Russell counties). Work performed for Kentucky Shared Tower Sites, McLean, VA, and the FCC.

2005 Principal Investigator, Phase I Intensive Archeological Survey of Sector 2-West (400 acres), Badlands Bombing Range, South Dakota. Work performed on behalf of HydroGeologic, Inc. and the U.S. Army Corps of Engineers (USACE), Omaha District.

2005 Project Manager, Phase II Architectural History National Register Evaluation of 10 Historic Buildings, Dayton, Ohio. Work performed for the Montgomery County, Regional Planning Commission and Ohio Department of Transportation, Region 7.

2004-06 Principal Investigator, Cultural Resources Coordinator, Section 4 Design Team for the Louisville-Southern Indiana Ohio River Bridges Project, H.W. Lochner, Inc. Work performed on behalf of the Kentucky Transportation Cabinet.

2005 Principal Investigator, Phase Ia Archeological Investigations for Metro Communications Cell Tower, Lafayette, Indiana. Work performed on behalf of Metro Electronics, Inc.

2004-05 Project Manager, Phase I Intensive Archeological and Geomorphological Investigations for Western Greenbrier Co-Production Plant, Rainelle, West Virginia on behalf of the Department of Energy and Potomac-Hudson Engineering, Inc

2004 Principal Investigator, Archeological and Geomorphological Monitoring for the Lincoln Avenue Cemetery, Warwick County, Indiana. Work associated with geotechnical drilling. Work performed for Bernardin Lochmueller and Associates, Evansville, IN.

2004 Principal Investigator, Archeological and Geomorphological Investigations of the Mason Mound Landform, Warren County, Ohio. Work performed on behalf of Woolpert, Inc.

2003-04 Project Manager and QA/QC editor, Native American Traditional Ranges in Illinois: A Report Prepared in Support of NAGPRA Considerations on behalf of the USCOE, St. Louis District in association with Central Mississippi Valley Archeological Research Institute.

2003-04 Project Manager, Phase Ia cultural resource investigations and EIS studies for Western Greenbrier Co-Production Plant, Rainelle, West Virginia on behalf of the Department of Energy and Potomac-Hudson Engineering, Inc.

1994 Project Manager and Principal Investigator, Phase I archeological investigations of 6 prehistoric, 3 historic and 6 Civil War sites associated with the Battle of Chancellorsville for the proposed Hunting Run Reservoir and Filtration Plant, Spotsylvania County, VA on behalf of Hayes, Seay, Mattern & Mattern.

1994 Principal Investigator, Intensive Phase I archeological and geomorphological investigations for the Dulles Toll Road Wetlands Replacement, resulted in the identification of three deeply buried Late Woodland sites, sites determined NRHP eligible at Phase I level documentation.

1993 Project Manager and Principal Investigator, Phase I survey of the Muddy Branch Relief Sewer Alignment, Montgomery County, MD on behalf of Rummel, Klepper, and Kahl.

1993 Project Manager and Principal Investigator, Phase I survey of Proposed Wastewater Treatment Facilities, Fauquier County, VA on behalf of BCM Engineers, Inc.

1992 Project Manager and Principal Investigator, Phase II Evaluation of Three Prehistoric Sites for the James River Water Supply Project, Henrico County, VA on behalf of CDM, Inc.

1992 Program Manager and Principal Investigator delivery order contracts, National Park Service, Denver Service Center, Eastern Applied Office, Silver Spring, MD. Projects included Phase I and II archeological investigations at Delaware Water Gap, NJ and PA; Shenandoah National Park, VA; Johnstown Flood Memorial, PA and Grandview National River, WV.

1991-1994 Project Manager and Principal Investigator, Directed and managed over 15 terrestrial and underwater archeological investigations for the Maryland State Highway Administration. Projects included inventory and evaluations for prehistoric and historic archeology and underwater archeology. Work performed in Allegany, Frederick, Howard, Montgomery, Baltimore, Anne Arundel, Prince Georges, Charles, St. Mary's, Wicomico, Dorchester, Worcester, and Somerset counties, MD.

1988-1990 Project Manager and Principal Investigator, Phase I, II, and III archeological and geomorphological investigations for the Fort Washington Lifecare Retirement Community, Prince George's County, MD. Work performed on behalf of the Marriott Corporation, MD.

1987-1989 Field Director and co-author, Prehistoric Principal Investigator, Phase I archaeological investigations of 55 miles of highway corridor for the Route 29 Charlottesville Bypass, Charlottesville, VA. Survey identified 60 archeological sites including prehistoric and historical sites. Survey conducted on behalf of Sverdrup Corporation, Fairfax, VA.

1988 Project Archeologist, Phase IA Archeological and Geomorphological Investigations for the Proposed Po River Reservoir and Water Filtration Plant, Spotsylvania County, VA on behalf of Hayes, Seay, Mattern & Mattern.

1987-1989 Field Director and senior author, Phase I, II, and III prehistoric and historic archeological investigations in Prince George's County, Maryland for James T. Lewis Enterprises, Ltd...

1987-1988 Field Director and senior author, Phase I survey of 105 acres and Phase II archeological evaluation of 10 prehistoric and/or historic sites for the Veterans Administration, Perry Point Medical Center, Cecil County, MD.

KEY PROJECTS (PARSONS)

1999-2003 Task Manager, Field Director of archeological surveys associated with Phase 1 UXO EE/CA studies including 4 seasons at the Badlands Bombing Range, SD; Camp Swift, TX; Camp Gordon Johnston and Brooksville Gunnery Range, FL. Archeological surveys and technical reports prepared for US Army Corps Omaha, Fort Worth, Huntsville, Jacksonville Districts.

2003 Task Manager. Prepared archeological component of NEPA documents for Fort Campbell, TN, Training Areas Programmatic EA and the 5th Special Forces EA. Louisville District, US Army Corps of Engineers.

2001-2003 Project Manager. Archeological survey of Camp Robinson, Little Rock, AR identified over 65 prehistoric sites and 300 historic sites; prepared detailed Phase I report, coordinated Native American consultation meetings, and directed artifact inventory and curation. Work performed under task orders on IDIQ contract on behalf of Military Department of Arkansas.

1996-2003 Principal Investigator. Managed and directed six Phase I archeological surveys (ca. 28,000 acres) and 3 Phase II evaluations at Avon Park AFR, FL. Work included preparation of detailed GIS predictive model, work performed on behalf of HQACC Langley AFB, VA.

2001-2002 Task Manager. Phase I archeological survey, EIS, and Section 106 coordination and documentation for the Louisville Light Rail Transit project. Work performed on behalf of Transit Authority of River City, Louisville, KY.

2002 Project Manager and Principal Investigator, Phase II Evaluation of Two Prehistoric Sites for the Edwardsville Sewer Interceptor Pipeline, Edwardsville, KS on behalf of B & G Consulting Engineers.

2001-2002 Project Manager. Archeological survey and Phase II evaluations for Ft. Leonard Wood West Gate Road. Identified 10 sites, 8 sites formally evaluated for NRHP, 3 sites determined eligible. Work performed for Missouri DOT, Fort Leonard Wood and Kansas City Corps.

2000 Project Manager and Principal Investigator, Phase I archeological survey and geomorphological testing at Tinker AFB, OK on behalf of the Air Force Materiel Command.

1999-2000 Principal Investigator. Phase I inventory of NASA facilities at Lewis Field and Plum Brook Station, Ohio for EIS Study of Cleveland Hopkins Airport, FAA, NASA, and Cleveland. Work performed for NASA and City of Cleveland.

1999 Principal Investigator/Project Manager. Managed Phase I survey, Big Island Site, Caesar Creek Lake, Ohio. Delivery order contract Louisville District, Army Corps of Engineers.

1999 Principal Investigator. Managed and directed intensive archeological survey and geomorphological evaluation of Fort Riley VA Cemetery. Kansas City District, US Army Corps of Engineers and Directorate of Environmental Services, Fort Riley, Kansas.

SELECTED PUBLICATIONS AND PAPERS

2000 The Hickory Bluff Ceramic Assemblages: Manufacture, Chronology, and Social Boundaries. Society for American Archaeology, Philadelphia, PA. (Junior Author).

1999 Montgomery, Potomac Creek, and Algonquian: Examination of Ceramic Variability in the Potomac Valley. Middle Atlantic Conference, Harrisburg, PA. (Symposium Chairperson).

1999 Another Roadside Attraction: Misunderstanding Context, Integrity, Significance, and Eligibility. Transportation Research Board Workshop, Madison, WI.

1998 “Bifacial vs. Bipolar: Lithic Reduction Strategies during the Late Archaic in Southern Maryland.” Middle Atlantic Archaeological Conference, Cape May, NJ.

1998 “Examination of Shepard and Potomac Creek Wares at a Montgomery Complex Site (44LD521).” Journal of Middle Atlantic Archaeology Volume 14:95-126.

1997 "GIS Applications to Archaeological Modeling in the Kissimmee Basin." Southeastern Archaeological Conference, Baton Rouge, Louisiana.

1996 "Ceramic Attributes and Accokeek Creek Chronology: An Analysis of Sherds from the Falcon's Landing (18PR13) and the Accotink Meander (44FX 1908) Sites." North American Archaeologist, 1996 (2):113-142 (co-author Michael J. Klein, Ph.D.).

1995 "A Comparison of Technological and Adaptive Strategies between Normanskill Occupations in the Delaware and Hudson Valleys." North American Archaeologist, 1995: 16(3):239-279.

1990 "A Story of Plants, Fire, and People: The Paleoecology and Subsistence in the Late Archaic and Early Woodland in Virginia (ca. 4500 to 2500 B.P.)." In Late Archaic and Early Woodland Research in Virginia: A Synthesis, pp. 185-220. Edited by Theodore R. Reinhart and Mary Ellen N. Hodges. Special Publication of the Archaeological Society of Virginia,

1981 "The Williams Site (13HN10): A Multicomponent Village in Southeastern Iowa, South Dakota Archaeology, 1981, Vol. 5:59-84.

1980 "The Osteoarchaeology of the McKinney Oneota Village." Research Papers of the Office of the State Archaeologist, Iowa City, Iowa, Vol. 2, No. 7, 1980.

1980 "The Southeast Iowa Lake Calvin Paleo-Indian Survey." Research Papers of the Office of the State Archaeologist, Iowa City, Iowa, 1980.

1979 “A Model for the Transition from Food Collecting to Food Producing Societies in Northern Italy (12,000 to 5,000 BP)." Master's thesis, University of Iowa.

SUMMARY OF PROFESSIONAL ACTIVITIES

Mr. Stevens is author or co-author of over one hundred and twenty (130) cultural resources reports, seven (7) publications, and sixteen (16) papers presented at professional meetings.

Appendix G3

BRYAN CORLE
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EDUCATION

B.A. George Mason University Anthropology Expected 2007

EXPERIENCE PROFILE

Bryan Corle has more than 13 years experience in North American Archeology and has been involved in investigations ranging from early prehistoric through urban historic. Since joining John Milner Associates, Mr. Corle has assisted archeological survey, testing, and data recoveries in Virginia, Maryland, Pennsylvania, West Virginia, and Washington, D.C.

KEY PROJECTS

2005 Assistant Archeologist. Phase1b archeological survey of the Warings Grove (72-4) historic site and the adjacent six acres, Prince Georges, Maryland. St. Paul Community Development, Temple Hills, Maryland.

2004 Assistant Archeologist. Multiple Cultural Resource investigations at Marine Corps Base Quantico, Archeological Investigations at 44PW1558, 44PW1559, 44ST494, and 44ST632, Prince William and Stafford, Virginia. EDAW, Alexandria, Virginia.

2004 Assistant Archeologist. Phase I Archeological Survey of the Northern Virginia Reinforcement Pipeline Project, FountainHead Regional Park, Fairfax County Virginia. Northern Virginia Regional Park Authority.

2004 Assistant Archeologist. Phase I archeological service Bull Run Marina Regional Park, Fairfax County, Virginia. Rhodeside and Harwell, Inc., Alexandria, Virginia

2003 Assistant Archeologist. Archeological Investigations of the Proposed Rewatered Turning Basin, Crescent Lawn Archeological District (18AG227), Cumberland, Allegany County, Maryland. United States Corps of Engineers Baltimore District, Baltimore, Maryland.

2002-2003 Assistant Archeologist. Phase I and Phase II Archeological Investigations for Multiple Cultural Resources at Marine Base Quantico, Virginia. EDAW, INC.

2002 Assistant Archeologist. Phase II Archeological Investigations at Sites 18PR548, 18PR549, and 18PR551, NASA Goddard Space Flight Center, Greenbelt, Maryland. NASA Goddard Space Flight Center.

Appendix G3

2002 Assistant Archeologist. Data Recovery Investigations at Buildings A, B, C within the Crescent Lawn Archeological District (18AG227), Cumberland, Allegany County, Maryland. Canal Place Preservation and Development Authority.

2001 Assistant Archeologist. Phase I and Phase II Archeological Investigations for Multiple Cultural Resources at Marine Base Quantico, Virginia. EDAW, Inc.

2001 Assistant Archeologist. Phase I Archeological Investigations of Battery Heights (44AX186), City of Alexandria, Virginia, Carr Homes, Inc.

2000 Assistant Archeologist. Data Recovery, Bailey's Farm (44SP228), Chancellorsville, Spotsylvania County, Virginia, County of Spotsylvania.

2000 Assistant Archeologist. Phase I Archeological Investigations of the Proposed Rewatered Turning Basin, Crescent Lawn Archeological District (18AG227), Cumberland, Allegany County, Maryland. United States Corps of Engineers Baltimore, Baltimore District, Baltimore, Maryland.

2000 Assistant Archeologist. Phase I Archeological Investigation NAN-3 and PTB-2 Wetland Mitigation Areas Charles County, Maryland. Maryland Department of Transportation, State Highway Administration.

1999 Assistant Archeologist. Data Recovery, Lot 12, Square 406, Washington, DC. General Services Administration and Architrave.

1999 Assistant Archeologist. Phase II Archeological Investigations Crescent Lawn Park, in Cumberland, Allegany County, Maryland. Maryland Department of Transportation, State Highway Administration.

1998 Archeological Technician. Data Recovery Maryland Route 36 in Lonaconing, Allegany County, Maryland. Maryland Department of Transportation, State Highway Administration.

1997 Assistant Field Supervisor. Data Recovery Investigations at South Strabane Site, Washington County, Pennsylvania. Indiana University of Pennsylvania, Archeological Services.

1996 Archeological Technician. Data Recovery at the National Museum of the American Indian Mall Museum Site, Washington, D.C. Venturi, Scott Brown and Associates, Inc., and the Smithsonian Institution, Office of Design and Construction.

1995 Crew Chief, Field Technician. Data Recovery Archeological Investigations, Route 219 Bypass, Somerset County, Pennsylvania. Greenhorne and O'mera, Inc.

1994 Archeological Technician. Archeological Investigations at Fort McHenry National Monument and Historic Shrine, Baltimore, Maryland. National Park Service, Mid-Atlantic Regional Office.

1993 Archeological Technician. Phase II Archeological Iinvestigations in Selinsgrove, Snyder County, Pennsylvania. Pennsylvania Department of Transportation, State Highway Administration.

1992 Archeological Technician. Data Recovery Investigations in Simpsonville, Howard County, Maryland. Maryland Department of Transportation, State Highway Administration.

1991 Crew Member. Crooked Creek Drainage Research Project, Armstrong County, Pennsylvania. Indiana University of Pennsylvania, Archeological Services.

1990 Crew Member. Data Recovery Investigations, Bedford County Airport, Bedford, Pennsylvania. Indiana University of Pennsylvania, Archeological Services.

CULTURAL RESOURCES REPORTS

Co-author of more than ten (10) cultural resources reports.

Appendix IV:

Cultural Resources Files and Library User Registration and Research Record Form

West Virginia State Historic Preservation Office

Cultural Resources Files and Library
User Registration and Research Record Form

INSTRUCTIONS: Part I must be completed before you will be permitted access to the SHPO Cultural Resource Files and Library. Part II is a record of the site files, cultural resource reports, USGS topographic maps and other materials you utilize during your visit. Part III will be completed and signed by a SHPO staff member only when you have completed your research and have returned the materials to which you have been given access.

I. IDENTIFICATION

DATE: 7/31/06

Name (s) Sandy Stevens

Organization or Company: John Milner Asso.

Address: 429 S. 2nd St.

Louisville, KY Phone 502 587 8800

FR Number (if known)

II MATERIALS UTILIZED

ARCHAEOLOGY:

USGS QUAD MAP NAMES:

Rainelle Nettie

Corliss

Quinwood

ARCHAEOLOGY SITE FORM #s

46 NI 520

46 NI 12

CRM Reports/Publications

01-817 (Not Found)

SURVEY AND NATIONAL REGISTER:

County Survey Files Yes

National Register Files Yes – Not Applicable

Other Materials

Historic 15' Quads

Meadow Creek Winona

Richwood

III MATERIALS RETURNED IN GOOD ORDER

DATE: 7/31/06 # Photocopies _____ $ 6.00

USER NAME: Sandy Stevens

SHPO STAFF SIGNATURE: _____

(Signature assures that materials have been returned to file)

Appendix H
Economic Impact Report

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Economic Impact of Western Greenbrier Co-Generation Facility

Prepared By

Randall A. Childs

Community & Economic Development Consultants, Inc.

June 2005

Appendix H

Appendix H

Introduction

This report summarizes the economic impact associated with the construction, demonstration phase, and operation of the proposed Western Greenbrier Co-Generation facility. The economic impact analysis and associated report were produced by Randall A. Childs. Randall is a principal of Community & Economic Development Consultants, Inc. (CEDCON) and works as an economist in the West Virginia University Bureau of Business and Economic Research. Randall has conducted numerous impact studies both through his work at WVU and CEDCON. These projects have included studies on power generation facilities, coal mines, the forest industry, the steel industry, The Greenbrier, housing, and travel and tourism, to name a few.

The proposed Western Greenbrier Co-Generation plant is a 92mw waste-coal fired generation plant. Preliminary design, permit applications, EIS, etc. began in 2004 and will be completed in 2005. The detailed design and construction will begin in 2006 and end in 2008. Startup and testing of the facility will take place in 2008, while the demonstration phase and preparation for full commercial operation will conclude in 2009 at which time full commercial operation of the plant will begin.

Methodology

The economic impact estimates provided in this report were estimated using data provided by Western Greenbrier Co-Generation, LLC on the expenditures during the construction, demonstration, and operational phases of the project, along with the IMPLAN economic impact model for the state of West Virginia. IMPLAN[1] is a widely accepted economic impact model that is used by consultants, universities, and government agencies across the country. The methodology used in this report provides conservative estimates of the economic impacts and, thus should be considered the lower bound of the true impacts. The realized impacts from the proposed facility may be more than the impacts estimated for this report.

Economic Impacts

Construction Phases

The construction of the waste-coal fired generation plant will create the largest impact during the overall project, albeit a one-time impact that will take place during the construction phases of the project. The total impact of the construction of the facility on the West Virginia economy will be $355.8 million in business volume or sales (Table 1).

[1] IMPLAN is a product of Minnesota IMPLAN Group, Inc. Information about IMPLAN can be found at www.implan.com.

Table 1
Economic Impact of Construction of Western Greenbrier Co-Generation Plant
West Virginia Economy

Type of Impact	Direct Impact	Indirect and Induced Impact	Total Impact
Business Volume (Sales, $millions)	284.0	71.8	355.8
Employment (Job-Years)	433	604	1,037
Employee Compensation ($millions)	31.8	13.6	45.4
Assorted State Taxes	$2,014,000	$911,000	$2,925,000

Notes: Employment is reported in job-years. 100 job-years is equivalent to 200 jobs for 6 months or 50 jobs. for 2 years. Totals may not sum due to rounding. Assorted state taxes include consumer sales taxes, personal income taxes, corporate net income taxes, and business franchise taxes.

This increased economic activity will result in over 1000 job-years. Job-years is used for the construction impacts since construction activity spans several years. Employment will vary during the construction phases, but is expected to average 185 construction employees during the 27 months of the main construction. Businesses employing these construction workers will spend $45.4 million in employee compensation during the construction of the facility. Direct employee compensation of the construction employees will be in excess of $70,000 per employee. Assorted state taxes will be nearly $3 million dollars.

There will also be additional impacts during the construction phases that are not captured in Table 1. These additional impacts are the result of expenditures in preparation for the operation of the facility. These additional expenditures will result in a $7.6 million impact on the state economy.

Demonstration Phase

The next phase of the project is the demonstration phase and is expected to begin in mid-2008 and conclude in 2009. The demonstration phase will generate $27.0 million of business volume (sales/revenues) during the year long demonstration (Table 2). The resulting economic activity will generate 202 new jobs and $8.0 million in employee compensation. The state will realize additional assorted state taxes of nearly one-half million dollars during the demonstration phase of the project.

Table 2
Economic Impact of Demonstration of Western Greenbrier Co-Generation Plant
West Virginia Economy

Type of Impact	Direct Impact	Indirect and Induced Impact	Total Impact
Business Volume (Sales, $millions)	15.2	11.8	27.0
Employment (Jobs)	109	93	202
Employee Compensation ($millions)	5.8	2.2	8.0
Assorted State Taxes	$361,000	$129,000	$490,000

Notes: Employment is reported as annual average jobs. Totals may not sum due to rounding. Assorted state taxes include consumer sales taxes, personal income taxes, corporate net income taxes, and business franchise taxes.

Full Commercial Operation

While the construction phases appear to generate the most significant impacts of the project, the continued operation of the facility will have the largest impact on the state. The impacts presented here, unlike the construction impacts, are annual impacts that occur each year that the facility is in operation.

The Western Greenbrier Co-Generation Plant is expected to employ 109 direct employees with annual employee compensation of more than $54,000 per employee. The expenditures from the operation of the facility, the monies spent by the employees, and the resulting expenditures that occur in the economy through the multiplier effect will generate $28.3 million in business volume each year. This will create 114 additional jobs in supporting industries for a total employment impact of 223 jobs. Businesses will spend $8.2 million annually on employee compensation for these employees and the state will receive in excess of $500,000 in assorted state taxes each year.

Table 3
Economic Impact of Operation of Western Greenbrier Co-Generation Plant
West Virginia Economy

Type of Impact	Direct Impact	Indirect and Induced Impact	Total Impact
Business Volume (Sales, $millions)	16.0	12.3	28.3
Employment (Jobs)	109	114	223
Employee Compensation ($millions)	5.9	2.3	8.2
Assorted State Taxes	$370,000	$134,000	$504,000

Notes: Employment is reported as annual average jobs. Totals may not sum due to rounding. Assorted state taxes include consumer sales taxes, personal income taxes, corporate net income taxes, and business franchise taxes.

Appendix A - Impact Definitions

Assorted State Taxes:	West Virginia state revenues from consumer sales tax, personal income tax, corporate net income tax, and business franchise tax.
Business Volume:	Sales plus net increase in finished inventories and the value of intra-corporate shipments. Equals output (see below) plus the cost of goods sold in retail and wholesale trade.
Employment:	The number of jobs in a business, industry, or region. Also the number of jobs attributable to an impact (see below). This is a measure of the number of full-time and part-time positions, not necessarily the number of employed persons. Annual average by place of work unless otherwise stated.
Employee Compensation:	Wages and salaries plus employers' contribution for social insurance (social security, unemployment insurance, workers compensation, etc.) and other labor income (pension contributions, health benefits, etc.). By place of work unless otherwise stated.
Impacts:	The results of the recirculation of funds throughout a regional economy due to the activity of a business, industry, or institution. Estimated by tracing back the flow of money through the initial businesses' employees and suppliers, the businesses selling to the employees and suppliers, and so on. Thus, they are a way to examine the distribution of industries and resources covered in the costs of the initial activity.
Output:	For most sectors, measured as sales plus net inventories and the value of intra-corporate shipments. For retail and wholesale trade, measured as gross margins (i.e. mark-ups on goods sold).

Appendix I
Human Health Risk Assessment*

**** Since publication of the Draft EIS, the health risk analysis has been revised based on updated project data (revised tables are included; original tables have been left in this appendix for the Final EIS, so that the reader may easily compare values between the original and updated results).***

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Health Risk Analysis

The various activities anticipated at the proposed Western Greenbrier co-generation power plant in Rainelle, Greenbrier County, West Virginia, that will result in the release of chemicals, directly or indirectly, in the area surrounding the proposed site. Specifically, operation of the power plant will result in the release of chemicals that are products of fuel combustion. Additionally, fugitive emissions are anticipated to result from a small portion of the volatile fraction of the coal and waste coal (gob) stream being released to the atmosphere during receiving, storage, and handling activities.

Estimation of Media Concentrations

Chemicals of potential concern (COPC) that are anticipated to be present in stack and fugitive emissions at the proposed site will be dispersed in air and deposited at varying rates into different environmental media such as land, surface water, and vegetation. Additionally, deposited constituents may accumulate in animal tissue as a result of feeding activities. In order to estimate potential human exposures to these constituents, it is necessary to quantify the environmental concentrations of each constituent of concern at the points where exposure is likely to occur. The degree to which a constituent may dissipate or accumulate in a specific environmental medium is dictated by its physical and constituent properties as well as local terrain and meteorological conditions.

Not all constituents emitted from the proposed power plant will persist through each complete pathway. For example, all of the constituents selected for evaluation are transferred in air (alone or adsorbed onto particles) and may be available to a receptor via inhalation. However, only a subset of the selected constituents will be present in soil, dust, water, etc. In addition, some constituents are likely to partition into the fatty compartments of the body, whereas others are not. Subsequently, constituents selected for evaluation were assessed for completion of each exposure pathway.

Human Exposure Scenario Identification

For a chemical exposure to occur at any site, the following conditions must be met: (1) source, (2) release mechanism, (3) migration pathway, (4) exposure route, and (5) receptor population. Consequently, there is no unacceptable carcinogenic risk (or non-carcinogen hazard) if either a chemical-specific (toxic) effect or exposure is not present. It is clear that human receptors may come into contact with COPC emitted to the atmosphere from the proposed power plant (i.e., stack and fugitive emissions) via two primary exposure routes – either directly through inhalation or indirectly as a result of subsequent ingestion of water, soil, vegetation, and animal tissue that become contaminated by COPC through the food chain (U.S. EPA, 1998a).

Evaluation of human health risks associated with exposure to air emissions from combustion facilities requires an assessment of ground-level ambient air concentrations of vapors and

particulates, annual wet and dry deposition rates for particulates, and annual wet and dry deposition rates for vapors within the area of concern. Additionally, mass balance equations must be employed that account for the degradation, transformation, and release processes that will ultimately influence the partitioning of COPC among solids (sediment or soil particles), water, and air (U.S. EPA, 2003a).

The modeling effort for this risk assessment considered four environmental transport pathways. Specifically, the models used in the characterization follow anticipated point source emissions (from the stack of the proposed power plant) as well as non-point source fugitive emissions resulting from various activities at the facility to the atmosphere, watershed, subsurface (i.e., vadose zone and aquifer), and surface water.

Chemicals in the various media are subject to various fate processes that can influence the concentration as well as the toxicity of the constituent. The fate processes that were considered in the risk characterization portion of the EIS include:

- Chemical/biological transformation (and associated products)
- Linear partitioning (e.g., water/air, water/soil, air/plant, water/biota)
- Nonlinear partitioning (e.g., metals in the vadose zone)
- Chemical reactions/speciation (e.g., mercury in surface water)

The fate and transport models used in the risk assessment were based on those in the U.S. EPA *Methodology for Assessing Health Risks Associated With Multiple Pathways of Exposure to Combustor Emissions* (U.S. EPA, 1998a), the U.S. EPA *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (U.S. EPA, 1998b) and subsequent correction to the Protocol (U.S. EPA, 1999b).

COPC Contact Rate

The predictive approach to exposure assessment is the method that is used most commonly to support U.S. EPA risk assessments and risk-based regulatory decisions for chemical agents of concern. Estimates based on this approach require information based on output from chemical transport modeling, transformations resulting from environmental fate processes, and knowledge of activities that bring the receptor in contact with the chemicals. This type of assessment can be used for all of the principal exposure routes (i.e., ingestion, inhalation, and dermal absorption) and environmental settings (i.e., occupational and residential environments, recreational activities, outdoor ambient air, indoor air, and consumption of foods and drinking water). An exposure assessment quantifies the magnitude, duration, and routes of exposure to chemicals and characterizes and enumerates the exposed populations.

Oftentimes, adequate empirical data are not readily available to develop and validate credible predictive techniques for some exposure scenarios. Consequently, analysts may resort to the use of federally or state ascribed default assumptions for exposure parameters (i.e., the individual variables that comprise an exposure algorithm and jointly

determine the value of the exposure estimate) and scenarios (the conditions under which exposure takes place).

Considerations that were given to the various exposure pathways in this risk assessment are described below.

Air Exposure Pathway –

Receptors will be exposed directly to COPC in vapor, particulate, and particle-bound phases as a result of normal inhalation (U.S. EPA, 1998b). Exposure from vapor and particulate inhalation are affected by vapor and particulate COPC concentrations, respiration rate during the period of exposure, and exposure length.

Food Exposure Pathways –

Plants and animals may be impacted by emission sources via direct uptake of COPC from air or from COPC deposited in soil. Consequently, humans may be exposed to COPC via the food chain when the plants and animal tissue are consumed. The amount of COPC exposure through this pathway is a function of the types of food consumed, amount of food consumed per day, concentration of COPC in the food, and percentage of the diet contaminated by COPC (U.S. EPA, 1998b).

Soil Exposure Pathways –

Children and adults may be exposed to COPC in soil as a result of incidental ingestion of soil that has adhered to their hands. COPC exposure via this route is influenced by soil concentration, rate of soil ingestion during the time of exposure, and length of time spent in the vicinity of the contaminated soil (U.S. EPA, 1998b).

Water Exposure Pathways –

Surface water (i.e., river/stream, lake, farm pond) or collected precipitation (e.g., cistern) that is used as a drinking water source will introduce water ingestion as a possible exposure pathway (U.S. EPA, 1998b). Additionally, recreational and/or subsistence fishing activities, with subsequent use of the fish and crustaceans as a food source, make the food chain an important route of exposure for communities that have surface water bodies in the vicinity of a combustion unit.

Exposure Scenarios

In the interest of conservatism, the following receptors and pathways were considered for the risk assessment:

- Resident/Home Gardener (adult and child)
  - Consumption of homegrown produce;
  - Consumption of locally raised beef, milk, pork, chicken and eggs;
  - Incidental soil ingestion;
  - Direct inhalation of vapors and particulates.
- Subsistence Farmer (adult and child)
  - Consumption of farm-produced beef and milk;
  - Consumption of homegrown produce;
  - Consumption of farm-produced pork, chicken and eggs;
  - Incidental soil ingestion;
  - Direct inhalation of vapors and particulates.
- Nursing Infant
  - Exposure to dioxin in mother's milk for all exposure scenarios.
- Subsistence Fisher (adult and child)
  - Consumption of homegrown produce;
  - Consumption of locally raised beef, milk, pork, chicken and eggs;
  - Incidental soil ingestion;
  - Direct inhalation of vapors and particulates;
  - Consumption of fish from specific waterbodies.
- School/Day Care Child
  - Incidental soil ingestion;
  - Direct inhalation of vapors and particulates.
- Hospital Patient/Extended Care Resident
  - Direct inhalation of vapors and particulates.

A scenario that considers workers who might work at the proposed power plant and live within the study area is not required in any of the guidance relative to performing screening-level risk analyses of facilities that burn hazardous waste. Additionally, individuals characterized in that scenario would be expected to spend only a portion of time at one location within the study area and may exit the study area for significant lengths of time.

Each of the receptors was evaluated using average baghouse outlet emissions of chemicals that were measured during the Pilot-Scale Boiler Emissions Test conducted by TRC Environmental Corporation on September 17, 2004, as well as U.S. Environmental Protection Agency AP-42 Series emission factors for other chemicals that are also associated with anthracite coal combustors.

An important part of the exposure assessment is the identification of subgroups, within the potentially exposed population of the study area. It is assumed that the exposure of each receptor can be represented using exposure factors that reflect patterns of behavior and activity representative of the receptor sub-group.

The use of the subsistence farmer, resident/home gardener, nursing infant, subsistence fisher, and sensitive sub-population (i.e., student/day care child and hospital patient/extended care resident) scenarios represent a conservative approach. The assumptions used in each scenario to calculate the estimated exposures to these receptors are expected to be the highest exposures found. These receptors were chosen to be the most conservative for individuals living in the area of the proposed power plant; so that if found to be within acceptable U.S. EPA guideline values, then the potential for exposure to the remaining population would be much lower. The exposure assumptions for each of the receptor types are described below.

Resident/Home Gardener (adult and child) –

The resident/home gardener is exposed via consumption of locally grown vegetables; locally raised beef, pork, chicken, and eggs (average contamination from a 20-km^2 area); incidental soil ingestion; and direct inhalation of vapors and particles. The primary difference between the typical resident/home gardener and a typical farmer is the difference in soil concentration based on the different exposure duration. Soil ingestion and direct air inhalation is based on average concentrations close to the receptor location.

Subsistence Farmer (adult and child) –

A subsistence farmer is a farmer who is assumed to raise cattle for both beef and milk consumption and grows produce for home consumption. In addition, the subsistence farmer is exposed via consumption of farm-raised pork, chicken, and eggs. The fraction of contaminated beef, milk, pork, chicken, eggs, and produce consumed by the subsistence farmer is assumed to be one. That is, a subsistence farmer would be a farmer who derives 100-percent of the food consumed from their own farm. Soil ingestion and direct air inhalation are based on conditions close to the receptor location.

Nursing Infant (all scenarios) –

The presence of compounds in mothers' milk provides an exposure pathway to infants,

who constitute a sensitive subpopulation. Concentrations of dioxins in the breast milk was estimated based on the maternal dietary intake of soil, vegetation, beef, dairy, pork, poultry, and eggs, as well as inhalation of ambient air. This approach was used to characterize exposure of infants to dioxins in breast milk.

Subsistence Fisher (adult and child) –

The subsistence fisher is exposed via consumption of contaminated fish and homegrown produce, incidental soil ingestion, and direct inhalation of vapors and particles. The fraction of contaminated fish and produce consumed by the subsistence fisher is assumed to be 100%. As a conservative measure, the subsistence fisher is also assumed to eat locally raised beef, pork, chicken, and eggs (average contamination from a 20-km^2 area). Soil ingestion and direct air inhalation is based on concentrations close to the receptor location.

Exposure Routes

The three primary exposure routes generally considered in human health risk assessments include inhalation, ingestion, and dermal absorption. Primary exposure routes, representing both direct and indirect pathways of exposure were considered in the risk assessment for the proposed power plant. These routes and associated pathways include:

- Inhalation of air;
- Ingestion of soil;
- Ingestion of locally-grown and home-grown produce;
- Ingestion of farm-produced beef and milk, pork, chicken, and eggs;
- Ingestion of locally-raised beef and milk, pork, chicken, and eggs;
- Ingestion of surface water;
- Ingestion of locally-caught fish; and
- Ingestion of mothers' breast milk by infants.

U.S. EPA has concluded that the potential for groundwater to become contaminated from combustor stack emissions by this pathway is limited, and that further evaluation of this pathway is unnecessary in risk assessments for combustor facilities (U.S. EPA, 1998b).

The dermal absorption route of exposure (from soil or water) was not considered for the purpose of this risk assessment because available data indicate that the contribution of dermal exposure to soils to overall risk is typically small (U.S. EPA, 1998b).

Human Health Risk and Hazard Characterization

The objective of the risk characterization portion of the risk assessment is to evaluate the potential health impacts of exposure to the constituents of emissions released into the environment by the proposed power plant. Risk characterization is the final step of the risk assessment process. In this step, cancer and non-cancer toxicity values for the COPC found in stack and fugitive emissions are examined in conjunction with estimated exposure doses corresponding to the receptor scenarios: resident/home gardener (adult and child), subsistence farmer (adult and child), nursing infant (all scenarios), subsistence fisher, school/day care child, and hospital patient/extended care resident. Total lifetime cancer risks and non-cancer hazards associated with direct and indirect exposures to constituents of the facility emissions will be compared with values considered acceptable by U.S. EPA.

Of special note is the method by which infant exposure to dioxin in mothers' breast milk will be assessed. The presence of compounds in mothers' milk provides an exposure pathway to infants, who constitute a sensitive subpopulation. The concentration of a constituent in breast milk is based on the maternal dietary intake of soil, vegetation, beef, dairy, pork, poultry, and eggs, as well as inhalation of air. However, because of the contracted exposure duration (i.e., one year) of the infant, "risk" to the infant was not calculated in the same fashion as for older children and adults. The nursing infant scenario evaluated exposure to dioxins in its mother's breast milk during a nursing period of one year. The exposure to an infant was compared to 50 pg/kg/day (5.0×10^{-8} mg/kg/day) established by U.S. EPA *Estimating Exposure to Dioxin-Like Compounds. Volume II: Properties, Sources, Occurrences, and Background Exposures, EPA/600/6-88/005Cb* (U.S. EPA, 1994).

U.S. EPA guidelines were followed in characterizing the health risks for carcinogenic constituents of stack and fugitive emissions from the proposed power plant. Cancer risks were calculated by multiplying lifetime average daily doses (LADD) by the respective chemical- and pathway-specific cancer slope factors (CSF). To account for exposures to multiple COPC it was assumed that cancer risks are additive (U.S. EPA, *The Risk Assessment Guidelines of 1999*). Pathway-specific risks were calculated by summing the cancer risk estimates of the individual COPC relevant to each pathway. Individuals might also be exposed to a given COPC or a combination of COPC through several pathways. In order to account for risks resulting from multipathway exposures, the total cancer risks for different receptor scenarios were calculated by summing the risks for all carcinogenic COPC across appropriate routes of exposure.

Non-cancer impacts on human health were evaluated by comparing projected or estimated daily constituent intakes with reference levels for each COPC. Reference doses (RfD) and reference concentrations (RfC) represent, respectively, estimated daily oral or inhalation exposure levels not expected to result in any adverse health effects in persons exposed over their entire lifetimes. Margins of safety are incorporated into the derivation of RfD and RfC values. Even sensitive subpopulations (such as children and the aged) should be protected when exposed to a given COPC at levels as high as the RfD

or RfC. RfD values are expressed in units of milligrams (mg) compound per kilogram (kg) body weight per day. RfC values are expressed in units of mg compound per cubic meter (m^3) of air. RfC values may be compared directly to exposure concentrations in air because human exposure characteristics (i.e., inhalation rate of 20 m^3/day and average adult male body weight of 70 kg) have been incorporated into their derivation.

The ratio of an exposure dose (or concentration) to the RfD (or RfC) is called the hazard quotient (HQ). A HQ of one or below is considered by the U.S. EPA to be protective of human health. For example, if the HQ is 0.01 (1×10^{-2}) then the calculated dose is 100 times less than the RfD or RfC and expected to safeguard the health of even the most sensitive members of the population. It should be noted that the RfD and RfC are not actual thresholds for adverse effects; therefore ratios greater than one do not necessarily indicate a non-cancer hazard. In fact, in some cases, depending on the substance being evaluated, a dose that is more than an order of magnitude greater than the RfD or RfC may not lead to adverse health effects.

A hazard index (HI) is used to assess the overall potential for non-cancer effects posed by combined constituent exposures (U.S. EPA, 1989). The HI is often calculated for those constituents that affect the same target organ (e.g., liver, nervous system, etc.) and is equal to the sum of the respective HQ for those constituents.

Risk Characterization Results

The total carcinogenic risks and non-carcinogenic hazards anticipated for the various receptors in the vicinity of the proposed power plant are as follows:

Receptor	Total Risk* (cancer)	Hazard Index* (non-cancer)
Resident/Home Gardener		
Adult	***0.00076x10^{-4}***	***0.01972***
Child	***0.00023x10^{-4}***	***0.02347***
Subsistence Farmer		
Adult	***0.0002x10^{-4}***	***0.00043***
Child	***0.000051x10^{-4}***	***0.00063***
Subsistence Fisher		
Adult	***0.0011x10^{-4}***	***0.00269***
Child	***0.00035x10^{-4}***	***0.00381***
School/Day Care Child	***0.000019x10^{-4}***	***0.0002***
Hospital Patient/Extended Care Resident	***0.0000016x10^{-4}***	***0.0000002***
U.S. EPA Criteria (Acceptable Risk Defined as Less Than)	1 x 10^{-4}	1.0

**** Values were updated because of new modeling efforts based on updated project data.***

The anticipated risks for all receptors are orders of magnitude lower than the acceptable range of 10^{-4} to 10^{-6}. Likewise, for non-carcinogens, the anticipated hazard indices are orders of magnitude below 1. The chemical-specific risks and hazards for each receptor are presented in this appendix.

Risk Assessment References

US EPA (1989). *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Interim Final*. EPA/540/1-89/002. Office of Emergency and Remedial Response. Washington, DC, 1989.

US EPA (1994). *Estimating Exposure to Dioxin-Like Compounds Vol.ume II: Properties, Sources, Occurrence and Background Exposure*. EPA/600/6-88/005Cb. Office of Research and Development. Washington DC.

U.S. EPA (1998a). *Methodology for Assessing Health Risks Associated With Multiple Pathways of Exposure to Combustor Emissions.* EPA600/R-98/137. National Center for Environmental Assessment. Cincinnati, OH. Update to EPA/600/6-90/003, *Methodology for Assessing Health Risks Associated With Indirect Exposure to Combustor Emissions*.

U.S. EPA (1998b). *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*. EPA530-D-98-001A. Office of Solid Waste and Emergency Response. Peer Review Draft, July 1998.

U.S. EPA (1999a). *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities*. EPA530-D-99-001A. Office of Solid Waste and Emergency Response. Peer Review Draft, August 1999.

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U.S. EPA (1999c). *Guidelines for Carcinogen Risk Assessment*. NCEA-F-0644. Risk Assessment Forum. Washington, DC. Review Draft, July 1999.

US EPA (2003a). *Multimedia, Multipathway, and Multireceptor Risk Assessment (3MRA) Modeling System. Volume I: Modeling System and Science.* EPA530-D-03-001a. Office of Research and Development and Office of Solid Waste. Washington, DC. SAB Review Draft, July 2003.

Table 1. Risk Analysis - Resident Home Gardener (Location: L4 (Rainelle Downtown))

	Total Daily Intake						Total Risk				Total Hazard			
	Carcinogen Total Daily Intake		Noncarcinogen Total Daily Intake		Total Daily Inhalation		Total Risk		Inhalation Risk		Total Hazard		Inhalation Hazard	
Chemical	Resident/Home Gardener Adult (mg/kg-day) IAR	Resident/Home Gardener Child (mg/kg-day) ICR	Resident/Home Gardener Adult (mg/kg-day) IARn	Resident/Home Gardener Child (mg/kg-day) ICRn	Resident/Home Gardener Adult (mg/kg-day) ADIa	Resident/Home Gardener Child (mg/kg-day) ADIc	Resident/Home Gardener Adult	Resident/Home Gardener Child	Resident/Home Gardener Adult	Resident/Home Gardener Child	Resident/Home Gardener Adult	Resident/Home Gardener Child	Resident/Home Gardener Adult	Resident/Home Gardener Child
PCDD/PCDF														
2,3,7,8-Tetrachlorodibenzodioxin	5.15E-14	4.03E-14	5.15E-14	4.03E-14	4.49E-18	2.00E-18	3.2E-09	5.0E-10	6.7E-13	3.0E-13				
Volatiles														
Acetaldehyde	2.35E-07	3.22E-07	2.35E-07	3.22E-07	7.98E-09	3.55E-09			6.1E-11	2.7E-11				
Acetone	2.01E-11	2.75E-11	2.01E-11	2.75E-11	9.03E-12	4.01E-12					2.14E-11	2.64E-11	1.00E-11	4.01E-12
Acetophenone	5.28E-10	7.31E-10	5.28E-10	7.31E-10	2.15E-10	9.54E-11					5.06E-09	7.01E-10	2.15E-09	9.54E-11
Acrolein	2.18E-08	3.22E-08	2.18E-08	3.22E-08	4.06E-09	1.80E-09					4.17E-05	6.18E-05	8.12E-06	3.61E-06
Benzene	1.29E-11	1.81E-11	1.29E-11	1.81E-11	4.25E-12	1.89E-12	2.9E-13	8.2E-14	1.1E-13	5.1E-14	3.10E-09	4.34E-09	1.06E-09	4.72E-10
Benzyl chloride	2.82E-08	4.29E-08	2.82E-08	4.29E-08	9.79E-09	4.35E-09	2.0E-09	6.0E-10			1.35E-05	2.06E-05	4.90E-06	2.18E-06
Carbon disulfide	2.19E-11	2.99E-11	2.19E-11	2.99E-11	1.44E-12	6.39E-13					2.10E-10	2.87E-10	1.44E-11	6.39E-12
Chlorobenzene	1.45E-09	1.99E-09	1.45E-09	1.99E-09	3.11E-10	1.38E-10					6.94E-08	9.55E-09	1.56E-08	6.92E-10
Chloroform	6.26E-12	9.32E-12	6.26E-12	9.32E-12	9.01E-13	4.00E-13			7.3E-14	3.2E-14	6.00E-10	8.93E-10	9.01E-11	4.00E-11
Cumene	6.74E-11	8.47E-11	6.74E-11	8.47E-11	7.52E-11	3.34E-11					6.46E-10	2.03E-10	7.52E-10	8.35E-11
Ethylbenzene	7.08E-10	1.04E-09	7.08E-10	1.04E-09	1.32E-09	5.87E-10					6.79E-09	9.10E-09	1.32E-08	5.34E-09
Ethyl Chloride (chloroethane)	2.00E-10	2.71E-10	2.00E-10	2.71E-10	5.91E-10	2.62E-10	2.4E-13	6.5E-14			4.80E-10	6.50E-10	1.48E-09	6.56E-10
Ethylene dichloride (I,2-dichloroethane)	8.68E-10	1.35E-09	8.68E-10	1.35E-09	5.58E-10	2.48E-10	7.1E-10	2.2E-10	1.1E-09	5.0E-10	9.25E-08	1.44E-07	6.20E-08	2.76E-08
Ethylene dibromide (I,2-dibromoethane)	2.77E-11	3.82E-11	2.77E-11	3.82E-11	2.15E-11	9.54E-12	1.0E-12	2.9E-13	2.0E-12	8.7E-13	1.33E-09	1.83E-09	1.07E-09	4.77E-10
Freon 11 (trichlorofluoromethane)	4.64E-12	6.57E-12	4.64E-12	6.57E-12	7.55E-13	3.35E-13					1.48E-11	9.00E-12	2.52E-12	4.79E-13
Freon 12 (dichlorodifluoromethane)	1.19E-11	1.66E-11	1.19E-11	1.66E-11	2.36E-12	1.05E-12					5.69E-11	1.77E-11	1.18E-11	1.17E-12
Hexane	3.43E-11	4.60E-11	3.43E-11	4.60E-11	4.53E-12	2.01E-12					2.99E-12	7.35E-11	4.12E-13	3.36E-12
Methyl bromide (bromomethane)	1.81E-08	2.49E-08	1.81E-08	2.49E-08	2.24E-09	9.97E-10					1.24E-05	4.77E-06	1.60E-06	1.99E-07
Methyl chloride (chloromethane)	4.83E-12	6.64E-12	4.83E-12	6.64E-12	5.27E-13	2.34E-13								
Methylene chloride	1.66E-07	2.61E-07	1.66E-07	2.61E-07	5.45E-09	2.42E-09	5.1E-10	1.6E-10	9.0E-12	4.0E-12	2.66E-06	3.13E-06	9.09E-08	3.03E-08
Methyl ethyl ketone (2-butanone)	2.35E-09	3.26E-09	2.35E-09	3.26E-09	2.79E-10	1.24E-10					3.76E-09	5.22E-09	4.65E-10	2.07E-10
Methyl methacrylate	4.47E-09	6.14E-09	4.47E-09	6.14E-09	4.94E-10	2.20E-10					3.06E-09	9.81E-08	3.53E-10	3.66E-09
Methyl tert butyl ether	1.17E-10	1.63E-10	1.17E-10	1.63E-10	1.59E-11	7.06E-12	1.9E-13	5.4E-14						
Styrene	1.52E-09	2.05E-09	1.52E-09	2.05E-09	6.01E-10	2.67E-10					7.28E-09	1.97E-08	3.01E-09	2.67E-09
Tetrachloroethene	3.91E-11	5.35E-11	3.91E-11	5.35E-11	4.08E-12	1.81E-12	8.7E-12	2.4E-12	8.2E-14	3.6E-14	3.75E-09	2.57E-11	4.08E-10	9.07E-13
Toluene	7.34E-10	1.00E-09	7.34E-10	1.00E-09	2.79E-10	1.24E-10					3.52E-09	4.82E-09	1.40E-09	6.20E-10
1,1,1-Trichloroethane	2.28E-09	3.12E-09	2.28E-09	3.12E-09	3.54E-10	1.57E-10					7.82E-09	2.99E-09	1.27E-09	1.57E-10
Vinyl acetate	4.89E-08	7.55E-08	4.89E-08	7.55E-08	5.15E-10	2.29E-10					4.69E-08	7.24E-08	5.15E-10	2.29E-10
Xylenes	3.66E-12	5.52E-12	3.66E-12	5.52E-12	1.07E-10	4.77E-11					1.76E-11	2.65E-11	5.37E-10	2.39E-10
Semi-Volatiles														
Benzo(a)pyrene (equivalents)	7.29E-09	8.04E-09	7.29E-09	8.04E-09	1.55E-12	6.87E-13	2.2E-08	4.8E-09	4.8E-12	2.1E-12				
Bis(2-ethylhexyl)phthalate	2.00E-06	3.43E-06	2.00E-06	3.43E-06	1.02E-09	4.53E-10	1.2E-08	3.9E-09			9.60E-05	1.64E-04	5.10E-08	2.27E-08
Bromoform	5.21E-10	7.28E-10	5.21E-10	7.28E-10	5.48E-10	2.43E-10	1.7E-12	4.7E-13	2.1E-12	9.5E-13	2.50E-08	3.49E-09	2.74E-08	1.22E-09
2,4-Dinitrotoluene	4.03E-10	5.84E-10	4.03E-10	5.84E-10	4.90E-12	2.18E-12					1.93E-07	2.80E-07	2.45E-09	1.09E-09
Formaldehyde	1.57E-06	2.20E-06	1.57E-06	2.20E-06	3.36E-09	1.49E-09			1.5E-10	6.7E-11	7.54E-06	1.06E-05	1.68E-08	7.47E-09
Isophorone	3.44E-10	5.31E-10	3.44E-10	5.31E-10	8.12E-09	3.61E-09	1.3E-13	4.1E-14			1.65E-09	2.55E-10	4.06E-08	1.80E-09
Phenol	5.10E-10	7.17E-10	5.10E-10	7.17E-10	2.25E-10	1.00E-10					1.63E-09	1.15E-09	7.52E-10	1.67E-10
PCBs														
Polychlorinated biphenyls	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
Inorganics														
Antimony	6.33E-07	5.59E-07	6.34E-07	5.69E-07	1.83E-10	8.12E-11					1.52E-03	2.73E-03	4.57E-07	4.06E-07
Arsenic	8.52E-09	9.06E-09	8.52E-09	9.06E-09	3.98E-12	1.77E-12	5.3E-09	1.1E-09	6.0E-11	2.7E-11	2.72E-05	2.90E-05	1.33E-08	5.89E-09
Beryllium	5.92E-06	4.37E-06	5.92E-06	4.37E-06	2.14E-10	9.53E-11			1.8E-09	8.0E-10	2.84E-03	8.37E-04	1.07E-07	1.91E-08
Cadmium	4.90E-09	3.53E-09	4.91E-09	3.54E-09	1.25E-12	5.54E-13			7.9E-12	3.5E-12	4.70E-06	3.40E-06	1.25E-09	5.54E-10
Chromium VI	1.99E-08	1.76E-08	1.99E-08	1.77E-08	1.37E-11	6.07E-12			5.6E-10	2.5E-10	6.37E-06	8.47E-07	4.55E-09	3.04E-10
Cobalt	2.32E-07	4.37E-07	2.40E-07	5.13E-07	1.03E-09	4.59E-10			1.0E-08	4.5E-09	1.15E-05	2.46E-05	5.16E-08	2.29E-08
Manganese	3.49E-07	7.08E-07	3.60E-07	8.03E-07	5.07E-09	2.26E-09					1.72E-05	5.50E-06	2.54E-07	1.61E-08
Mercury (elemental)	7.55E-10	4.96E-10	7.55E-10	4.96E-10	3.03E-14	1.34E-14								
Nickel	1.16E-05	9.19E-06	1.16E-05	9.19E-06	2.90E-09	1.29E-09					5.56E-04	4.40E-04	1.45E-07	6.44E-08
Selenium	5.28E-05	7.07E-05	5.28E-05	7.07E-05	1.35E-08	5.98E-09					1.01E-02	1.36E-02	2.69E-06	1.20E-06
Acid Gases														
HCl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-07	6.20E-08								
							5.9E-08	**1.8E-08**	**1.4E-08**	**6.2E-09**	**0.01530**	**0.01789**	**0.000019**	**0.000008**

Appendix I (old tables)

Table 2. Risk Analysis - Subsistence Farmer (Location: F1 (Williamsburg))

	Total Daily Intake								Total Risk					Total Hazard				
	Carcinogen Total Daily Intake			Noncarcinogen Total Daily Intake			Total Daily Inhalation		Total Risk			Inhalation Risk		Total Hazard			Inhalation Hazard	
Chemical	Subsistence Farmer Adult (mg/kg-day) IAF	Subsistence Farmer Child (mg/kg-day) ICF	Infant (pg/kg-day) II	Subsistence Farmer Adult (mg/kg-day) IAFn	Subsistence Farmer Child (mg/kg-day) ICFn	Infant (pg/kg-day) II	Subsistence Farmer Adult (mg/kg-day) ADI_{Fa}	Subsistence Farmer Child (mg/kg-day) ADI_{c}	Subsistence Farmer Adult	Subsistence Farmer Child	Infant (mg/day)	Subsistence Farmer Adult	Subsistence Farmer Child	Subsistence Farmer Adult	Subsistence Farmer Child	Infant (mg/day)	Subsistence Farmer Adult	Subsistence Farmer Child
PCDD/PCDF																		
2,3,7,8-Tetrachlorodibenzodioxin	9.02E-15	7.08E-15	0.00029	9.02E-15	7.08E-15	0.00029	1.05E-18	3.49E-19	7.4E-10	8.7E-11	0.00029	1.6E-13	5.2E-14			0.00029		
Volatiles																		
Acetaldehyde	1.65E-07	2.26E-07		1.65E-07	2.26E-07		1.86E-09	6.20E-10				1.4E-11	4.8E-12					
Acetone	1.41E-11	1.93E-11		1.41E-11	1.93E-11		2.11E-12	7.02E-13						1.50E-11	1.85E-11		2.34E-12	7.02E-13
Acetophenone	3.69E-10	5.09E-10		3.69E-10	5.09E-10		5.01E-11	1.67E-11						3.54E-09	4.88E-10		5.01E-10	1.67E-11
Acrolein	1.52E-08	2.25E-08		1.52E-08	2.25E-08		9.47E-10	3.16E-10						2.92E-05	4.32E-05		1.89E-06	6.31E-07
Benzene	9.02E-12	1.26E-11		9.02E-12	1.26E-11		9.92E-13	3.31E-13	2.7E-13	5.7E-14		2.7E-14	8.9E-15	2.16E-09	3.01E-09		2.48E-10	8.27E-11
Benzyl chloride	1.97E-08	3.00E-08		1.97E-08	3.00E-08		2.28E-09	7.62E-10	1.8E-09	4.2E-10				9.46E-06	1.44E-05		1.14E-06	3.81E-07
Carbon disulfide	1.53E-11	2.09E-11		1.53E-11	2.09E-11		3.36E-13	1.12E-13						1.47E-10	2.01E-10		3.36E-12	1.12E-12
Chlorobenzene	9.95E-10	1.37E-09		9.95E-10	1.37E-09		7.27E-11	2.42E-11						4.77E-08	6.55E-09		3.63E-09	1.21E-10
Chloroform	4.37E-12	6.46E-12		4.37E-12	6.46E-12		2.10E-13	7.01E-14				1.7E-14	5.7E-15	4.19E-10	6.20E-10		2.10E-11	7.01E-12
Cumene	3.73E-11	4.98E-11		3.73E-11	4.98E-11		1.75E-11	5.85E-12						3.58E-10	1.19E-10		1.75E-10	1.46E-11
Ethylbenzene	4.41E-10	6.68E-10		4.41E-10	6.68E-10		3.08E-10	1.03E-10						4.23E-09	5.82E-09		3.08E-09	9.34E-10
Ethyl Chloride (chloroethane)	1.13E-10	1.58E-10		1.13E-10	1.58E-10		1.38E-10	4.59E-11	1.8E-13	3.8E-14				2.70E-10	3.80E-10		3.44E-10	1.15E-10
Ethylene dichloride (I,2-dichloroethane)	6.07E-10	9.40E-10		6.07E-10	9.40E-10		1.30E-10	4.34E-11	6.7E-10	1.5E-10		2.6E-10	8.7E-11	6.47E-08	1.00E-07		1.45E-08	4.83E-09
Ethylene dibromide (I,2-dibromoethane)	1.93E-11	2.66E-11		1.93E-11	2.66E-11		5.01E-12	1.67E-12	9.6E-13	2.0E-13		4.6E-13	1.5E-13	9.27E-10	1.27E-09		2.51E-10	8.35E-11
Freon 11 (trichlorofluoromethane)	3.22E-12	4.53E-12		3.22E-12	4.53E-12		1.76E-13	5.87E-14						1.03E-11	6.20E-12		5.87E-13	8.39E-14
Freon 12 (dichlorodifluoromethane)	8.28E-12	1.15E-11		8.28E-12	1.15E-11		5.51E-13	1.84E-13						3.97E-11	1.23E-11		2.76E-12	2.04E-13
Hexane	2.26E-11	3.09E-11		2.26E-11	3.09E-11		1.06E-12	3.52E-13						1.97E-12	4.93E-11		9.61E-14	5.87E-13
Methyl bromide (bromomethane)	1.26E-08	1.74E-08		1.26E-08	1.74E-08		5.24E-10	1.75E-10						8.66E-06	3.34E-06		3.74E-07	3.49E-08
Methyl chloride (chloromethane)	3.38E-12	4.64E-12		3.38E-12	4.64E-12		1.23E-13	4.10E-14										
Methylene chloride	1.16E-07	1.83E-07		1.16E-07	1.83E-07		1.27E-09	4.24E-10	4.8E-10	1.1E-10		2.1E-12	7.0E-13	1.86E-06	2.19E-06		2.12E-08	5.30E-09
Methyl ethyl ketone (2-butanone)	1.65E-09	2.28E-09		1.65E-09	2.28E-09		6.51E-11	2.17E-11						2.63E-09	3.64E-09		1.09E-10	3.62E-11
Methyl methacrylate	3.13E-09	4.29E-09		3.13E-09	4.29E-09		1.15E-10	3.84E-11						2.14E-09	6.86E-08		8.23E-11	6.40E-10
Methyl tert butyl ether	8.20E-11	1.14E-10		8.20E-11	1.14E-10		3.71E-12	1.24E-12	1.8E-13	3.7E-14								
Styrene	1.01E-09	1.37E-09		1.01E-09	1.37E-09		1.40E-10	4.68E-11						4.82E-09	1.31E-08		7.01E-10	4.68E-10
Tetrachloroethene	2.72E-11	3.72E-11		2.72E-11	3.72E-11		9.52E-13	3.17E-13	8.0E-12	1.7E-12		1.9E-14	6.3E-15	2.61E-09	1.78E-11		9.52E-11	1.59E-13
Toluene	5.07E-10	6.94E-10		5.07E-10	6.94E-10		6.51E-11	2.17E-11						2.43E-09	3.33E-09		3.26E-10	1.09E-10
1,1,1-Trichloroethane	1.39E-09	1.91E-09		1.39E-09	1.91E-09		8.27E-11	2.76E-11						4.77E-09	1.83E-09		2.95E-10	2.76E-11
Vinyl acetate	3.42E-08	5.28E-08		3.42E-08	5.28E-08		1.20E-10	4.01E-11						3.28E-08	5.06E-08		1.20E-10	4.01E-11
Xylenes	1.52E-12	2.20E-12		1.52E-12	2.20E-12		2.51E-11	8.35E-12						7.28E-12	1.05E-11		1.25E-10	4.18E-11
Semi-Volatiles																		
Benzo(a)pyrene (equivalents)	1.28E-09	1.41E-09		1.28E-09	1.41E-09		3.61E-13	1.20E-13	5.1E-09	8.5E-10		1.1E-12	3.7E-13					
Bis(2-ethylhexyl)phthalate	6.01E-07	9.50E-07		6.01E-07	9.50E-07		2.38E-10	7.93E-11	4.6E-09	1.1E-09				2.88E-05	4.56E-05		1.19E-08	3.97E-09
Bromoform	3.54E-10	4.93E-10		3.54E-10	4.93E-10		1.28E-10	4.26E-11	1.5E-12	3.2E-13		5.0E-13	1.7E-13	1.70E-08	2.36E-09		6.39E-09	2.13E-10
2,4-Dinitrotoluene	2.82E-10	4.08E-10		2.82E-10	4.08E-10		1.14E-12	3.81E-13						1.35E-07	1.96E-07		5.72E-10	1.91E-10
Formaldehyde	1.10E-06	1.54E-06		1.10E-06	1.54E-06		7.84E-10	2.61E-10				3.5E-11	1.2E-11	5.28E-06	7.39E-06		3.92E-09	1.31E-09
Isophorone	3.30E-11	5.34E-11		3.30E-11	5.34E-11		1.89E-09	6.31E-10	1.7E-14	4.2E-15				1.58E-10	2.56E-11		9.47E-09	3.16E-10
Phenol	3.57E-10	5.01E-10		3.57E-10	5.01E-10		5.26E-11	1.75E-11						1.14E-09	8.00E-10		1.75E-10	2.92E-11
PCBs																		
Polychlorinated biphenyls	0.00E+00	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00										
Inorganics																		
Antimony	1.21E-08	1.31E-08		1.21E-08	1.33E-08		3.77E-11	1.26E-11						2.89E-05	6.35E-05		9.43E-08	6.29E-08
Arsenic	1.16E-10	1.41E-10		1.16E-10	1.41E-10		8.22E-13	2.74E-13	9.5E-11	1.7E-11		1.2E-11	4.1E-12	3.69E-07	4.50E-07		2.74E-09	9.13E-10
Beryllium	6.57E-08	4.88E-08		6.57E-08	4.88E-08		4.43E-11	1.48E-11				3.7E-10	1.2E-10	3.15E-05	9.36E-06		2.21E-08	2.95E-09
Cadmium	2.73E-10	4.12E-10		2.75E-10	4.30E-10		2.58E-13	8.58E-14				1.6E-12	5.4E-13	2.63E-07	4.12E-07		2.58E-10	8.58E-11
Chromium VI	5.69E-08	7.86E-08		5.69E-08	7.88E-08		2.82E-12	9.40E-13				1.2E-10	3.9E-11	1.82E-05	3.78E-06		9.40E-10	4.70E-11
Cobalt	4.87E-09	7.67E-09		4.89E-09	7.84E-09		2.13E-10	7.11E-11				2.1E-09	7.0E-10	2.34E-07	3.76E-07		1.07E-08	3.55E-09
Manganese	1.40E-08	2.23E-08		1.41E-08	2.34E-08		1.05E-09	3.49E-10						6.76E-07	1.60E-07		5.24E-08	2.50E-09
Mercury (elemental)	8.58E-12	5.63E-12		8.58E-12	5.63E-12		6.25E-15	2.08E-15										
Nickel	1.34E-07	1.11E-07		1.34E-07	1.11E-07		5.99E-10	2.00E-10						6.45E-06	5.31E-06		2.99E-08	9.98E-09
Selenium	9.59E-07	1.58E-06		9.59E-07	1.58E-06		2.78E-09	9.26E-10						1.84E-04	3.03E-04		5.56E-07	1.85E-07
Acid Gases																		
HCl	0.00E+00	0.00E+00		0.00E+00	0.00E+00		3.26E-08	1.09E-08										
									1.6E-08	**3.7E-09**		**2.9E-09**	**9.7E-10**	**0.00036**	**0.00050**		**0.000004**	**0.000001**

Appendix I (old tables)

Table 3. Risk Analysis - Subsistence Fisher (Location:S7 (Brown Creek))

Chemical	Total Daily Intake								Total Daily Inhalation	
	Carcinogen Total Daily Intake				Noncarcinogen Total Daily Intake					
	Subsistence Fisher Adult [Flowing Water] (mg/kg-day) ISF_FW	Subsistence Fisher Child [Flowing Water] (mg/kg-day) ICSF_FW	Subsistence Fisher Adult [Quiescent Water] (mg/kg-day) ISF_QW	Subsistence Fisher Child [Quiescent Water] (mg/kg-day) ICSF_QW	Subsistence Fisher Adult [Flowing Water] (mg/kg-day) ISF_FWn	Subsistence Fisher Child [Flowing Water] (mg/kg-day) ICSF_FWn	Subsistence Fisher Adult [Quiescent Water] (mg/kg-day) ISF_QWn	Subsistence Fisher Child [Quiescent Water] (mg/kg-day) ICSF_QWn	Subsistence Fisher Adult (mg/kg-day) ADIa	Subsistence Fisher Child (mg/kg-day) ADIc
PCDD/PCDF										
2,3,7,8-Tetrachlorodibenzodioxin	8.08E-14	6.32E-14	8.08E-14	6.32E-14	8.08E-14	6.32E-14	8.08E-14	6.32E-14	7.05E-18	3.13E-18
Volatiles										
Acetaldehyde	3.69E-07	5.06E-07	3.70E-07	5.06E-07	3.69E-07	5.06E-07	3.70E-07	5.06E-07	1.25E-08	5.56E-09
Acetone	3.15E-11	4.32E-11	3.16E-11	4.32E-11	3.15E-11	4.32E-11	3.16E-11	4.32E-11	1.42E-11	6.30E-12
Acetophenone	8.28E-10	1.15E-09	1.04E-09	1.28E-09	8.28E-10	1.15E-09	1.04E-09	1.28E-09	3.37E-10	1.50E-10
Acrolein	3.41E-08	5.06E-08	3.83E-08	5.33E-08	3.41E-08	5.06E-08	3.83E-08	5.33E-08	6.37E-09	2.83E-09
Benzene	2.03E-11	2.84E-11	2.27E-11	3.00E-11	2.03E-11	2.84E-11	2.27E-11	3.00E-11	6.67E-12	2.96E-12
Benzyl chloride	4.43E-08	6.73E-08	5.13E-08	7.19E-08	4.43E-08	6.73E-08	5.13E-08	7.19E-08	1.54E-08	6.83E-09
Carbon disulfide	3.43E-11	4.70E-11	3.44E-11	4.70E-11	3.43E-11	4.70E-11	3.44E-11	4.70E-11	2.26E-12	1.00E-12
Chlorobenzene	2.27E-09	3.13E-09	2.34E-09	3.17E-09	2.27E-09	3.13E-09	2.34E-09	3.17E-09	4.88E-10	2.17E-10
Chloroform	9.83E-12	1.46E-11	1.15E-11	1.57E-11	9.83E-12	1.46E-11	1.15E-11	1.57E-11	1.41E-12	6.28E-13
Cumene	1.06E-10	1.33E-10	1.06E-10	1.33E-10	1.06E-10	1.33E-10	1.06E-10	1.33E-10	1.18E-10	5.24E-11
Ethylbenzene	1.11E-09	1.64E-09	1.12E-09	1.64E-09	1.11E-09	1.64E-09	1.12E-09	1.64E-09	2.07E-09	9.21E-10
Ethyl Chloride (chloroethane)	3.14E-10	4.26E-10	3.45E-10	4.46E-10	3.14E-10	4.26E-10	3.45E-10	4.46E-10	9.26E-10	4.12E-10
Ethylene dichloride (I,2-dichloroethane)	1.36E-09	2.12E-09	1.54E-09	2.23E-09	1.36E-09	2.12E-09	1.54E-09	2.23E-09	8.76E-10	3.89E-10
Ethylene dibromide (I,2-dibromoethane)	4.35E-11	5.99E-11	4.60E-11	6.15E-11	4.35E-11	5.99E-11	4.60E-11	6.15E-11	3.37E-11	1.50E-11
Freon 11 (trichlorofluoromethane)	7.28E-12	1.03E-11	7.99E-12	1.08E-11	7.28E-12	1.03E-11	7.99E-12	1.08E-11	1.18E-12	5.26E-13
Freon 12 (dichlorodifluoromethane)	1.86E-11	2.61E-11	2.06E-11	2.73E-11	1.86E-11	2.61E-11	2.06E-11	2.73E-11	3.71E-12	1.65E-12
Hexane	5.38E-11	7.22E-11	5.53E-11	7.31E-11	5.38E-11	7.22E-11	5.53E-11	7.31E-11	7.11E-12	3.16E-12
Methyl bromide (bromomethane)	2.83E-08	3.91E-08	3.00E-08	4.01E-08	2.83E-08	3.91E-08	3.00E-08	4.01E-08	3.52E-09	1.56E-09
Methyl chloride (chloromethane)	7.57E-12	1.04E-11	7.88E-12	1.06E-11	7.57E-12	1.04E-11	7.88E-12	1.06E-11	8.27E-13	3.68E-13
Methylene chloride	2.61E-07	4.10E-07	3.25E-07	4.51E-07	2.61E-07	4.10E-07	3.25E-07	4.51E-07	8.56E-09	3.80E-09
Methyl ethyl ketone (2-butanone)	3.69E-09	5.12E-09	3.96E-09	5.29E-09	3.69E-09	5.12E-09	3.96E-09	5.29E-09	4.38E-10	1.95E-10
Methyl methacrylate	7.01E-09	9.63E-09	7.25E-09	9.79E-09	7.01E-09	9.63E-09	7.25E-09	9.79E-09	7.75E-10	3.44E-10
Methyl tert butyl ether	1.84E-10	2.55E-10	2.02E-10	2.67E-10	1.84E-10	2.55E-10	2.02E-10	2.67E-10	2.49E-11	1.11E-11
Styrene	2.38E-09	3.22E-09	2.39E-09	3.23E-09	2.38E-09	3.22E-09	2.39E-09	3.23E-09	9.43E-10	4.19E-10
Tetrachloroethene	6.14E-11	8.40E-11	6.15E-11	8.41E-11	6.14E-11	8.40E-11	6.15E-11	8.41E-11	6.40E-12	2.84E-12
Toluene	1.15E-09	1.58E-09	1.17E-09	1.59E-09	1.15E-09	1.58E-09	1.17E-09	1.59E-09	4.38E-10	1.95E-10
1,1,1-Trichloroethane	3.58E-09	4.90E-09	3.58E-09	4.90E-09	3.58E-09	4.90E-09	3.58E-09	4.90E-09	5.56E-10	2.47E-10
Vinyl acetate	7.67E-08	1.18E-07	8.29E-08	1.22E-07	7.67E-08	1.18E-07	8.29E-08	1.22E-07	8.09E-10	3.59E-10
Xylenes	5.78E-12	8.68E-12	6.23E-12	8.97E-12	5.78E-12	8.68E-12	6.23E-12	8.97E-12	1.68E-10	7.49E-11
Semi-Volatiles										
Benzo(a)pyrene (equivalents)	1.14E-08	1.26E-08	1.14E-08	1.26E-08	1.14E-08	1.26E-08	1.14E-08	1.26E-08	2.43E-12	1.08E-12
Bis(2-ethylhexyl)phthalate	3.14E-06	5.38E-06	3.14E-06	5.38E-06	3.14E-06	5.38E-06	3.14E-06	5.38E-06	1.60E-09	7.11E-10
Bromoform	8.18E-10	1.14E-09	1.30E-09	1.45E-09	8.18E-10	1.14E-09	1.30E-09	1.45E-09	8.59E-10	3.82E-10
2,4-Dinitrotoluene	6.32E-10	9.15E-10	6.34E-10	9.17E-10	6.32E-10	9.15E-10	6.34E-10	9.17E-10	7.69E-12	3.42E-12
Formaldehyde	2.47E-06	3.45E-06	2.47E-06	3.45E-06	2.47E-06	3.45E-06	2.47E-06	3.45E-06	5.27E-09	2.34E-09
Isophorone	5.42E-10	8.34E-10	6.07E-10	8.77E-10	5.42E-10	8.34E-10	6.07E-10	8.77E-10	1.27E-08	5.66E-09
Phenol	8.01E-10	1.13E-09	8.57E-10	1.16E-09	8.01E-10	1.13E-09	8.57E-10	1.16E-09	3.54E-10	1.57E-10
PCBs										
Polychlorinated biphenyls	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inorganics										
Antimony	4.92E-08	4.37E-08	4.92E-08	4.37E-08	4.93E-08	4.44E-08	4.93E-08	4.44E-08	2.88E-10	1.28E-10
Arsenic	7.61E-10	9.20E-10	7.61E-10	9.20E-10	7.61E-10	9.20E-10	7.61E-10	9.20E-10	6.28E-12	2.79E-12
Beryllium	4.55E-07	3.36E-07	4.55E-07	3.36E-07	4.55E-07	3.36E-07	4.55E-07	3.36E-07	3.38E-10	1.50E-10
Cadmium	3.79E-10	2.73E-10	3.79E-10	2.74E-10	3.79E-10	2.74E-10	3.79E-10	2.74E-10	1.97E-12	8.74E-13
Chromium VI	1.55E-09	1.38E-09	1.55E-09	1.38E-09	1.55E-09	1.38E-09	1.55E-09	1.38E-09	2.15E-11	9.58E-12
Cobalt	2.31E-08	4.25E-08	2.34E-08	4.27E-08	2.37E-08	4.83E-08	2.40E-08	4.85E-08	1.63E-09	7.24E-10
Manganese	3.53E-08	6.79E-08	4.22E-08	7.25E-08	3.60E-08	7.52E-08	4.30E-08	7.98E-08	8.00E-09	3.56E-09
Mercury (elemental)	5.96E-11	3.90E-11	5.96E-11	3.90E-11	5.96E-11	3.90E-11	5.96E-11	3.90E-11	4.77E-14	2.12E-14
Nickel	9.03E-07	7.25E-07	9.04E-07	7.25E-07	9.03E-07	7.25E-07	9.04E-07	7.25E-07	4.57E-09	2.03E-09
Selenium	6.54E-06	1.08E-05	6.55E-06	1.08E-05	6.54E-06	1.08E-05	6.55E-06	1.08E-05	2.12E-08	9.43E-09
Acid Gases										
HCl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-07	9.73E-08

Appendix I (old tables)

Table 3. Risk Analysis - Subsistence Fisher (Location:S7 (Brown Creek)) Cont.

Chemical	Total Risk						Total Hazard					
	Total Risk				Inhalation Risk		Total Hazard				Inhalation Hazard	
	Subsistence Fisher Adult [Flowing Water]	Subsistence Fisher Child [Flowing Water]	Subsistence Fisher Adult [Quiescent Water]	Subsistence Fisher Child [Quiescent Water]	Subsistence Fisher Adult	Subsistence Fisher Child	Subsistence Fisher Adult [Flowing Water]	Subsistence Fisher Child [Flowing Water]	Subsistence Fisher Adult [Quiescent Water]	Subsistence Fisher Child [Quiescent Water]	Subsistence Fisher Adult	Subsistence Fisher Child
PCDD/PCDF												
2,3,7,8-Tetrachlorodibenzodioxin	5.0E-09	7.8E-10	5.0E-09	7.8E-10	1.1E-12	4.7E-13						
Volatiles												
Acetaldehyde					9.6E-11	4.3E-11						
Acetone							3.36E-11	4.14E-11	3.37E-11	4.14E-11	1.57E-11	6.30E-12
Acetophenone							7.94E-09	1.10E-09	9.94E-09	1.23E-09	3.37E-09	1.50E-10
Acrolein							6.55E-05	9.70E-05	7.34E-05	1.02E-04	1.27E-05	5.66E-06
Benzene	4.6E-13	1.3E-13	5.1E-13	1.4E-13	1.8E-13	8.0E-14	4.87E-09	6.81E-09	5.43E-09	7.18E-09	1.67E-09	7.41E-10
Benzyl chloride	3.1E-09	9.4E-10	3.6E-09	1.0E-09			2.12E-05	3.23E-05	2.46E-05	3.45E-05	7.68E-06	3.41E-06
Carbon disulfide							3.29E-10	4.50E-10	3.30E-10	4.51E-10	2.26E-11	1.00E-11
Chlorobenzene							1.09E-07	1.50E-08	1.12E-07	1.52E-08	2.44E-08	1.09E-09
Chloroform					1.1E-13	5.1E-14	9.42E-10	1.40E-09	1.10E-09	1.51E-09	1.41E-10	6.28E-11
Cumene							1.01E-09	3.19E-10	1.01E-09	3.19E-10	1.18E-09	1.31E-10
Ethylbenzene							1.06E-08	1.43E-08	1.07E-08	1.43E-08	2.07E-08	8.37E-09
Ethyl Chloride (chloroethane)	3.7E-13	1.0E-13	4.1E-13	1.1E-13			7.53E-10	1.02E-09	8.27E-10	1.07E-09	2.32E-09	1.03E-09
Ethylene dichloride (I,2-dichloroethane)	1.1E-09	3.5E-10	1.3E-09	3.7E-10	1.8E-09	7.8E-10	1.45E-07	2.25E-07	1.64E-07	2.38E-07	9.73E-08	4.33E-08
Ethylene dibromide (I,2-dibromoethane)	1.6E-12	4.5E-13	1.7E-12	4.6E-13	3.1E-12	1.4E-12	2.08E-09	2.87E-09	2.20E-09	2.95E-09	1.68E-09	7.49E-10
Freon 11 (trichlorofluoromethane)							2.33E-11	1.41E-11	2.55E-11	1.47E-11	3.95E-12	7.52E-13
Freon 12 (dichlorodifluoromethane)							8.93E-11	2.78E-11	9.88E-11	2.91E-11	1.85E-11	1.83E-12
Hexane							4.69E-12	1.15E-10	4.82E-12	1.17E-10	6.46E-13	5.27E-12
Methyl bromide (bromomethane)							1.94E-05	7.49E-06	2.05E-05	7.69E-06	2.51E-06	3.13E-07
Methyl chloride (chloromethane)												
Methylene chloride	8.0E-10	2.5E-10	1.0E-09	2.8E-10	1.4E-11	6.3E-12	4.17E-06	4.91E-06	5.19E-06	5.41E-06	1.43E-07	4.75E-08
Methyl ethyl ketone (2-butanone)							5.90E-09	8.18E-09	6.33E-09	8.46E-09	7.30E-10	3.24E-10
Methyl methacrylate							4.80E-09	1.54E-07	4.97E-09	1.56E-07	5.53E-10	5.74E-09
Methyl tert butyl ether	3.0E-13	8.4E-14	3.3E-13	8.8E-14								
Styrene							1.14E-08	3.09E-08	1.15E-08	3.09E-08	4.72E-09	4.19E-09
Tetrachloroethene	1.4E-11	3.7E-12	1.4E-11	3.7E-12	1.3E-13	5.7E-14	5.89E-09	4.03E-11	5.90E-09	4.03E-11	6.40E-10	1.42E-12
Toluene							5.52E-09	7.56E-09	5.61E-09	7.61E-09	2.19E-09	9.73E-10
1,1,1-Trichloroethane							1.23E-08	4.70E-09	1.23E-08	4.70E-09	1.99E-09	2.47E-10
Vinyl acetate							7.36E-08	1.14E-07	7.95E-08	1.17E-07	8.09E-10	3.59E-10
Xylenes							2.77E-11	4.16E-11	2.99E-11	4.30E-11	8.42E-10	3.74E-10
Semi-Volatiles												
Benzo(a)pyrene (equivalents)	3.4E-08	7.6E-09	3.4E-08	7.6E-09	7.5E-12	3.3E-12						
Bis(2-ethylhexyl)phthalate	1.8E-08	6.2E-09	1.8E-08	6.2E-09			1.51E-04	2.58E-04	1.51E-04	2.58E-04	8.00E-08	3.56E-08
Bromoform	2.7E-12	7.4E-13	4.2E-12	9.4E-13	3.4E-12	1.5E-12	3.92E-08	5.48E-09	6.23E-08	6.98E-09	4.30E-08	1.91E-09
2,4-Dinitrotoluene							3.03E-07	4.39E-07	3.04E-07	4.40E-07	3.84E-09	1.71E-09
Formaldehyde					2.4E-10	1.1E-10	1.18E-05	1.66E-05	1.18E-05	1.66E-05	2.64E-08	1.17E-08
Isophorone	2.1E-13	6.5E-14	2.4E-13	6.8E-14			2.60E-09	4.00E-10	2.91E-09	4.20E-10	6.37E-08	2.83E-09
Phenol							2.56E-09	1.80E-09	2.74E-09	1.86E-09	1.18E-09	2.62E-10
PCBs												
Polychlorinated biphenyls												
Inorganics												
Antimony							1.18E-04	2.13E-04	1.18E-04	2.13E-04	7.20E-07	6.40E-07
Arsenic	4.7E-10	1.1E-10	4.7E-10	1.1E-10	9.5E-11	4.2E-11	2.43E-06	2.94E-06	2.43E-06	2.94E-06	2.09E-08	9.30E-09
Beryllium					2.8E-09	1.3E-09	2.18E-04	6.45E-05	2.18E-04	6.45E-05	1.69E-07	3.01E-08
Cadmium					1.2E-11	5.5E-12	3.63E-07	2.63E-07	3.63E-07	2.63E-07	1.97E-09	8.74E-10
Chromium VI					8.8E-10	3.9E-10	4.95E-07	6.64E-08	4.95E-07	6.64E-08	7.18E-09	4.79E-10
Cobalt					1.6E-08	7.1E-09	1.14E-06	2.31E-06	1.15E-06	2.33E-06	8.14E-08	3.62E-08
Manganese							1.73E-06	5.15E-07	2.06E-06	5.46E-07	4.00E-07	2.54E-08
Mercury (elemental)												
Nickel							4.33E-05	3.47E-05	4.33E-05	3.48E-05	2.29E-07	1.02E-07
Selenium							1.25E-03	2.07E-03	1.26E-03	2.08E-03	4.24E-06	1.89E-06
Acid Gases												
HCl												
	8.5E-08	**2.6E-08**	**8.6E-08**	**2.6E-08**	**2.2E-08**	**9.7E-09**	**0.00194**	**0.00282**	**0.00196**	**0.00283**	**0.000029**	**0.000012**

Appendix I (old tables)

Table 4. Risk Analysis - School/Day Care (Location: L7 (Rainelle School))

	Total Daily Intake			Total Risk		Total Hazards	
	Total Daily Soil Ingestion		Total Daily Inhalation	Total Risk	Inhalation Risk	Total Hazard	Inhalation Hazard
Chemical	Carcinogen Contaminant Intake From Soil (mg/kg-day) I_{CDC}	Noncarcinogen Contaminant Intake From Soil (mg/kg-day) I_{CDCn}	Day Care Student (mg/kg-day) ADIc	Day Care Student	Day Care Student	Day Care Student	Day Care Student
PCDD/PCDF							
2,3,7,8-Tetrachlorodibenzodioxin	4.87E-19	4.99E-19	4.02E-19	6.0E-15	6.0E-14		
Volatiles							
Acetaldehyde	2.78E-11	2.78E-11	7.13E-10		5.5E-12		
Acetone	2.37E-15	2.37E-15	8.07E-13			2.27E-15	8.07E-13
Acetophenone	6.97E-13	6.98E-13	1.92E-11			6.69E-13	1.92E-11
Acrolein	1.39E-11	1.39E-11	3.63E-10			2.67E-08	7.25E-07
Benzene	3.12E-14	3.12E-14	3.80E-13	1.4E-16	1.0E-14	7.49E-12	9.50E-11
Benzyl chloride	1.98E-11	1.98E-11	8.75E-10	2.8E-13		9.52E-09	4.37E-07
Carbon disulfide	5.62E-15	5.62E-15	1.29E-13			5.39E-14	1.29E-12
Chlorobenzene	3.14E-12	3.15E-12	2.78E-11			1.51E-11	1.39E-10
Chloroform	1.91E-14	1.92E-14	8.05E-14		6.5E-15	1.84E-12	8.05E-12
Cumene	1.04E-13	1.04E-13	6.72E-12			2.48E-13	1.68E-11
Ethylbenzene	2.48E-12	2.48E-12	1.18E-10			2.16E-11	1.07E-09
Ethyl Chloride (chloroethane)	1.03E-12	1.03E-12	5.28E-11	2.5E-16		2.48E-12	1.32E-10
Ethylene dichloride (I,2-dichloroethane)	9.56E-13	9.56E-13	4.99E-11	1.6E-13	1.0E-10	1.02E-10	5.54E-09
Ethylene dibromide (I,2-dibromoethane)	2.99E-14	2.99E-14	1.92E-12	2.2E-16	1.7E-13	1.43E-12	9.59E-11
Freon 11 (trichlorofluoromethane)	1.76E-14	1.77E-14	6.74E-14			2.43E-14	9.63E-14
Freon 12 (dichlorodifluoromethane)	2.95E-14	2.96E-14	2.11E-13			3.16E-14	2.35E-13
Hexane	5.08E-14	5.09E-14	4.05E-13			8.14E-14	6.75E-13
Methyl bromide (bromomethane)	1.22E-11	1.22E-11	2.01E-10			2.34E-09	4.01E-08
Methyl chloride (chloromethane)	2.48E-15	2.48E-15	4.71E-14				
Methylene chloride	2.54E-11	2.54E-11	4.87E-10	1.6E-14	8.0E-13	3.04E-10	6.09E-09
Methyl ethyl ketone (2-butanone)	1.52E-12	1.52E-12	2.49E-11			2.43E-12	4.16E-11
Methyl methacrylate	2.32E-12	2.33E-12	4.41E-11			3.72E-11	7.36E-10
Methyl tert butyl ether	9.02E-14	9.04E-14	1.42E-12	3.0E-17			
Styrene	1.40E-12	1.40E-12	5.37E-11			1.34E-11	5.37E-10
Tetrachloroethene	2.15E-14	2.15E-14	3.65E-13	9.5E-16	7.3E-15	1.03E-14	1.82E-13
Toluene	6.04E-13	6.04E-13	2.49E-11			2.90E-12	1.25E-10
1,1,1-Trichloroethane	1.47E-11	1.48E-11	3.17E-11			1.42E-11	3.17E-11
Vinyl acetate	3.45E-11	3.50E-11	4.61E-11			3.35E-11	4.61E-11
Xylenes	7.59E-15	7.59E-15	9.59E-12			3.64E-14	4.80E-11
Semi-Volatiles							
Benzo(a)pyrene (equivalents)	5.18E-14	5.22E-14	1.38E-13	3.1E-14	4.3E-13		
Bis(2-ethylhexyl)phthalate	8.60E-14	8.60E-14	9.11E-11	9.9E-17		4.12E-12	4.56E-09
Bromoform	1.62E-12	1.62E-12	4.89E-11	1.1E-15	1.9E-13	7.78E-12	2.45E-10
2,4-Dinitrotoluene	1.64E-13	1.65E-13	4.38E-13			7.93E-11	2.19E-10
Formaldehyde	2.38E-13	2.38E-13	3.00E-10		1.4E-11	1.14E-12	1.50E-09
Isophorone	5.74E-13	5.74E-13	7.25E-10	4.5E-17		2.75E-13	3.63E-10
Phenol	3.79E-13	3.79E-13	2.01E-11			6.06E-13	3.36E-11
PCBs							
Polychlorinated biphenyls	0.00E+00	0.00E+00	0.00E+00				
Inorganics							
Antimony	1.70E-08	2.98E-08	1.71E-11			1.43E-04	8.57E-08
Arsenic	6.55E-13	6.56E-13	3.74E-13	8.1E-14	5.6E-12	2.10E-09	1.25E-09
Beryllium	3.53E-11	3.53E-11	2.01E-11		1.7E-10	6.78E-09	4.03E-09
Cadmium	5.37E-11	6.86E-11	1.17E-13		7.4E-13	6.58E-08	1.17E-10
Chromium VI	4.19E-10	4.91E-10	1.28E-12		5.3E-11	2.36E-08	6.41E-11
Cobalt	1.15E-07	2.21E-07	9.69E-11		9.5E-10	1.06E-05	4.85E-09
Manganese	3.03E-07	4.36E-07	4.76E-10			2.99E-06	3.40E-09
Mercury (elemental)	3.10E-13	3.43E-13	2.84E-15				
Nickel	4.77E-10	4.78E-10	2.72E-10			2.29E-08	1.36E-08
Selenium	2.22E-09	2.22E-09	1.26E-09			4.25E-07	2.53E-07
Acid Gases							
HCl	0.00E+00	0.00E+00	1.25E-08				
				1.3E-09	**1.3E-09**	**0.00016**	**0.000002**

Appendix I (old tables)

Table 5. Risk Analysis - Nursing Home/Hospital Patient Extended Care Resident (Location: L2 - Rainelle Nursing Home)

Chemical	Total Daily Inhalation Nursing Home Patient (mg/kg-day) ADIa	Total Risk Nursing Home Patient	Inhalation Hazard Nursing Home Patient
PCDD/PCDF			
2,3,7,8-Tetrachlorodibenzodioxin	1.40E-20	2.1E-15	
Volatiles			
Acetaldehyde	2.49E-11	1.9E-13	
Acetone	2.82E-14		3.14E-14
Acetophenone	6.71E-13		6.71E-12
Acrolein	1.27E-11		2.54E-08
Benzene	1.33E-14	3.6E-16	3.32E-12
Benzyl chloride	3.06E-11		1.53E-08
Carbon disulfide	4.50E-15		4.50E-14
Chlorobenzene	9.73E-13		4.87E-11
Chloroform	2.82E-15	2.3E-16	2.82E-13
Cumene	2.35E-13		2.35E-12
Ethylbenzene	4.13E-12		4.13E-11
Ethyl Chloride (chloroethane)	1.85E-12		4.61E-12
Ethylene dichloride (I,2-dichloroethane)	1.74E-12	3.5E-12	1.94E-10
Ethylene dibromide (I,2-dibromoethane)	6.71E-14	6.1E-15	3.36E-12
Freon 11 (trichlorofluoromethane)	2.36E-15		7.86E-15
Freon 12 (dichlorodifluoromethane)	7.38E-15		3.69E-14
Hexane	1.42E-14		1.29E-15
Methyl bromide (bromomethane)	7.01E-12		5.01E-09
Methyl chloride (chloromethane)	1.65E-15		
Methylene chloride	1.70E-11	2.8E-14	2.84E-10
Methyl ethyl ketone (2-butanone)	8.72E-13		1.45E-12
Methyl methacrylate	1.54E-12		1.10E-12
Methyl tert butyl ether	4.97E-14		
Styrene	1.88E-12		9.39E-12
Tetrachloroethene	1.28E-14	2.6E-16	1.28E-12
Toluene	8.72E-13		4.36E-12
1,1,1-Trichloroethane	1.11E-12		3.95E-12
Vinyl acetate	1.61E-12		1.61E-12
Xylenes	3.36E-13		1.68E-12
Semi-Volatiles			
Benzo(a)pyrene (equivalents)	4.83E-15	1.5E-14	
Bis(2-ethylhexyl)phthalate	3.19E-12		1.59E-10
Bromoform	1.71E-12	6.7E-15	8.56E-11
2,4-Dinitrotoluene	1.53E-14		7.66E-12
Formaldehyde	1.05E-11	4.7E-13	5.25E-11
Isophorone	2.54E-11		1.27E-10
Phenol	7.05E-13		2.35E-12
PCBs			
Polychlorinated biphenyls	0.00E+00		
Inorganics			
Antimony	7.72E-13		1.93E-09
Arsenic	1.68E-14	2.5E-13	5.60E-11
Beryllium	9.06E-13	7.6E-12	4.53E-10
Cadmium	5.27E-15	3.3E-14	5.27E-12
Chromium VI	5.77E-14	2.4E-12	1.92E-11
Cobalt	4.36E-12	4.3E-11	2.18E-10
Manganese	2.14E-11		1.07E-09
Mercury (elemental)	1.28E-16		
Nickel	1.22E-11		6.12E-10
Selenium	5.68E-11		1.14E-08
Acid Gases			
HCl	4.36E-10		
		5.7E-11	**0.00000006**

Appendix I (old tables)

Table 1 (Revised, March 2007) . Risk Analysis - Resident Home Gardener (Location: L4 (Rainelle Downtown))

Chemical	Total Daily Intake: Carcinogen Total Daily Intake: Resident/Home Gardener Adult (mg/kg-day) IAR	Total Daily Intake: Carcinogen Total Daily Intake: Resident/Home Gardener Child (mg/kg-day) ICR	Total Daily Intake: Noncarcinogen Total Daily Intake: Resident/Home Gardener Adult (mg/kg-day) IARn	Total Daily Intake: Noncarcinogen Total Daily Intake: Resident/Home Gardener Child (mg/kg-day) ICRn	Total Daily Intake: Total Daily Inhalation: Resident/Home Gardener Adult (mg/kg-day) ADIa	Total Daily Intake: Total Daily Inhalation: Resident/Home Gardener Child (mg/kg-day) ADIc	Total Risk: Total Risk: Resident/Home Gardener Adult	Total Risk: Total Risk: Resident/Home Gardener Child	Total Risk: Inhalation Risk: Resident/Home Gardener Adult	Total Risk: Inhalation Risk: Resident/Home Gardener Child	Total Hazard: Total Hazard: Resident/Home Gardener Adult	Total Hazard: Total Hazard: Resident/Home Gardener Child	Total Hazard: Inhalation Hazard: Resident/Home Gardener Adult	Total Hazard: Inhalation Hazard: Resident/Home Gardener Child
PCDD/PCDF														
2,3,7,8-Tetrachlorodibenzodioxin	6.14E-14	4.81E-14	6.14E-14	4.81E-14	5.36E-18	2.38E-18	3.8E-09	5.9E-10	8.0E-13	3.6E-13				
Volatiles														
Acetaldehyde	3.42E-07	4.68E-07	3.42E-07	4.68E-07	1.16E-08	5.15E-09			8.9E-11	4.0E-11				
Acetone	2.40E-11	3.29E-11	2.40E-11	3.29E-11	1.08E-11	4.79E-12					2.56E-11	3.15E-11	1.20E-11	4.79E-12
Acetophenone	7.55E-10	1.05E-09	7.55E-10	1.05E-09	3.07E-10	1.37E-10					7.24E-09	1.00E-09	3.07E-09	1.37E-10
Acrolein	3.16E-08	4.69E-08	3.16E-08	4.69E-08	5.90E-09	2.62E-09					6.07E-05	8.99E-05	1.18E-05	5.24E-06
Benzene	1.54E-11	2.16E-11	1.54E-11	2.16E-11	5.08E-12	2.26E-12	3.5E-13	9.8E-14	1.4E-13	6.1E-14	3.70E-09	5.18E-09	1.27E-09	5.64E-10
Benzyl chloride	4.10E-08	6.24E-08	4.10E-08	6.24E-08	1.42E-08	6.33E-09	2.9E-09	8.7E-10			1.97E-05	2.99E-05	7.12E-06	3.16E-06
Carbon disulfide	2.61E-11	3.58E-11	2.61E-11	3.58E-11	1.72E-12	7.64E-13					2.51E-10	3.43E-10	1.72E-11	7.64E-12
Chlorobenzene	2.09E-09	2.87E-09	2.09E-09	2.87E-09	4.49E-10	1.99E-10					1.00E-07	1.38E-08	2.24E-08	9.97E-10
Chloroform	7.49E-12	1.12E-11	7.49E-12	1.12E-11	1.08E-12	4.79E-13			8.7E-14	3.9E-14	7.19E-10	1.07E-09	1.08E-10	4.79E-11
Cumene	9.21E-11	1.16E-10	9.21E-11	1.16E-10	1.03E-10	4.57E-11					8.83E-10	2.78E-10	1.03E-09	1.14E-10
Ethylbenzene	1.03E-09	1.51E-09	1.03E-09	1.51E-09	1.91E-09	8.50E-10					9.83E-09	1.32E-08	1.91E-08	7.73E-09
Ethyl Chloride (chloroethane)	2.91E-10	3.94E-10	2.91E-10	3.94E-10	8.59E-10	3.82E-10	3.5E-13	9.4E-14			6.98E-10	9.46E-10	2.15E-09	9.54E-10
Ethylene dichloride (1,2-dichloroethane)	1.26E-09	1.95E-09	1.26E-09	1.95E-09	8.08E-10	3.59E-10	1.0E-09	3.2E-10	1.6E-09	7.2E-10	1.34E-07	2.08E-07	8.97E-08	3.99E-08
Ethylene dibromide (1,2-dibromoethane)	3.31E-11	4.56E-11	3.31E-11	4.56E-11	2.56E-11	1.14E-11	1.2E-12	3.4E-13	2.3E-12	1.0E-12	1.59E-09	2.18E-09	1.28E-09	5.70E-10
Freon 11 (trichlorofluoromethane)	5.54E-12	7.84E-12	5.54E-12	7.84E-12	9.01E-13	4.01E-13					1.77E-11	1.07E-11	3.00E-12	5.72E-13
Freon 12 (dichlorodifluoromethane)	1.42E-11	1.98E-11	1.42E-11	1.98E-11	2.82E-12	1.25E-12					6.79E-11	2.11E-11	1.41E-11	1.39E-12
Hexane	4.10E-11	5.50E-11	4.10E-11	5.50E-11	5.41E-12	2.41E-12					3.57E-12	8.78E-11	4.92E-13	4.01E-12
Methyl bromide (bromomethane)	2.62E-08	3.61E-08	2.62E-08	3.61E-08	3.26E-09	1.45E-09					1.80E-05	6.93E-06	2.33E-06	2.89E-07
Methyl chloride (chloromethane)	5.77E-12	7.93E-12	5.77E-12	7.93E-12	6.30E-13	2.80E-13								
Methylene chloride	1.80E-07	2.82E-07	1.80E-07	2.82E-07	5.90E-09	2.62E-09	5.5E-10	1.7E-10	9.7E-12	4.3E-12	2.87E-06	3.38E-06	9.83E-08	3.28E-08
Methyl ethyl ketone (2-butanone)	6.68E-08	9.27E-08	6.68E-08	9.27E-08	7.92E-09	3.52E-09					1.07E-07	1.48E-07	1.32E-08	5.87E-09
Methyl methacrylate	3.71E-09	5.10E-09	3.71E-09	5.10E-09	4.10E-10	1.82E-10					2.54E-09	8.15E-08	2.93E-10	3.04E-09
Methyl tert butyl ether	1.40E-10	1.94E-10	1.40E-10	1.94E-10	1.89E-11	8.41E-12	2.3E-13	6.4E-14						
Styrene	1.29E-09	1.75E-09	1.29E-09	1.75E-09	5.13E-10	2.28E-10					6.21E-09	1.68E-08	2.56E-09	2.28E-09
Tetrachloroethene	4.67E-11	6.39E-11	4.67E-11	6.39E-11	4.87E-12	2.17E-12	1.0E-11	2.8E-12	9.7E-14	4.3E-14	4.48E-09	3.07E-11	4.87E-10	1.08E-12
Toluene	1.28E-08	1.75E-08	1.28E-08	1.75E-08	4.87E-09	2.17E-09					6.14E-08	8.41E-08	2.44E-08	1.08E-08
1,1,1-Trichloroethane	2.64E-09	3.61E-09	2.64E-09	3.61E-09	4.10E-10	1.82E-10					9.04E-09	3.46E-09	1.46E-09	1.82E-10
Vinyl acetate	1.46E-08	2.25E-08	1.46E-08	2.25E-08	1.54E-10	6.83E-11					1.40E-08	2.16E-08	1.54E-10	6.83E-11
Xylenes	2.58E-11	3.89E-11	2.58E-11	3.89E-11	7.56E-10	3.36E-10					1.24E-10	1.86E-10	3.78E-09	1.68E-09
Semi-Volatiles														
Benzo(a)pyrene (equivalents)	8.68E-09	9.58E-09	8.68E-09	9.58E-09	1.84E-12	8.18E-13	2.6E-08	5.7E-09	5.7E-12	2.5E-12				
Bis(2-ethylhexyl)phthalate	2.92E-06	4.99E-06	2.92E-06	4.99E-06	1.49E-09	6.60E-10	1.7E-08	5.7E-09			1.40E-04	2.39E-04	7.43E-08	3.30E-08
Bromoform	7.56E-10	1.06E-09	7.56E-10	1.06E-09	7.94E-10	3.53E-10	2.5E-12	6.9E-13	3.1E-12	1.4E-12	3.63E-08	5.06E-09	3.97E-08	1.77E-09
2,4-Dinitrotoluene	4.81E-10	6.97E-10	4.81E-10	6.97E-10	5.85E-12	2.60E-12					2.31E-07	3.34E-07	2.92E-09	1.30E-09
Formaldehyde	2.28E-06	3.19E-06	2.28E-06	3.19E-06	4.87E-09	2.17E-09			2.2E-10	9.7E-11	1.09E-05	1.53E-05	2.44E-08	1.08E-08
Isophorone	5.00E-10	7.72E-10	5.00E-10	7.72E-10	1.18E-08	5.24E-09	2.0E-13	6.0E-14			2.40E-09	3.70E-10	5.90E-08	2.62E-09
Phenol	7.25E-10	1.02E-09	7.25E-10	1.02E-09	3.20E-10	1.42E-10					2.32E-09	1.63E-09	1.07E-09	2.37E-10
PCBs														
Polychlorinated biphenyls	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
Inorganics														
Antimony	8.24E-07	7.28E-07	8.25E-07	7.40E-07	2.72E-10	1.21E-10					1.98E-03	3.55E-03	6.80E-07	6.05E-07
Arsenic	8.86E-09	9.50E-09	8.86E-09	9.50E-09	4.71E-12	2.09E-12	5.5E-09	1.2E-09	7.1E-11	3.2E-11	2.83E-05	3.04E-05	1.57E-08	6.97E-09
Beryllium	7.48E-06	5.52E-06	7.48E-06	5.52E-06	3.10E-10	1.38E-10			2.6E-09	1.2E-09	3.58E-03	1.06E-03	1.55E-07	2.76E-08
Cadmium	5.07E-09	3.65E-09	5.07E-09	3.66E-09	1.48E-12	6.56E-13			9.3E-12	4.1E-12	4.86E-06	3.51E-06	1.48E-09	6.56E-10
Chromium VI	2.06E-08	1.82E-08	2.06E-08	1.83E-08	1.62E-11	7.19E-12			6.6E-10	2.9E-10	6.59E-06	8.77E-07	5.39E-09	3.60E-10
Cobalt	2.95E-07	5.55E-07	3.05E-07	6.50E-07	1.48E-09	6.59E-10			1.5E-08	6.5E-09	1.46E-05	3.12E-05	7.42E-08	3.30E-08
Manganese	4.45E-07	9.00E-07	4.58E-07	1.02E-06	7.30E-09	3.24E-09					2.20E-05	6.98E-06	3.65E-07	2.32E-08
Mercury (elemental)	7.81E-10	5.13E-10	7.81E-10	5.13E-10	3.58E-14	1.59E-14								
Nickel	1.46E-05	1.15E-05	1.46E-05	1.15E-05	4.17E-09	1.85E-09					6.98E-04	5.54E-04	2.08E-07	9.26E-08
Selenium	6.83E-05	9.30E-05	6.83E-05	9.30E-05	1.94E-08	8.62E-09					1.31E-02	1.78E-02	3.88E-06	1.72E-06
Acid Gases														
HCl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E-07	9.00E-08								
							7.6E-08	**2.3E-08**	**2.0E-08**	**8.8E-09**	**0.01972**	**0.02347**	**0.000027**	**0.000011**

Appendix I (revised tables)

Table 2 (Revised, March 2007). Risk Analysis - Subsistence Farmer (Location: F1 (Williamsburg))

Chemical	Total Daily Intake: Carcinogen Total Daily Intake: Subsistence Farmer Adult (mg/kg-day) IAF	Total Daily Intake: Carcinogen Total Daily Intake: Subsistence Farmer Child (mg/kg-day) ICF	Total Daily Intake: Carcinogen Total Daily Intake: Infant (pg/kg-day) II	Total Daily Intake: Noncarcinogen Total Daily Intake: Subsistence Farmer Adult (mg/kg-day) IAFn	Total Daily Intake: Noncarcinogen Total Daily Intake: Subsistence Farmer Child (mg/kg-day) ICFn	Total Daily Intake: Noncarcinogen Total Daily Intake: Infant (pg/kg-day) II	Total Daily Inhalation: Subsistence Farmer Adult (mg/kg-day) ADI_{Sa}	Total Daily Inhalation: Subsistence Farmer Child (mg/kg-day) ADI_{c}	Total Risk: Total Risk: Subsistence Farmer Adult	Total Risk: Total Risk: Subsistence Farmer Child	Total Risk: Total Risk: Infant (mg/day)	Total Risk: Inhalation Risk: Subsistence Farmer Adult	Total Risk: Inhalation Risk: Subsistence Farmer Child	Total Hazard: Total Hazard: Subsistence Farmer Adult	Total Hazard: Total Hazard: Subsistence Farmer Child	Total Hazard: Total Hazard: Infant (mg/day)	Total Hazard: Inhalation Hazard: Subsistence Farmer Adult	Total Hazard: Inhalation Hazard: Subsistence Farmer Child
PCDD/PCDF																		
2,3,7,8-Tetrachlorodibenzodioxin	9.49E-15	7.44E-15	0.00030	9.49E-15	7.44E-15	0.00030	1.10E-18	3.68E-19	7.8E-10	9.2E-11	0.00030	1.7E-13	5.5E-14			0.00030		
Volatiles																		
Acetaldehyde	2.11E-07	2.89E-07		2.11E-07	2.89E-07		2.39E-09	7.96E-10				1.8E-11	6.1E-12					
Acetone	1.48E-11	2.03E-11		1.48E-11	2.03E-11		2.22E-12	7.40E-13						1.58E-11	1.95E-11		2.47E-12	7.40E-13
Acetophenone	4.66E-10	6.43E-10		4.66E-10	6.43E-10		6.33E-11	2.11E-11						4.46E-09	6.17E-10		6.33E-10	2.11E-11
Acrolein	1.95E-08	2.89E-08		1.95E-08	2.89E-08		1.22E-09	4.05E-10						3.75E-05	5.54E-05		2.43E-06	8.10E-07
Benzene	9.50E-12	1.32E-11		9.50E-12	1.32E-11		1.05E-12	3.48E-13	2.9E-13	6.0E-14		2.8E-14	9.4E-15	2.28E-09	3.17E-09		2.61E-10	8.71E-11
Benzyl chloride	2.53E-08	3.85E-08		2.53E-08	3.85E-08		2.93E-09	9.78E-10	2.4E-09	5.4E-10				1.21E-05	1.85E-05		1.47E-06	4.89E-07
Carbon disulfide	1.61E-11	2.21E-11		1.61E-11	2.21E-11		3.54E-13	1.18E-13						1.55E-10	2.12E-10		3.54E-12	1.18E-12
Chlorobenzene	1.27E-09	1.74E-09		1.27E-09	1.74E-09		9.24E-11	3.08E-11						6.07E-08	8.33E-09		4.62E-09	1.54E-10
Chloroform	4.62E-12	6.83E-12		4.62E-12	6.83E-12		2.22E-13	7.40E-14				1.8E-14	6.0E-15	4.43E-10	6.55E-10		2.22E-11	7.40E-12
Cumene	4.50E-11	6.00E-11		4.50E-11	6.00E-11		2.12E-11	7.05E-12						4.32E-10	1.44E-10		2.12E-10	1.76E-11
Ethylbenzene	5.64E-10	8.54E-10		5.64E-10	8.54E-10		3.94E-10	1.31E-10						5.41E-09	7.44E-09		3.94E-09	1.19E-09
Ethyl Chloride (chloroethane)	1.44E-10	2.03E-10		1.44E-10	2.03E-10		1.77E-10	5.89E-11	2.3E-13	4.8E-14				3.46E-10	4.87E-10		4.42E-10	1.47E-10
Ethylene dichloride (1,2-dichloroethane)	7.75E-10	1.20E-09		7.75E-10	1.20E-09		1.66E-10	5.54E-11	8.5E-10	2.0E-10		3.3E-10	1.1E-10	8.26E-08	1.28E-07		1.85E-08	6.16E-09
Ethylene dibromide (1,2-dibromoethane)	2.04E-11	2.80E-11		2.04E-11	2.80E-11		5.28E-12	1.76E-12	1.0E-12	2.1E-13		4.8E-13	1.6E-13	9.77E-10	1.34E-09		2.64E-10	8.80E-11
Freon 11 (trichlorofluoromethane)	3.40E-12	4.77E-12		3.40E-12	4.77E-12		1.86E-13	6.19E-14						1.09E-11	6.54E-12		6.19E-13	8.84E-14
Freon 12 (dichlorodifluoromethane)	8.71E-12	1.21E-11		8.71E-12	1.21E-11		5.80E-13	1.93E-13						4.18E-11	1.29E-11		2.90E-12	2.15E-13
Hexane	2.39E-11	3.25E-11		2.39E-11	3.25E-11		1.11E-12	3.71E-13						2.08E-12	5.20E-11		1.01E-13	6.19E-13
Methyl bromide (bromomethane)	1.62E-08	2.23E-08		1.62E-08	2.23E-08		6.70E-10	2.23E-10						1.11E-05	4.27E-06		4.79E-07	4.47E-08
Methyl chloride (chloromethane)	3.56E-12	4.89E-12		3.56E-12	4.89E-12		1.30E-13	4.32E-14										
Methylene chloride	1.11E-07	1.74E-07		1.11E-07	1.74E-07		1.22E-09	4.05E-10	4.6E-10	1.1E-10		2.0E-12	6.7E-13	1.77E-06	2.09E-06		2.03E-08	5.06E-09
Methyl ethyl ketone (2-butanone)	4.13E-08	5.71E-08		4.13E-08	5.71E-08		1.63E-09	5.44E-10						6.60E-08	9.13E-08		2.72E-09	9.07E-10
Methyl methacrylate	2.29E-09	3.14E-09		2.29E-09	3.14E-09		8.44E-11	2.81E-11						1.57E-09	5.03E-08		6.03E-11	4.69E-10
Methyl tert butyl ether	8.62E-11	1.19E-10		8.62E-11	1.19E-10		3.90E-12	1.30E-12	1.9E-13	3.9E-14								
Styrene	7.56E-10	1.03E-09		7.56E-10	1.03E-09		1.06E-10	3.52E-11						3.63E-09	9.89E-09		5.28E-10	3.52E-10
Tetrachloroethene	2.87E-11	3.92E-11		2.87E-11	3.92E-11		1.00E-12	3.34E-13	8.5E-12	1.7E-12		2.0E-14	6.7E-15	2.75E-09	1.88E-11		1.00E-10	1.67E-13
Toluene	7.82E-09	1.07E-08		7.82E-09	1.07E-08		1.00E-09	3.34E-10						3.75E-08	5.13E-08		5.02E-09	1.67E-09
1,1,1-Trichloroethane	1.42E-09	1.95E-09		1.42E-09	1.95E-09		8.44E-11	2.81E-11						4.87E-09	1.87E-09		3.02E-10	2.81E-11
Vinyl acetate	9.00E-09	1.39E-08		9.00E-09	1.39E-08		3.16E-11	1.05E-11						8.63E-09	1.33E-08		3.16E-11	1.05E-11
Xylenes	9.44E-12	1.37E-11		9.44E-12	1.37E-11		1.56E-10	5.19E-11						4.53E-11	6.55E-11		7.78E-10	2.59E-10
Semi-Volatiles																		
Benzo(a)pyrene (equivalents)	1.34E-09	1.48E-09		1.34E-09	1.48E-09		3.79E-13	1.26E-13	5.4E-09	8.9E-10		1.2E-12	3.9E-13					
Bis(2-ethylhexyl)phthalate	7.72E-07	1.22E-06		7.72E-07	1.22E-06		3.06E-10	1.02E-10	5.9E-09	1.4E-09				3.70E-05	5.85E-05		1.53E-08	5.10E-09
Bromoform	4.54E-10	6.31E-10		4.54E-10	6.31E-10		1.64E-10	5.45E-11	2.0E-12	4.1E-13		6.4E-13	2.1E-13	2.17E-08	3.03E-09		8.18E-09	2.73E-10
2,4-Dinitrotoluene	2.97E-10	4.30E-10		2.97E-10	4.30E-10		1.20E-12	4.02E-13						1.42E-07	2.06E-07		6.02E-10	2.01E-10
Formaldehyde	1.41E-06	1.97E-06		1.41E-06	1.97E-06		1.00E-09	3.34E-10				4.5E-11	1.5E-11	6.75E-06	9.45E-06		5.02E-09	1.67E-09
Isophorone	2.42E-10	3.55E-10		2.42E-10	3.55E-10		2.43E-09	8.10E-10	1.3E-13	2.8E-14				1.16E-09	1.70E-10		1.22E-08	4.05E-10
Phenol	4.48E-10	6.28E-10		4.48E-10	6.28E-10		6.60E-11	2.20E-11						1.43E-09	1.00E-09		2.20E-10	3.67E-11
PCBs																		
Polychlorinated biphenyls	0.00E+00	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00										
Inorganics																		
Antimony	1.55E-08	1.69E-08		1.55E-08	1.70E-08		7.65E-11	2.55E-11						3.71E-05	8.15E-05		1.91E-07	1.27E-07
Arsenic	1.18E-10	1.43E-10		1.18E-10	1.43E-10		1.32E-12	4.41E-13	9.7E-11	1.8E-11		2.0E-11	6.7E-12	3.76E-07	4.58E-07		4.41E-09	1.47E-09
Beryllium	8.19E-08	6.08E-08		8.19E-08	6.08E-08		8.71E-11	2.90E-11				7.3E-10	2.4E-10	3.93E-05	1.17E-05		4.36E-08	5.81E-09
Cadmium	5.86E-11	4.46E-11		5.86E-11	4.47E-11		4.15E-13	1.38E-13				2.6E-12	8.7E-13	5.62E-08	4.29E-08		4.15E-10	1.38E-10
Chromium VI	3.90E-10	4.26E-10		3.90E-10	4.26E-10		4.55E-12	1.52E-12				1.9E-10	6.2E-11	1.25E-07	2.04E-08		1.52E-09	7.58E-11
Cobalt	7.96E-09	1.29E-08		8.07E-09	1.40E-08		4.17E-10	1.39E-10				4.1E-09	1.4E-09	3.87E-07	6.69E-07		2.08E-08	6.95E-09
Manganese	1.73E-08	2.77E-08		1.75E-08	2.90E-08		2.05E-09	6.84E-10						8.38E-07	1.99E-07		1.03E-07	4.88E-09
Mercury (elemental)	8.74E-12	5.73E-12		8.74E-12	5.73E-12		1.01E-14	3.35E-15										
Nickel	1.67E-07	1.37E-07		1.67E-07	1.37E-07		1.17E-09	3.90E-10						7.98E-06	6.58E-06		5.86E-08	1.95E-08
Selenium	1.19E-06	1.96E-06		1.19E-06	1.96E-06		5.45E-09	1.82E-09						2.29E-04	3.77E-04		1.09E-06	3.63E-07
Acid Gases																		
HCl	0.00E+00	0.00E+00		0.00E+00	0.00E+00		4.17E-08	1.39E-08										
									2.0E-08	**5.1E-09**		**5.4E-09**	**1.8E-09**	**0.00043**	**0.00063**		**0.000006**	**0.000002**

Appendix I (revised tables)

Table 3 (Revised, March 2007). Risk Analysis - Subsistence Fisher (Location: S7 (Brown Creek))

Chemical	Total Daily Intake: Carcinogen Total Daily Intake: Subsistence Fisher Adult [Flowing Water] (mg/kg-day) ISF_FW	Subsistence Fisher Child [Flowing Water] (mg/kg-day) ICSF_FW	Subsistence Fisher Adult [Quiescent Water] (mg/kg-day) ISF_QW	Subsistence Fisher Child [Quiescent Water] (mg/kg-day) ICSF_QW	Noncarcinogen Total Daily Intake: Subsistence Fisher Adult [Flowing Water] (mg/kg-day) ISF_FWn	Subsistence Fisher Child [Flowing Water] (mg/kg-day) ICSF_FWn	Subsistence Fisher Adult [Quiescent Water] (mg/kg-day) ISF_QWn	Subsistence Fisher Child [Quiescent Water] (mg/kg-day) ICSF_QWn	Total Daily Inhalation: Subsistence Fisher Adult (mg/kg-day) ADIa	Subsistence Fisher Child (mg/kg-day) ADIc
PCDD/PCDF										
2,3,7,8-Tetrachlorodibenzodioxin	8.12E-14	6.36E-14	8.12E-14	6.36E-14	8.12E-14	6.36E-14	8.12E-14	6.36E-14	7.09E-18	3.15E-18
Volatiles										
Acetaldehyde	4.53E-07	6.20E-07	4.53E-07	6.20E-07	4.53E-07	6.20E-07	4.53E-07	6.20E-07	1.53E-08	6.82E-09
Acetone	2.61E-10	3.58E-10	2.61E-10	3.58E-10	2.61E-10	3.58E-10	2.61E-10	3.58E-10	1.43E-11	6.34E-12
Acetophenone	3.00E-09	4.16E-09	3.10E-09	4.22E-09	3.00E-09	4.16E-09	3.10E-09	4.22E-09	4.06E-10	1.81E-10
Acrolein	1.73E-07	2.38E-07	1.74E-07	2.38E-07	1.73E-07	2.38E-07	1.74E-07	2.38E-07	7.81E-09	3.47E-09
Benzene	4.73E-11	6.63E-11	4.93E-11	6.75E-11	4.73E-11	6.63E-11	4.93E-11	6.75E-11	6.72E-12	2.98E-12
Benzyl chloride	2.67E-07	3.65E-07	2.68E-07	3.66E-07	2.67E-07	3.65E-07	2.68E-07	3.66E-07	1.88E-08	8.37E-09
Carbon disulfide	1.73E-11	2.42E-11	1.80E-11	2.46E-11	1.73E-11	2.42E-11	1.80E-11	2.46E-11	2.27E-12	1.01E-12
Chlorobenzene	6.09E-09	8.70E-09	6.26E-09	8.81E-09	6.09E-09	8.70E-09	6.26E-09	8.81E-09	5.93E-10	2.64E-10
Chloroform	1.15E-11	1.59E-11	1.18E-11	1.62E-11	1.15E-11	1.59E-11	1.18E-11	1.62E-11	1.43E-12	6.34E-13
Cumene	2.60E-10	3.61E-10	2.60E-10	3.61E-10	2.60E-10	3.61E-10	2.60E-10	3.61E-10	1.36E-10	6.04E-11
Ethylbenzene	1.02E-08	1.50E-08	1.08E-08	1.54E-08	1.02E-08	1.50E-08	1.08E-08	1.54E-08	2.53E-09	1.12E-09
Ethyl Chloride (chloroethane)	4.37E-09	6.33E-09	4.48E-09	6.40E-09	4.37E-09	6.33E-09	4.48E-09	6.40E-09	1.14E-09	5.05E-10
Ethylene dichloride (I,2-dichloroethane)	6.57E-09	9.07E-09	6.75E-09	9.19E-09	6.57E-09	9.07E-09	6.75E-09	9.19E-09	1.07E-09	4.75E-10
Ethylene dibromide (I,2-dibromoethane)	1.88E-10	2.60E-10	1.94E-10	2.65E-10	1.88E-10	2.60E-10	1.94E-10	2.65E-10	3.39E-11	1.51E-11
Freon 11 (trichlorofluoromethane)	1.09E-11	1.54E-11	1.12E-11	1.56E-11	1.09E-11	1.54E-11	1.12E-11	1.56E-11	1.19E-12	5.30E-13
Freon 12 (dichlorodifluoromethane)	2.88E-11	4.04E-11	2.99E-11	4.11E-11	2.88E-11	4.04E-11	2.99E-11	4.11E-11	3.73E-12	1.66E-12
Hexane	1.37E-10	2.12E-10	1.60E-10	2.27E-10	1.37E-10	2.12E-10	1.60E-10	2.27E-10	7.16E-12	3.18E-12
Methyl bromide (bromomethane)	3.47E-08	4.78E-08	3.54E-08	4.82E-08	3.47E-08	4.78E-08	3.54E-08	4.82E-08	4.31E-09	1.91E-09
Methyl chloride (chloromethane)	7.63E-12	1.05E-11	7.73E-12	1.06E-11	7.63E-12	1.05E-11	7.73E-12	1.06E-11	8.33E-13	3.70E-13
Methylene chloride	5.23E-08	7.23E-08	5.38E-08	7.32E-08	5.23E-08	7.23E-08	5.38E-08	7.32E-08	7.81E-09	3.47E-09
Methyl ethyl ketone (2-butanone)	5.25E-08	7.38E-08	5.61E-08	7.61E-08	5.25E-08	7.38E-08	5.61E-08	7.61E-08	1.05E-08	4.66E-09
Methyl methacrylate	5.69E-09	7.81E-09	5.75E-09	7.85E-09	5.69E-09	7.81E-09	5.75E-09	7.85E-09	5.42E-10	2.41E-10
Methyl tert butyl ether	1.48E-10	2.05E-10	1.54E-10	2.09E-10	1.48E-10	2.05E-10	1.54E-10	2.09E-10	2.50E-11	1.11E-11
Styrene	6.93E-09	9.77E-09	6.95E-09	9.79E-09	6.93E-09	9.77E-09	6.95E-09	9.79E-09	6.78E-10	3.01E-10
Tetrachloroethene	9.78E-11	1.37E-10	9.89E-11	1.38E-10	9.78E-11	1.37E-10	9.89E-11	1.38E-10	6.45E-12	2.86E-12
Toluene	3.89E-08	5.56E-08	4.07E-08	5.68E-08	3.89E-08	5.56E-08	4.07E-08	5.68E-08	6.45E-09	2.86E-09
1,1,1-Trichloroethane	1.23E-07	1.70E-07	1.23E-07	1.70E-07	1.23E-07	1.70E-07	1.23E-07	1.70E-07	5.42E-10	2.41E-10
Vinyl acetate	2.29E-09	3.14E-09	2.31E-09	3.15E-09	2.29E-09	3.14E-09	2.31E-09	3.15E-09	2.03E-10	9.03E-11
Xylenes	6.83E-10	9.85E-10	7.04E-10	9.98E-10	6.83E-10	9.85E-10	7.04E-10	9.98E-10	1.00E-09	4.44E-10
Semi-Volatiles										
Benzo(a)pyrene (equivalents)	1.16E-08	1.29E-08	1.16E-08	1.29E-08	1.16E-08	1.29E-08	1.16E-08	1.29E-08	2.44E-12	1.08E-12
Bis(2-ethylhexyl)phthalate	3.86E-06	6.60E-06	3.86E-06	6.60E-06	3.86E-06	6.60E-06	3.86E-06	6.60E-06	1.96E-09	8.73E-10
Bromoform	1.05E-08	1.47E-08	1.07E-08	1.49E-08	1.05E-08	1.47E-08	1.07E-08	1.49E-08	1.05E-09	4.67E-10
2,4-Dinitrotoluene	6.80E-11	9.49E-11	7.02E-11	9.63E-11	6.80E-11	9.49E-11	7.02E-11	9.63E-11	7.74E-12	3.44E-12
Formaldehyde	2.70E-08	3.70E-08	2.71E-08	3.71E-08	2.70E-08	3.70E-08	2.71E-08	3.71E-08	6.45E-09	2.86E-09
Isophorone	1.96E-07	2.74E-07	1.97E-07	2.75E-07	1.96E-07	2.74E-07	1.97E-07	2.75E-07	1.56E-08	6.94E-09
Phenol	2.77E-09	3.83E-09	2.85E-09	3.88E-09	2.77E-09	3.83E-09	2.85E-09	3.88E-09	4.24E-10	1.88E-10
PCBs										
Polychlorinated biphenyls	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inorganics										
Antimony	5.19E-08	4.13E-08	5.19E-08	4.13E-08	5.19E-08	4.13E-08	5.19E-08	4.13E-08	3.65E-10	1.62E-10
Arsenic	7.66E-10	9.34E-10	7.66E-10	9.34E-10	7.66E-10	9.34E-10	7.66E-10	9.34E-10	6.32E-12	2.81E-12
Beryllium	5.90E-07	4.68E-07	5.90E-07	4.68E-07	5.90E-07	4.68E-07	5.90E-07	4.68E-07	4.17E-10	1.85E-10
Cadmium	3.75E-10	2.75E-10	3.75E-10	2.75E-10	3.75E-10	2.75E-10	3.75E-10	2.75E-10	1.98E-12	8.81E-13
Chromium VI	1.29E-09	1.03E-09	1.29E-09	1.03E-09	1.29E-09	1.03E-09	1.29E-09	1.03E-09	2.17E-11	9.66E-12
Cobalt	2.26E-08	3.75E-08	2.28E-08	3.76E-08	2.26E-08	3.75E-08	2.28E-08	3.76E-08	1.99E-09	8.86E-10
Manganese	3.72E-08	5.73E-08	3.79E-08	5.77E-08	3.72E-08	5.73E-08	3.79E-08	5.77E-08	9.80E-09	4.36E-09
Mercury (elemental)	5.89E-11	3.89E-11	5.89E-11	3.89E-11	5.89E-11	3.89E-11	5.89E-11	3.89E-11	4.81E-14	2.14E-14
Nickel	1.14E-06	9.54E-07	1.14E-06	9.54E-07	1.14E-06	9.54E-07	1.14E-06	9.55E-07	5.60E-09	2.49E-09
Selenium	7.86E-06	1.30E-05	7.87E-06	1.30E-05	7.86E-06	1.30E-05	7.87E-06	1.30E-05	2.60E-08	1.16E-08
Acid Gases										
HCl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.68E-07	1.19E-07

Appendix I (revised tables)

Table 3 (Revised, March 2007). Risk Analysis - Subsistence Fisher (Location: S7 (Brown Creek)) Cont.

Chemical	Total Risk				Inhalation Risk		Total Hazard				Inhalation Hazard	
	Total Risk						Total Hazard					
	Subsistence Fisher Adult [Flowing Water]	Subsistence Fisher Child [Flowing Water]	Subsistence Fisher Adult [Quiescent Water]	Subsistence Fisher Child [Quiescent Water]	Subsistence Fisher Adult	Subsistence Fisher Child	Subsistence Fisher Adult [Flowing Water]	Subsistence Fisher Child [Flowing Water]	Subsistence Fisher Adult [Quiescent Water]	Subsistence Fisher Child [Quiescent Water]	Subsistence Fisher Adult	Subsistence Fisher Child
PCDD/PCDF												
2,3,7,8-Tetrachlorodibenzodioxin	5.0E-09	7.8E-10	5.0E-09	7.8E-10	1.1E-12	4.7E-13						
Volatiles												
Acetaldehyde					1.2E-10	5.3E-11						
Acetone							2.78E-10	3.43E-10	2.78E-10	3.43E-10	1.58E-11	6.34E-12
Acetophenone							2.88E-08	3.99E-09	2.97E-08	4.05E-09	4.06E-09	1.81E-10
Acrolein							3.33E-04	4.56E-04	3.33E-04	4.56E-04	1.56E-05	6.94E-06
Benzene	1.1E-12	3.0E-13	1.1E-12	3.1E-13	1.8E-13	8.1E-14	1.13E-08	1.59E-08	1.18E-08	1.62E-08	1.68E-09	7.46E-10
Benzyl chloride	1.9E-08	5.1E-09	1.9E-08	5.1E-09			1.28E-04	1.75E-04	1.28E-04	1.76E-04	9.42E-06	4.19E-06
Carbon disulfide							1.66E-10	2.32E-10	1.72E-10	2.36E-10	2.27E-11	1.01E-11
Chlorobenzene							2.92E-07	4.17E-08	3.00E-07	4.22E-08	2.97E-08	1.32E-09
Chloroform					1.2E-13	5.1E-14	1.10E-09	1.53E-09	1.13E-09	1.55E-09	1.43E-10	6.34E-11
Cumene							2.49E-09	8.66E-10	2.49E-09	8.67E-10	1.36E-09	1.51E-10
Ethylbenzene							9.75E-08	1.31E-07	1.04E-07	1.34E-07	2.53E-08	1.02E-08
Ethyl Chloride (chloroethane)	5.2E-12	1.5E-12	5.3E-12	1.5E-12			1.05E-08	1.52E-08	1.07E-08	1.54E-08	2.84E-09	1.26E-09
Ethylene dichloride (1,2-dichloroethane)	5.4E-09	1.5E-09	5.5E-09	1.5E-09	2.1E-09	9.5E-10	7.00E-07	9.67E-07	7.19E-07	9.80E-07	1.19E-07	5.28E-08
Ethylene dibromide (1,2-dibromoethane)	7.0E-12	1.9E-12	7.3E-12	2.0E-12	3.1E-12	1.4E-12	9.00E-09	1.25E-08	9.31E-09	1.27E-08	1.70E-09	7.54E-10
Freon 11 (trichlorofluoromethane)							3.47E-11	2.11E-11	3.59E-11	2.14E-11	3.97E-12	7.57E-13
Freon 12 (dichlorodifluoromethane)							1.38E-10	4.30E-11	1.43E-10	4.38E-11	1.86E-11	1.84E-12
Hexane							1.20E-11	3.39E-10	1.40E-11	3.63E-10	6.51E-13	5.30E-12
Methyl bromide (bromomethane)							2.37E-05	9.16E-06	2.42E-05	9.25E-06	3.08E-06	3.83E-07
Methyl chloride (chloromethane)												
Methylene chloride	1.6E-10	4.5E-11	1.7E-10	4.5E-11	1.3E-11	5.7E-12	8.36E-07	8.66E-07	8.60E-07	8.78E-07	1.30E-07	4.34E-08
Methyl ethyl ketone (2-butanone)							8.40E-08	1.18E-07	8.96E-08	1.22E-07	1.75E-08	7.77E-09
Methyl methacrylate							3.89E-09	1.25E-07	3.94E-09	1.25E-07	3.87E-10	4.02E-09
Methyl tert butyl ether	2.4E-13	6.8E-14	2.5E-13	6.9E-14								
Styrene							3.32E-08	9.37E-08	3.33E-08	9.39E-08	3.39E-09	3.01E-09
Tetrachloroethene	2.2E-11	6.1E-12	2.2E-11	6.1E-12	1.3E-13	5.7E-14	9.38E-09	6.58E-11	9.48E-09	6.62E-11	6.45E-10	1.43E-12
Toluene							1.87E-07	2.67E-07	1.95E-07	2.72E-07	3.22E-08	1.43E-08
1,1,1-Trichloroethane							4.20E-07	1.63E-07	4.20E-07	1.63E-07	1.94E-09	2.41E-10
Vinyl acetate							2.19E-09	3.01E-09	2.21E-09	3.02E-09	2.03E-10	9.03E-11
Xylenes							3.28E-09	4.72E-09	3.38E-09	4.78E-09	5.00E-09	2.22E-09
Semi-Volatiles												
Benzo(a)pyrene (equivalents)	3.5E-08	7.7E-09	3.5E-08	7.7E-09	7.6E-12	3.4E-12						
Bis(2-ethylhexyl)phthalate	2.2E-08	7.6E-09	2.2E-08	7.6E-09			1.85E-04	3.16E-04	1.85E-04	3.16E-04	9.82E-08	4.37E-08
Bromoform	3.4E-11	9.6E-12	3.5E-11	9.7E-12	4.1E-12	1.8E-12	5.03E-07	7.06E-08	5.15E-07	7.14E-08	5.25E-08	2.34E-09
2,4-Dinitrotoluene							3.26E-08	4.55E-08	3.36E-08	4.62E-08	3.87E-09	1.72E-09
Formaldehyde					2.9E-10	1.3E-10	1.29E-07	1.77E-07	1.30E-07	1.78E-07	3.22E-08	1.43E-08
Isophorone	7.7E-11	2.1E-11	7.7E-11	2.1E-11			9.40E-07	1.32E-07	9.42E-07	1.32E-07	7.81E-08	3.47E-09
Phenol							8.87E-09	6.13E-09	9.09E-09	6.20E-09	1.41E-09	3.14E-10
PCBs												
Polychlorinated biphenyls												
Inorganics												
Antimony							1.24E-04	1.98E-04	1.24E-04	1.98E-04	9.14E-07	8.12E-07
Arsenic	4.7E-10	1.2E-10	4.7E-10	1.2E-10	9.5E-11	4.2E-11	2.45E-06	2.99E-06	2.45E-06	2.99E-06	2.11E-08	9.36E-09
Beryllium					3.5E-09	1.6E-09	2.83E-04	8.98E-05	2.83E-04	8.98E-05	2.08E-07	3.70E-08
Cadmium					1.2E-11	5.6E-12	3.60E-07	2.63E-07	3.60E-07	2.63E-07	1.98E-09	8.81E-10
Chromium VI					8.9E-10	4.0E-10	4.13E-07	4.95E-08	4.13E-07	4.95E-08	7.24E-09	4.83E-10
Cobalt					2.0E-08	8.7E-09	1.09E-06	1.80E-06	1.09E-06	1.80E-06	9.96E-08	4.43E-08
Manganese							1.78E-06	3.92E-07	1.82E-06	3.95E-07	4.90E-07	3.11E-08
Mercury (elemental)												
Nickel							5.45E-05	4.58E-05	5.45E-05	4.58E-05	2.80E-07	1.24E-07
Selenium							1.51E-03	2.49E-03	1.51E-03	2.50E-03	5.21E-06	2.31E-06
Acid Gases												
HCl												
	1.1E-07	**3.5E-08**	**1.1E-07**	**3.5E-08**	**2.7E-08**	**1.2E-08**	**0.00269**	**0.00381**	**0.00269**	**0.00381**	**0.000036**	**0.000015**

Appendix I (revised tables)

Table 4 (Revised, March 2007). Risk Analysis - School/Day Care (Location: L7 (Rainelle School))

	Total Daily Intake			Total Risk		Total Hazard	
	Total Daily Soil Ingestion		Total Daily Inhalation	Total Risk	Inhalation Risk	Total Hazard	Inhalation Hazard
Chemical	Carcinogen Contaminant Intake From Soil (mg/kg-day) I_{CDC}	Noncarcinogen Contaminant Intake From Soil (mg/kg-day) I_{CDCn}	Day Care Student (mg/kg-day) ADIc	Day Care Student	Day Care Student	Day Care Student	Day Care Student
PCDD/PCDF							
2,3,7,8-Tetrachlorodibenzodioxin	6.00E-19	6.14E-19	4.94E-19	7.4E-15	7.4E-14		
Volatiles							
Acetaldehyde	4.17E-11	4.17E-11	1.07E-09		8.2E-12		
Acetone	2.92E-15	2.92E-15	9.95E-13			2.80E-15	9.95E-13
Acetophenone	1.03E-12	1.03E-12	2.84E-11			9.89E-13	2.84E-11
Acrolein	2.09E-11	2.09E-11	5.45E-10			4.01E-08	1.09E-06
Benzene	3.84E-14	3.85E-14	4.69E-13	1.7E-16	1.3E-14	9.23E-12	1.17E-10
Benzyl chloride	2.98E-11	2.98E-11	1.31E-09	4.2E-13		1.43E-08	6.57E-07
Carbon disulfide	6.94E-15	6.94E-15	1.59E-13			6.66E-14	1.59E-12
Chlorobenzene	4.68E-12	4.69E-12	4.14E-11			2.25E-11	2.07E-10
Chloroform	2.36E-14	2.37E-14	9.95E-14		8.1E-15	2.28E-12	9.95E-12
Cumene	1.46E-13	1.46E-13	9.48E-12			3.51E-13	2.37E-11
Ethylbenzene	3.71E-12	3.72E-12	1.77E-10			3.24E-11	1.60E-09
Ethyl Chloride (chloroethane)	1.55E-12	1.55E-12	7.92E-11	3.7E-16		3.72E-12	1.98E-10
Ethylene dichloride (I,2-dichloroethane)	1.43E-12	1.43E-12	7.46E-11	2.3E-13	1.5E-10	1.52E-10	8.28E-09
Ethylene dibromide (I,2-dibromoethane)	3.68E-14	3.68E-14	2.37E-12	2.8E-16	2.2E-13	1.77E-12	1.18E-10
Freon 11 (trichlorofluoromethane)	2.17E-14	2.18E-14	8.32E-14			2.99E-14	1.19E-13
Freon 12 (dichlorodifluoromethane)	3.64E-14	3.65E-14	2.60E-13			3.89E-14	2.89E-13
Hexane	6.27E-14	6.28E-14	5.00E-13			1.00E-13	8.33E-13
Methyl bromide (bromomethane)	1.83E-11	1.83E-11	3.00E-10			3.51E-09	6.01E-08
Methyl chloride (chloromethane)	3.06E-15	3.06E-15	5.81E-14				
Methylene chloride	2.83E-11	2.84E-11	5.45E-10	1.7E-14	9.0E-13	3.40E-10	6.81E-09
Methyl ethyl ketone (2-butanone)	4.45E-11	4.46E-11	7.31E-10			7.12E-11	1.22E-09
Methyl methacrylate	1.99E-12	2.00E-12	3.78E-11			3.19E-11	6.31E-10
Methyl tert butyl ether	1.11E-13	1.11E-13	1.75E-12	3.6E-17			
Styrene	1.23E-12	1.24E-12	4.73E-11			1.18E-11	4.73E-10
Tetrachloroethene	2.65E-14	2.66E-14	4.50E-13	1.2E-15	9.0E-15	1.27E-14	2.25E-13
Toluene	1.09E-11	1.09E-11	4.50E-10			5.22E-11	2.25E-09
1,1,1-Trichloroethane	1.76E-11	1.77E-11	3.78E-11			1.70E-11	3.78E-11
Vinyl acetate	1.06E-11	1.08E-11	1.42E-11			1.03E-11	1.42E-11
Xylenes	5.52E-14	5.52E-14	6.98E-11			2.65E-13	3.49E-10
Semi-Volatiles							
Benzo(a)pyrene (equivalents)	6.38E-14	6.42E-14	1.70E-13	3.8E-14	5.3E-13		
Bis(2-ethylhexyl)phthalate	1.29E-13	1.29E-13	1.37E-10	1.5E-16		6.20E-12	6.85E-09
Bromoform	2.43E-12	2.43E-12	7.33E-11	1.6E-15	2.9E-13	1.17E-11	3.67E-10
2,4-Dinitrotoluene	2.03E-13	2.04E-13	5.40E-13			9.78E-11	2.70E-10
Formaldehyde	3.57E-13	3.57E-13	4.50E-10		2.0E-11	1.71E-12	2.25E-09
Isophorone	8.62E-13	8.62E-13	1.09E-09	6.7E-17		4.13E-13	5.45E-10
Phenol	5.56E-13	5.56E-13	2.96E-11			8.89E-13	4.93E-11
PCBs							
Polychlorinated biphenyls	0.00E+00	0.00E+00	0.00E+00				
Inorganics							
Antimony	2.18E-08	3.83E-08	2.61E-11			1.83E-04	1.30E-07
Arsenic	6.67E-13	6.68E-13	4.51E-13	8.2E-14	6.8E-12	2.13E-09	1.50E-09
Beryllium	4.40E-11	4.40E-11	2.97E-11		2.5E-10	8.44E-09	5.94E-09
Cadmium	5.47E-11	7.00E-11	1.41E-13		8.9E-13	6.71E-08	1.41E-10
Chromium VI	4.27E-10	5.01E-10	1.55E-12		6.4E-11	2.40E-08	7.75E-11
Cobalt	1.42E-07	2.73E-07	1.42E-10		1.4E-09	1.31E-05	7.11E-09
Manganese	3.76E-07	5.40E-07	6.99E-10			3.70E-06	4.99E-09
Mercury (elemental)	3.16E-13	3.50E-13	3.43E-15				
Nickel	5.91E-10	5.91E-10	3.99E-10			2.84E-08	2.00E-08
Selenium	2.75E-09	2.75E-09	1.86E-09			5.28E-07	3.71E-07
Acid Gases							
HCl	0.00E+00	0.00E+00	1.87E-08				
				1.9E-09	**1.9E-09**	**0.00020**	**0.000002**

Appendix I (revised tables)

Table 5 (Revised, March 2007). Risk Analysis - Nursing Home/Hospital Patient Extended Care Resident (Location: L2 (Rainelle Nursing Home))

Chemical	Total Daily Inhalation Nursing Home Patient (mg/kg-day) ADIa	Total Inhalation Risk Nursing Home Patient	Total Inhalation Hazard Nursing Home Patient
PCDD/PCDF			
2,3,7,8-Tetrachlorodibenzodioxin	3.74E-20	5.6E-15	
Volatiles			
Acetaldehyde	8.08E-11	6.2E-13	
Acetone	7.52E-14		8.36E-14
Acetophenone	2.15E-12		2.15E-11
Acrolein	4.12E-11		8.23E-08
Benzene	3.54E-14	9.6E-16	8.86E-12
Benzyl chloride	9.92E-11		4.96E-08
Carbon disulfide	1.20E-14		1.20E-13
Chlorobenzene	3.13E-12		1.57E-10
Chloroform	7.51E-15	6.1E-16	7.51E-13
Cumene	7.16E-13		7.16E-12
Ethylbenzene	1.33E-11		1.33E-10
Ethyl Chloride (chloroethane)	5.99E-12		1.50E-11
Ethylene dichloride (I,2-dichloroethane)	5.64E-12	1.1E-11	6.26E-10
Ethylene dibromide (I,2-dibromoethane)	1.79E-13	1.6E-14	8.95E-12
Freon 11 (trichlorofluoromethane)	6.29E-15		2.10E-14
Freon 12 (dichlorodifluoromethane)	1.97E-14		9.84E-14
Hexane	3.78E-14		3.43E-15
Methyl bromide (bromomethane)	2.27E-11		1.62E-08
Methyl chloride (chloromethane)	4.39E-15		
Methylene chloride	4.12E-11	6.8E-14	6.86E-10
Methyl ethyl ketone (2-butanone)	5.53E-11		9.22E-11
Methyl methacrylate	2.86E-12		2.05E-12
Methyl tert butyl ether	1.32E-13		
Styrene	3.58E-12		1.79E-11
Tetrachloroethene	3.40E-14	6.8E-16	3.40E-12
Toluene	3.40E-11		1.70E-10
1,1,1-Trichloroethane	2.86E-12		1.02E-11
Vinyl acetate	1.07E-12		1.07E-12
Xylenes	5.28E-12		2.64E-11
Semi-Volatiles			
Benzo(a)pyrene (equivalents)	1.29E-14	4.0E-14	
Bis(2-ethylhexyl)phthalate	1.04E-11		5.19E-10
Bromoform	5.55E-12	2.2E-14	2.77E-10
2,4-Dinitrotoluene	4.08E-14		2.04E-11
Formaldehyde	3.40E-11	1.5E-12	1.70E-10
Isophorone	8.22E-11		4.11E-10
Phenol	2.24E-12		7.46E-12
PCBs			
Polychlorinated biphenyls	0.00E+00		
Inorganics			
Antimony	2.27E-12		5.68E-09
Arsenic	3.92E-14	5.9E-13	1.31E-10
Beryllium	2.58E-12	2.2E-11	1.29E-09
Cadmium	1.23E-14	7.7E-14	1.23E-11
Chromium VI	1.35E-13	5.5E-12	4.49E-11
Cobalt	1.24E-11	1.2E-10	6.19E-10
Manganese	6.08E-11		3.04E-09
Mercury (elemental)	2.98E-16		
Nickel	3.48E-11		1.74E-09
Selenium	1.61E-10		3.23E-08
Acid Gases			
HCl	1.41E-09		
		1.6E-10	**0.00000020**

Appendix I (revised tables)

Appendix J

Intersection Photos and Traffic Modeling Output

Appendix J1 – Intersection Photos

Appendix J2 – HCM Traffic Modeling Output

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Figure 1. Intersection A - on WV20 facing east toward Tom Raine



Figure 2. Intersection A - on WV20 facing south



Figure 3. Intersection B - on US60 facing west



Figure 4. Intersection B - on WV20 facing north



Figure 5. Intersection C - on US60 facing south toward Park Center Shopping area



Figure 6. Intersection C - on US60 facing east



Figure 7. Intersection D - on US60 facing east



Figure 8. Intersection D - on US60 facing west



Figure 9. Intersection E - on US60 facing northwest



Figure 10. Intersection E - on US60 facing northeast

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	11/04/04	Analysis Year	2004
Analysis Time Period	AM (May 13, Th 7:15-8:15)		

Project Description: WGC EIS

East/West Street: Tom Raine Dr — North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: North-South — Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	3	137	4	3	55	8
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	3	137	4	3	55	8
Percent Heavy Vehicles	4	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	3	0	3	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	3	0	3	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	3	3		6				
C (m) (vph)	1527	1442		1560				
v/c	0.00	0.00		0.00				
95% queue length	0.01	0.01		0.01				
Control Delay	7.4	7.5		9.3				
LOS	A	A		A				
Approach Delay	--	--	9.3					
Approach LOS	--	--	A					

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Two-Way Stop Control

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	11/04/04	Analysis Year	2004
Analysis Time Period	MID (May 12, W 12:10-1:10)		

Project Description: WGC EIS

East/West Street: Tom Raine Dr — North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: North-South — Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	121	15	26	94	4
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	0	121	15	26	94	4
Percent Heavy Vehicles	1	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	25	2	26	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	25	2	26	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	0	26		53				
C (m) (vph)	1501	1454		1370				
v/c	0.00	0.02		0.04				
95% queue length	0.00	0.05		0.12				
Control Delay	7.4	7.5		9.7				
LOS	A	A		A				
Approach Delay	--	--	9.7					
Approach LOS	--	--	A					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	11/04/04	Analysis Year	2004
Analysis Time Period	PM (May 11, Tu 4:00-5:00)		
Project Description	WGC EIS		
East/West Street:	Tom Raine Dr	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	North-South	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	91	12	6	120	13
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	0	91	12	6	120	13
Percent Heavy Vehicles	1	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	28	4	10	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	28	4	10	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	0	6		42				
C (m) (vph)	1458	1489		974				
v/c	0.00	0.00		0.04				
95% queue length	0.00	0.01		0.14				
Control Delay	7.5	7.4		9.8				
LOS	A	A		A				
Approach Delay	--	--	9.8					
Approach LOS	--	--	A					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	Jan 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	AM		
Project Description	WGC EIS		
East/West Street:	Tom Raine Dr	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	North-South	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	4	154	5	4	62	8
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	4	154	5	4	62	8
Percent Heavy Vehicles	3	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	4	0	4	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	4	0	4	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	4	4		8				
C (m) (vph)	1524	1420		1502				
v/c	0.00	0.00		0.01				
95% queue length	0.01	0.01		0.02				
Control Delay	7.4	7.5		9.4				
LOS	A	A		A				
Approach Delay	--	--	9.4					
Approach LOS	--	--	A					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	Jan 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	MID		
Project Description	WGC EIS		
East/West Street:	Tom Raine Dr	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	North-South	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	136	17	29	106	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	0	136	17	29	106	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	28	2	29	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	28	2	29	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	0	29		59				
C (m) (vph)	1492	1440		1312				
v/c	0.00	0.02		0.04				
95% queue length	0.00	0.06		0.14				
Control Delay	7.4	7.6		9.9				
LOS	A	A		A				
Approach Delay	--	--	9.9					
Approach LOS	--	--	A					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	PM		
Project Description	WGC EIS		
East/West Street:	Tom Raine Dr	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	North-South	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	103	13	7	135	14
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	0	103	13	7	135	14
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	31	5	11	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	31	5	11	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	0	7		47				
C (m) (vph)	1445	1473		927				
v/c	0.00	0.00		0.05				
95% queue length	0.00	0.01		0.16				
Control Delay	7.5	7.5		10.0				
LOS	A	A		A				
Approach Delay	--	--	10.0					
Approach LOS	--	--	A					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	Apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	AM		
Project Description	WGC EIS		
East/West Street:	Tom Raine Dr	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	North-South	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	4	154	10	34	62	8
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	4	154	10	34	62	8
Percent Heavy Vehicles	3	--	--	38	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	7	0	23	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	7	0	23	0	0	0
Percent Heavy Vehicles	15	0	55	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	4	34		30				
C (m) (vph)	1524	1223		998				
v/c	0.00	0.03		0.03				
95% queue length	0.01	0.09		0.09				
Control Delay	7.4	8.0		10.0				
LOS	A	A		B				
Approach Delay	--	--	10.0					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	Apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	MID		
Project Description	WGC EIS		
East/West Street:	Tom Raine Dr	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	North-South	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	136	20	48	106	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	0	136	20	48	106	5
Percent Heavy Vehicles	0	--	--	27	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	31	2	48	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	31	2	48	0	0	0
Percent Heavy Vehicles	3	0	27	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	0	48		81				
C (m) (vph)	1492	1285		1416				
v/c	0.00	0.04		0.06				
95% queue length	0.00	0.12		0.18				
Control Delay	7.4	7.9		10.2				
LOS	A	A		B				
Approach Delay	--	--	10.2					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	A: WV20/Tom Raine Dr
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	Apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	PM		
Project Description	WGC EIS		
East/West Street:	Tom Raine Dr	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	North-South	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	103	16	26	135	14
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	0	103	16	26	135	14
Percent Heavy Vehicles	0	--	--	48	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	36	5	41	0	0	0
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	36	5	41	0	0	0
Percent Heavy Vehicles	3	0	31	0	0	0
Percent Grade (%)		0			0	
Flared Approach		Y			N	
Storage		1			0	
RT Channelized			0			0
Lanes	0	1	0	0	0	0
Configuration		LTR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR				
v (vph)	0	26		82				
C (m) (vph)	1445	1228		1318				
v/c	0.00	0.02		0.06				
95% queue length	0.00	0.06		0.20				
Control Delay	7.5	8.0		10.1				
LOS	A	A		B				
Approach Delay	--	--	10.1					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., V
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	AM (May 12, W 7:35-8:35)		
Project Description	WGC EIS		
East/West Street:	US60	North/South Street:	WV20 (aka S. Sewell St.)
Intersection Orientation:	East-West	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	6	122	13	65	133	29
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	6	122	13	65	133	29
Proportion of heavy vehicles, P_{HV}	5	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	18	2	161	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	18	2	161	0	0	0
Proportion of heavy vehicles, P_{HV}	5	0	5	10	0	0
Percent grade (%)		0			0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	6	65	20		161			
Capacity, c_m (vph)	1399	1401	549		914			
v/c ratio	0.00	0.05	0.04		0.18			
Queue length (95%)	0.01	0.15	0.11		0.64			
Control Delay (s/veh)	7.6	7.7	11.8		9.8			
LOS	A	A	B		A			
Approach delay (s/veh)	--	--	10.0					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	MID (May 12, W 12:12-1:12)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	92	4	117	89	32
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	1	92	4	117	89	32
Proportion of heavy vehicles, P_{HV}	10	--	--	7	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	15	10	119	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	15	10	119	0	0	0
Proportion of heavy vehicles, P_{HV}	1	0	1	10	0	0
Percent grade (%)		0			0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	1	117	25		119			
Capacity, c_m (vph)	1418	1467	504		966			
v/c ratio	0.00	0.08	0.05		0.12			
Queue length (95%)	0.00	0.26	0.16		0.42			
Control Delay (s/veh)	7.5	7.7	12.5		9.3			
LOS	A	A	B		A			
Approach delay (s/veh)	--	--	9.8					
Approach LOS	--	--	A					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., W
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	PM (May 11, Tu 4:45-5:45)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	88	13	145	124	13
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	1	88	13	145	124	13
Proportion of heavy vehicles, P_{HV}	4	--	--	1	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	12	8	109	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	12	8	109	0	0	0
Proportion of heavy vehicles, P_{HV}	1	0	1	10	0	0
Percent grade (%)		0			0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	1	145	20		109			
Capacity, c_m (vph)	1435	1498	447		966			
v/c ratio	0.00	0.10	0.04		0.11			
Queue length (95%)	0.00	0.32	0.14		0.38			
Control Delay (s/veh)	7.5	7.7	13.4		9.2			
LOS	A	A	B		A			
Approach delay (s/veh)	--	--	9.9					
Approach LOS	--	--	A					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	AM		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	7	137	14	74	150	33
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	7	137	14	74	150	33
Proportion of heavy vehicles, P_{HV}	5	--	--	11	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	21	2	181	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	21	2	181	0	0	0
Proportion of heavy vehicles, P_{HV}	5	5	5	10	0	0
Percent grade (%)	0				0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	7	74	23		181			
Capacity, c_m (vph)	1374	1377	506		895			
v/c ratio	0.01	0.05	0.05		0.20			
Queue length (95%)	0.02	0.17	0.14		0.76			
Control Delay (s/veh)	7.6	7.8	12.5		10.0			
LOS	A	A	B		B			
Approach delay (s/veh)	--	--	10.3					
Approach LOS	--	--	B					

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Two-Way Stop Control

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	MID		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	104	5	131	100	36
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	1	104	5	131	100	36
Proportion of heavy vehicles, P_{HV}	10	--	--	8	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	17	11	134	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	17	11	134	0	0	0
Proportion of heavy vehicles, P_{HV}	1	0	1	10	0	0
Percent grade (%)	0				0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	1	131	28		134			
Capacity, c_m (vph)	1400	1445	465		951			
v/c ratio	0.00	0.09	0.06		0.14			
Queue length (95%)	0.00	0.30	0.19		0.49			
Control Delay (s/veh)	7.6	7.7	13.2		9.4			
LOS	A	A	B		A			
Approach delay (s/veh)	--	--	10.1					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	PM		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	99	14	163	140	14
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	1	99	14	163	140	14
Proportion of heavy vehicles, P_{HV}	0	--	--	1	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	13	8	123	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	13	8	123	0	0	0
Proportion of heavy vehicles, P_{HV}	1	0	1	10	0	0
Percent grade (%)		0			0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	1	163	21		123			
Capacity, c_m (vph)	1439	1483	405		951			
v/c ratio	0.00	0.11	0.05		0.13			
Queue length (95%)	0.00	0.37	0.16		0.45			
Control Delay (s/veh)	7.5	7.7	14.4		9.3			
LOS	A	A	B		A			
Approach delay (s/veh)	--	--	10.1					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	Apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	AM		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	7	137	19	99	150	33
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	7	137	19	99	150	33
Proportion of heavy vehicles, P_{HV}	5	--	--	19	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	24	2	197	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	24	2	197	0	0	0
Proportion of heavy vehicles, P_{HV}	13	5	10	10	0	0
Percent grade (%)		0			0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	7	99	26		197			
Capacity, c_m (vph)	1374	1327	452		880			
v/c ratio	0.01	0.07	0.06		0.22			
Queue length (95%)	0.02	0.24	0.18		0.86			
Control Delay (s/veh)	7.6	7.9	13.5		10.3			
LOS	A	A	B		B			
Approach delay (s/veh)	--	--	10.6					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	apr 2005	Analysis Year	BUILD 2008
Analysis Time Period	MID		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	104	8	147	100	36
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	1	104	8	147	100	36
Proportion of heavy vehicles, P_{HV}	10	--	--	14	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	20	11	151	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	20	11	151	0	0	0
Proportion of heavy vehicles, P_{HV}	11	0	8	10	0	0
Percent grade (%)		0			0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	1	147	31		151			
Capacity, c_m (vph)	1400	1406	431		930			
v/c ratio	0.00	0.10	0.07		0.16			
Queue length (95%)	0.00	0.35	0.23		0.58			
Control Delay (s/veh)	7.6	7.9	14.0		9.6			
LOS	A	A	B		A			
Approach delay (s/veh)	--	--	10.4					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	B: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	apr 2005	Analysis Year	BUILD 2008
Analysis Time Period	PM		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (aka S. Sewell St.)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	99	17	179	140	14
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	1	99	17	179	140	14
Proportion of heavy vehicles, P_{HV}	0	--	--	7	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	1	1	0
Configuration	LTR			L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	18	8	148	0	0	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	18	8	148	0	0	0
Proportion of heavy vehicles, P_{HV}	12	0	8	10	0	0
Percent grade (%)		0			0	
Flared approach		N			N	
Storage		0			0	
RT Channelized?			1			0
Lanes	0	1	1	0	0	0
Configuration	LT		R			

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	L	LT		R			
Volume, v (vph)	1	179	26		148			
Capacity, c_m (vph)	1439	1442	374		930			
v/c ratio	0.00	0.12	0.07		0.16			
Queue length (95%)	0.00	0.42	0.22		0.57			
Control Delay (s/veh)	7.5	7.9	15.3		9.6			
LOS	A	A	C		A			
Approach delay (s/veh)	--	--	10.5					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	AM (May 13, Th 7:45-8:45)		

Project Description: WGC EIS

East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	5	269	27	58	231	4
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	5	269	27	58	231	4
Proportion of heavy vehicles, P_{HV}	5	--	--	4	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	11	0	51	2	4	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	11	0	51	2	4	0
Proportion of heavy vehicles, P_{HV}	1	0	1	0	0	0
Percent grade (%)	0			0		
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	5	58	11		51		6	
Capacity, c_m (vph)	1315	1254	370		759			
v/c ratio	0.00	0.05	0.03		0.07			
Queue length (95%)	0.01	0.15	0.09		0.22			
Control Delay (s/veh)	7.7	8.0	15.0		10.1		15.1	
LOS	A	A	C		B			
Approach delay (s/veh)	--	--	11.0			15.1		
Approach LOS	--	--	B			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., V
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	MID (May 11, Tu 11:50-12:50)		

Project Description: WGC EIS

East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	0	294	63	132	273	10
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	294	63	132	273	10
Proportion of heavy vehicles, P_{HV}	3	--	--	2	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	43	3	149	16	1	4
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	43	3	149	16	1	4
Proportion of heavy vehicles, P_{HV}	1	0	1	0	0	0
Percent grade (%)	0			0		
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	0	132	46		149		21	
Capacity, c_m (vph)	1274	1202	249		718		246	
v/c ratio	0.00	0.11	0.18		0.21		0.09	
Queue length (95%)	0.00	0.37	0.68		0.78		0.28	
Control Delay (s/veh)	7.8	8.4	22.7		11.3		21.9	
LOS	A	A	C		B		C	
Approach delay (s/veh)	--	--	14.0			21.9		
Approach LOS	--	--	B			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	PM (May 12, W 4:30-5:30)		

Project Description: WGC EIS

East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	2	234	47	73	298	19
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	2	234	47	73	298	19
Proportion of heavy vehicles, P_{HV}	2	--	--	2	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	32	3	121	10	2	8
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	32	3	121	10	2	8
Proportion of heavy vehicles, P_{HV}	1	0	1	0	0	0
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	2	73	35		121		20	
Capacity, c_m (vph)	1243	1282	325		783		475	
v/c ratio	0.00	0.06	0.11		0.15		0.04	
Queue length (95%)	0.00	0.18	0.36		0.55		0.13	
Control Delay (s/veh)	7.9	8.0	17.4		10.4		14.9	
LOS	A	A	C		B		B	
Approach delay (s/veh)	--	--	12.0			14.9		
Approach LOS	--	--	B			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., W
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	AM		

Project Description: WGC EIS

East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	6	303	30	65	260	5
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	6	303	30	65	260	5
Proportion of heavy vehicles, P_{HV}	0	--	--	0	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	12	0	58	2	5	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	12	0	58	2	5	0
Proportion of heavy vehicles, P_{HV}	2	0	2	0	0	0
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	6	65	12		58		7	
Capacity, c_m (vph)	1311	1238	321		723			
v/c ratio	0.00	0.05	0.04		0.08			
Queue length (95%)	0.01	0.17	0.12		0.26			
Control Delay (s/veh)	7.8	8.1	16.7		10.4		16.5	
LOS	A	A	C		B			
Approach delay (s/veh)	--	--	11.5			16.5		
Approach LOS	--	--	B			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	MID		

Project Description: WGC EIS

East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	0	330	71	148	308	11
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	330	71	148	308	11
Proportion of heavy vehicles, P_{HV}	0	--	--	2	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	48	4	168	18	1	5
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	48	4	168	18	1	5
Proportion of heavy vehicles, P_{HV}	1	0	1	0	0	0
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	0	148	52		168		24	
Capacity, c_m (vph)	1252	1158	207		681		198	
v/c ratio	0.00	0.13	0.25		0.25		0.12	
Queue length (95%)	0.00	0.44	0.99		0.98		0.41	
Control Delay (s/veh)	7.9	8.6	28.2		12.0		26.7	
LOS	A	A	D		B		D	
Approach delay (s/veh)	--	--	15.8			26.7		
Approach LOS	--	--	C			D		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., W
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	PM		

Project Description: WGC EIS

East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	2	263	53	82	335	22
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	2	263	53	82	335	22
Proportion of heavy vehicles, P_{HV}	0	--	--	0	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	36	4	136	11	2	8
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	36	4	136	11	2	8
Proportion of heavy vehicles, P_{HV}	0	0	0	0	0	0
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	2	82	40		136		21	
Capacity, c_m (vph)	1213	1256	282		754		388	
v/c ratio	0.00	0.07	0.14		0.18		0.05	
Queue length (95%)	0.00	0.21	0.49		0.66		0.17	
Control Delay (s/veh)	8.0	8.1	19.9		10.8		16.8	
LOS	A	A	C		B		C	
Approach delay (s/veh)	--	--	12.9			16.8		
Approach LOS	--	--	B			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	apr 2005	Analysis Year	BUILD 2008
Analysis Time Period	AM		

Project Description: WGC EIS
East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	6	319	30	65	285	5
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	6	319	30	65	285	5
Proportion of heavy vehicles, P_{HV}	0	--	--	0	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	12	0	58	2	5	0
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	12	0	58	2	5	0
Proportion of heavy vehicles, P_{HV}	2	0	2	0	0	0
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	6	65	12		58		7	
Capacity, c_m (vph)	1283	1221	302		708			
v/c ratio	0.00	0.05	0.04		0.08			
Queue length (95%)	0.01	0.17	0.12		0.27			
Control Delay (s/veh)	7.8	8.1	17.4		10.5		17.2	
LOS	A	A	C		B			
Approach delay (s/veh)	--	--	11.7			17.2		
Approach LOS	--	--	B			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	MID		

Project Description: WGC EIS
East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	0	346	71	148	324	11
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	346	71	148	324	11
Proportion of heavy vehicles, P_{HV}	0	--	--	2	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	48	4	168	18	1	5
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	48	4	168	18	1	5
Proportion of heavy vehicles, P_{HV}	1	0	1	0	0	0
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	0	148	52		168		24	
Capacity, c_m (vph)	1236	1142	196		667		187	
v/c ratio	0.00	0.13	0.27		0.25		0.13	
Queue length (95%)	0.00	0.45	1.07		1.01		0.44	
Control Delay (s/veh)	7.9	8.6	30.0		12.2		28.1	
LOS	A	A	D		B		D	
Approach delay (s/veh)	--	--	16.4			28.1		
Approach LOS	--	--	C			D		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	C: US60/WV20 & Locust St
Agency/Co.	PHE	Jurisdiction	Rainelle, Greenbrier Co., WV
Date Performed	apr 2005	Analysis Year	BUILD 2008
Analysis Time Period	PM		

Project Description: WGC EIS

East/West Street: US60/WV20 (Kanawha Ave) | North/South Street: Locust St. & Park Center

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	2	288	53	82	351	22
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	2	288	53	82	351	22
Proportion of heavy vehicles, P_{HV}	0	--	--	0	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	36	4	136	11	2	8
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	36	4	136	11	2	8
Proportion of heavy vehicles, P_{HV}	0	0	0	0	0	0
Percent grade (%)	0			0		
Flared approach		N			Y	
Storage		1			1	
RT Channelized?			1			0
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L	L	LT		R		LTR	
Volume, v (vph)	2	82	40		136		21	
Capacity, c_m (vph)	1197	1229	265		731		362	
v/c ratio	0.00	0.07	0.15		0.19		0.06	
Queue length (95%)	0.01	0.21	0.53		0.68		0.18	
Control Delay (s/veh)	8.0	8.1	21.0		11.0		17.6	
LOS	A	A	C		B		C	
Approach delay (s/veh)	--	--	13.3			17.6		
Approach LOS	--	--	B			C		

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SHORT REPORT

General Information		Site Information	
Analyst	CMO	Intersection	D: US60 & 7th St
Agency or Co.	PHE	Area Type	CBD or Similar
Date Performed	11/11/04	Jurisdiction	Rainelle, WV (Greenbrier Co.)
Time Period	AM (May 12, W 7:45-8:45)	Analysis Year	2004

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	10	234	1	4	224	13	9	4	6	9	5	6
% Heavy veh	6	6	0	0	8	8	0	0	0	16	0	16
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	3			3								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G = 0.0	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 | Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	245	241	19	20
Lane group cap.	792	777	455	408
v/c ratio	0.31	0.31	0.04	0.05
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	9.5	9.5	18.3	18.3
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	1.0	1.0	0.2	0.2
PF factor	1.000	1.000	0.969	0.969
Control delay	10.5	10.5	17.9	18.0
Lane group LOS	B	B	B	B
Apprch. delay	10.5	10.5	17.9	18.0
Approach LOS	B	B	B	B
Intersec. delay	11.0	Intersection LOS		B

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SHORT REPORT

General Information		Site Information	
Analyst	CMO	Intersection	D: US60 & 7th St
Agency or Co.	PHE	Area Type	CBD or Similar
Date Performed	11/11/04	Jurisdiction	Rainelle, WV (Greenbrier Co.)
Time Period	MID (May 11, Tu 12:05-1:05)	Analysis Year	2004

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	15	311	11	3	311	11	26	3	5	11	2	20
% Heavy veh	4	4	0	0	4	4	0	0	0	13	0	13
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	5			5								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G =	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 — Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	337	325	34	33
Lane group cap.	792	800	445	391
v/c ratio	0.43	0.41	0.08	0.08
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	10.3	10.1	18.5	18.5
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	1.7	1.5	0.3	0.4
PF factor	1.000	1.000	0.969	0.969
Control delay	11.9	11.7	18.2	18.4
Lane group LOS	B	B	B	B
Apprch. delay	11.9	11.7	18.2	18.4
Approach LOS	B	B	B	B
Intersec. delay	12.4	Intersection LOS		B

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SHORT REPORT

General Information		Site Information	
Analyst	CMO	Intersection	D: US60 & 7th St
Agency or Co.	PHE	Area Type	CBD or Similar
Date Performed	11/11/04	Jurisdiction	Rainelle, WV (Greenbrier Co.)
Time Period	PM (May 12, W 4:30-5:30)	Analysis Year	2004

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	3	313	3	1	323	2	19	3	9	12	8	27
% Heavy veh	1	1	0	0	2	2	0	0	0	1	0	1
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	5			5								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G =	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 — Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	319	326	31	47
Lane group cap.	826	819	442	439
v/c ratio	0.39	0.40	0.07	0.11
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	10.0	10.1	18.4	18.6
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	1.4	1.5	0.3	0.5
PF factor	1.000	1.000	0.969	0.969
Control delay	11.3	11.5	18.2	18.6
Lane group LOS	B	B	B	B
Apprch. delay	11.3	11.5	18.2	18.6
Approach LOS	B	B	B	B
Intersec. delay	12.2	Intersection LOS		B

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SHORT REPORT

General Information		Site Information	
Analyst	CMO	Intersection	D: US60 & 7th St
Agency or Co.	PHE	Area Type	CBD or Similar
Date Performed	JAN 2005	Jurisdiction	Rainelle, WV (Greenbrier Co.)
Time Period	AM	Analysis Year	NO BUILD 2008

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	11	263	1	5	252	14	10	5	7	10	6	7
% Heavy veh	5	5	0	0	7	7	0	0	0	16	0	16
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	3			3								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G = 0.0	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 — Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	275	271	22	23
Lane group cap.	799	784	454	408
v/c ratio	0.34	0.35	0.05	0.06
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	9.7	9.7	18.3	18.3
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	1.2	1.2	0.2	0.3
PF factor	1.000	1.000	0.969	0.969
Control delay	10.9	10.9	17.9	18.0
Lane group LOS	B	B	B	B
Apprch. delay	10.9	10.9	17.9	18.0
Approach LOS	B	B	B	B
Intersec. delay	11.4	Intersection LOS		B

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SHORT REPORT

General Information		Site Information	
Analyst	CMO	Intersection	D: US60 & 7th St
Agency or Co.	PHE	Area Type	CBD or Similar
Date Performed	JAN 2005	Jurisdiction	Rainelle, WV (Greenbrier Co.)
Time Period	MID	Analysis Year	NO BUILD 2008

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	17	350	12	4	350	12	29	4	6	12	2	23
% Heavy veh	4	4	0	0	4	4	0	0	0	13	0	13
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	5			5								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G =	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 — Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	379	366	39	37
Lane group cap.	790	799	443	389
v/c ratio	0.48	0.46	0.09	0.10
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	10.7	10.5	18.5	18.6
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	2.1	1.9	0.4	0.5
PF factor	1.000	1.000	0.969	0.969
Control delay	12.8	12.4	18.4	18.5
Lane group LOS	B	B	B	B
Apprch. delay	12.8	12.4	18.4	18.5
Approach LOS	B	B	B	B
Intersec. delay	13.1	Intersection LOS		B

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SHORT REPORT

General Information

Analyst	CMO
Agency or Co.	PHE
Date Performed	JAN 2005
Time Period	PM

Site Information

Intersection	D: US60 & 7th St
Area Type	CBD or Similar
Jurisdiction	Rainelle, WV (Greenbrier Co.)
Analysis Year	NO BUILD 2008

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	4	352	4	1	363	2	22	4	10	13	8	30
% Heavy veh	1	1	0	0	2	2	0	0	0	1	0	1
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	5			5								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G =	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	360	366	36	51
Lane group cap.	825	819	441	438
v/c ratio	0.44	0.45	0.08	0.12
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	10.3	10.4	18.5	18.7
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	1.7	1.8	0.4	0.5
PF factor	1.000	1.000	0.969	0.969
Control delay	12.0	12.2	18.3	18.7
Lane group LOS	B	B	B	B
Apprch. delay	12.0	12.2	18.3	18.7
Approach LOS	B	B	B	B
Intersec. delay	12.8	Intersection LOS		B

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SHORT REPORT

General Information

Analyst	CMO
Agency or Co.	PHE
Date Performed	apr 2006
Time Period	AM

Site Information

Intersection	D: US60 & 7th St
Area Type	CBD or Similar
Jurisdiction	Rainelle, WV (Greenbrier Co.)
Analysis Year	BUILD 2008

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	13	275	3	5	272	14	13	5	7	10	6	9
% Heavy veh	4	9	0	0	11	7	0	0	0	16	0	13
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	3			3								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G = 0.0	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	291	291	25	25
Lane group cap.	769	757	453	408
v/c ratio	0.38	0.38	0.06	0.06
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	9.9	10.0	18.3	18.4
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	1.4	1.5	0.2	0.3
PF factor	1.000	1.000	0.969	0.969
Control delay	11.3	11.4	18.0	18.1
Lane group LOS	B	B	B	B
Apprch. delay	11.3	11.4	18.0	18.1
Approach LOS	B	B	B	B
Intersec. delay	11.9	Intersection LOS		B

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SHORT REPORT

General Information		Site Information	
Analyst	CMO	Intersection	D: US60 & 7th St
Agency or Co.	PHE	Area Type	CBD or Similar
Date Performed	apr 2006	Jurisdiction	Rainelle, WV (Greenbrier Co.)
Time Period	MID	Analysis Year	BUILD 2008

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	19	362	14	4	362	12	31	4	6	12	2	25
% Heavy veh	4	7	0	0	7	4	0	0	0	13	0	12
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	5			5								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G =	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	395	378	41	39
Lane group cap.	768	778	442	390
v/c ratio	0.51	0.49	0.09	0.10
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	11.0	10.7	18.6	18.6
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	2.5	2.2	0.4	0.5
PF factor	1.000	1.000	0.969	0.969
Control delay	13.4	12.9	18.4	18.5
Lane group LOS	B	B	B	B
Apprch. delay	13.4	12.9	18.4	18.5
Approach LOS	B	B	B	B
Intersec. delay	13.7	Intersection LOS		B

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SHORT REPORT

General Information		Site Information	
Analyst	CMO	Intersection	D: US60 & 7th St
Agency or Co.	PHE	Area Type	CBD or Similar
Date Performed	apr 2006	Jurisdiction	Rainelle, WV (Greenbrier Co.)
Time Period	PM	Analysis Year	BUILD 2008

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Num. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group		LTR			LTR			LTR			LTR	
Volume (vph)	6	372	7	1	375	2	24	4	10	13	8	32
% Heavy veh	1	4	0	0	5	2	0	0	0	1	0	1
PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Actuated (P/A)	P	P	P	P	P	P	P	P	P	P	P	P
Startup lost time		2.0			2.0			2.0			2.0	
Ext. eff. green		2.0			2.0			2.0			2.0	
Arrival type		3			3			4			4	
Unit Extension		3.0			3.0			3.0			3.0	
Ped/Bike/RTOR Volume	0		0	0		0	0		0	0		0
Lane Width		16.0			16.0			12.0			12.0	
Parking/Grade/Parking	Y	0	N	Y	0	N	N	0	N	N	0	N
Parking/hr	5			5								
Bus stops/hr		0			0			0			0	
Unit Extension		3.0			3.0			3.0			3.0	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 43.0	G =	G =	G =	G = 25.0	G =	G =	G =
	Y = 5	Y =	Y =	Y =	Y = 5	Y =	Y =	Y =

Duration of Analysis (hrs) = 1.00 Cycle Length C = 78.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB	WB	NB	SB
Adj. flow rate	385	378	38	53
Lane group cap.	800	796	440	437
v/c ratio	0.48	0.47	0.09	0.12
Green ratio	0.55	0.55	0.32	0.32
Unif. delay d1	10.7	10.6	18.5	18.7
Delay factor k	0.50	0.50	0.50	0.50
Increm. delay d2	2.1	2.0	0.4	0.6
PF factor	1.000	1.000	0.969	0.969
Control delay	12.8	12.7	18.3	18.7
Lane group LOS	B	B	B	B
Apprch. delay	12.8	12.7	18.3	18.7
Approach LOS	B	B	B	B
Intersec. delay	13.3	Intersection LOS		B

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, Greenbrier Co., WV
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	AM (May 13, Th 7:30-8:30)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	69	244	0	0	237	58
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	69	244	0	0	237	58
Proportion of heavy vehicles, P_{HV}	10	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	46	0	90
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	46	0	90
Proportion of heavy vehicles, P_{HV}	10	0	10	6	0	6
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	69						136	
Capacity, c_m (vph)	1222						1153	
v/c ratio	0.06						0.12	
Queue length (95%)	0.18						0.40	
Control Delay (s/veh)	8.1						11.9	
LOS	A						B	
Approach delay (s/veh)	--	--					11.9	
Approach LOS	--	--					B	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, Greenbrier Co., WV
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	MID (May 13, Th 11:45-12:45)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	72	198	0	0	220	29
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	72	198	0	0	220	29
Proportion of heavy vehicles, P_{HV}	8	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	32	0	76
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	32	0	76
Proportion of heavy vehicles, P_{HV}	10	0	10	3	0	3
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	72						108	
Capacity, c_m (vph)	1282						1141	
v/c ratio	0.06						0.09	
Queue length (95%)	0.18						0.31	
Control Delay (s/veh)	8.0						11.0	
LOS	A						B	
Approach delay (s/veh)	--	--					11.0	
Approach LOS	--	--					B	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, Greenbrier Co., WV
Date Performed	11/11/04	Analysis Year	2004
Analysis Time Period	PM (May 11, Tu 5-6)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	78	213	0	0	336	66
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	78	213	0	0	336	66
Proportion of heavy vehicles, P_{HV}	4	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	47	0	57
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	47	0	57
Proportion of heavy vehicles, P_{HV}	10	0	10	2	0	2
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	78						104	
Capacity, c_m (vph)	1146						794	
v/c ratio	0.07						0.13	
Queue length (95%)	0.22						0.45	
Control Delay (s/veh)	8.4						13.4	
LOS	A						B	
Approach delay (s/veh)	--	--					13.4	
Approach LOS	--	--					B	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	AM		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	77	275	0	0	267	65
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	77	275	0	0	267	65
Proportion of heavy vehicles, P_{HV}	10	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	52	0	101
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	52	0	101
Proportion of heavy vehicles, P_{HV}	10	0	10	6	0	6
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	77						153	
Capacity, c_m (vph)	1184						1056	
v/c ratio	0.07						0.14	
Queue length (95%)	0.21						0.51	
Control Delay (s/veh)	8.3						12.8	
LOS	A						B	
Approach delay (s/veh)	--	--					12.8	
Approach LOS	--	--					B	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	MID		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	81	223	0	0	247	33
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	81	223	0	0	247	33
Proportion of heavy vehicles, P_{HV}	8	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	36	0	86
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	36	0	86
Proportion of heavy vehicles, P_{HV}	10	0	10	3	0	3
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	81						122	
Capacity, c_m (vph)	1249						1095	
v/c ratio	0.06						0.11	
Queue length (95%)	0.21						0.38	
Control Delay (s/veh)	8.1						11.6	
LOS	A						B	
Approach delay (s/veh)	--	--					11.6	
Approach LOS	--	--					B	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	PM		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	88	240	0	0	379	75
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	88	240	0	0	379	75
Proportion of heavy vehicles, P_{HV}	4	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	53	0	64
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	53	0	64
Proportion of heavy vehicles, P_{HV}	10	0	10	2	0	2
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	88						117	
Capacity, c_m (vph)	1096						689	
v/c ratio	0.08						0.17	
Queue length (95%)	0.26						0.61	
Control Delay (s/veh)	8.6						14.7	
LOS	A						B	
Approach delay (s/veh)	--	--					14.7	
Approach LOS	--	--					B	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	AM (source: Anj/JK/Donegan)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	85	278	0	0	275	65
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	85	278	0	0	275	65
Proportion of heavy vehicles, P_{HV}	17	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	52	0	110
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	52	0	110
Proportion of heavy vehicles, P_{HV}	10	0	10	6	0	12
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	85						162	
Capacity, c_m (vph)	1140						1044	
v/c ratio	0.07						0.16	
Queue length (95%)	0.24						0.55	
Control Delay (s/veh)	8.4						13.1	
LOS	A						B	
Approach delay (s/veh)	--	--					13.1	
Approach LOS	--	--					B	

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Two-Way Stop Control Page 1 of 1

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	MID (source: Anj/JK/Donegan)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	88	226	0	0	250	33
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	88	226	0	0	250	33
Proportion of heavy vehicles, P_{HV}	15	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	36	0	93
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	36	0	93
Proportion of heavy vehicles, P_{HV}	10	0	10	3	0	10
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	88						129	
Capacity, c_m (vph)	1208						1046	
v/c ratio	0.07						0.12	
Queue length (95%)	0.24						0.42	
Control Delay (s/veh)	8.2						11.8	
LOS	A						B	
Approach delay (s/veh)	--	--					11.8	
Approach LOS	--	--					B	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	PM (source: Anj/JK/Donegan)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	97	248	0	0	382	75
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	97	248	0	0	382	75
Proportion of heavy vehicles, P_{HV}	11	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	53	0	72
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	53	0	72
Proportion of heavy vehicles, P_{HV}	10	0	10	2	0	12
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	97						125	
Capacity, c_m (vph)	1058						696	
v/c ratio	0.09						0.18	
Queue length (95%)	0.30						0.66	
Control Delay (s/veh)	8.7						15.1	
LOS	A						C	
Approach delay (s/veh)	--	--				15.1		
Approach LOS	--	--				C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	AM (Green Valley source)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	78	278	0	0	275	65
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	78	278	0	0	275	65
Proportion of heavy vehicles, P_{HV}	24	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	52	0	103
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	52	0	103
Proportion of heavy vehicles, P_{HV}	10	0	10	6	0	18
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	78						155	
Capacity, c_m (vph)	1106						1043	
v/c ratio	0.07						0.15	
Queue length (95%)	0.23						0.52	
Control Delay (s/veh)	8.5						13.1	
LOS	A						B	
Approach delay (s/veh)	--	--				13.1		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1
Agency/Co.	PHE	Jurisdiction	Rupert, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	MID (Green Valley source)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	81	226	0	0	250	33
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	81	226	0	0	250	33
Proportion of heavy vehicles, P_{HV}	23	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	36	0	86
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	36	0	86
Proportion of heavy vehicles, P_{HV}	10	0	10	3	0	18
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	81						122	
Capacity, c_m (vph)	1168						1044	
v/c ratio	0.07						0.12	
Queue length (95%)	0.22						0.40	
Control Delay (s/veh)	8.3						11.8	
LOS	A						B	
Approach delay (s/veh)	--	--				11.8		
Approach LOS	--	--				B		

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Two-Way Stop Control Page 1 of 1

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	E: US60 & CR1 - Green Valley
Agency/Co.	PHE	Jurisdiction	Rupert, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	PM (Green Valley source)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: CR1 (Anjean Rd/Church)
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	90	248	0	0	382	75
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	90	248	0	0	382	75
Proportion of heavy vehicles, P_{HV}	18	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	53	0	65
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	53	0	65
Proportion of heavy vehicles, P_{HV}	10	0	10	2	0	20
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L						LR	
Volume, v (vph)	90						118	
Capacity, c_m (vph)	1025						675	
v/c ratio	0.09						0.17	
Queue length (95%)	0.29						0.63	
Control Delay (s/veh)	8.9						15.2	
LOS	A						C	
Approach delay (s/veh)	--	--				15.2		
Approach LOS	--	--				C		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	CMO
Agency/Co.	PHE
Date Performed	12/08/04
Analysis Time Period	AM (Oct 20, W 8:15-8:30)

Site Information

Intersection	F: US60 & WV20 (in Charmco)
Jurisdiction	Charmco, Greenbrier Co., V.
Analysis Year	2004

Project Description WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	24	208	0	0	156	56
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	24	208	0	0	156	56
Proportion of heavy vehicles, P_{HV}	7	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	68	0	52
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	68	0	52
Proportion of heavy vehicles, P_{HV}	10	0	10	3	0	3
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	24					68		52
Capacity, c_m (vph)	1329					563		856
v/c ratio	0.02					0.12		0.06
Queue length (95%)	0.06					0.41		0.19
Control Delay (s/veh)	7.8					12.3		9.5
LOS	A					B		A
Approach delay (s/veh)	--	--				11.1		
Approach LOS	--	--				B		

Two-Way Stop Control

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	CMO
Agency/Co.	PHE
Date Performed	12/08/04
Analysis Time Period	MID (Oct 19, Tu 12:30-12:45)

Site Information

Intersection	F: US60 & WV20 (in Charmco)
Jurisdiction	Charmco, Greenbrier Co., WV
Analysis Year	2004

Project Description WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	84	140	0	0	120	64
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	84	140	0	0	120	64
Proportion of heavy vehicles, P_{HV}	7	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	52	0	60
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	52	0	60
Proportion of heavy vehicles, P_{HV}	10	0	10	11	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	84					52		60
Capacity, c_m (vph)	1361					509		871
v/c ratio	0.06					0.10		0.07
Queue length (95%)	0.20					0.34		0.22
Control Delay (s/veh)	7.8					12.9		9.4
LOS	A					B		A
Approach delay (s/veh)	--	--				11.0		
Approach LOS	--	--				B		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20 (in Charmco)
Agency/Co.	PHE	Jurisdiction	Charmco, Greenbrier Co., WV
Date Performed	12/08/04	Analysis Year	2004
Analysis Time Period	PM (Oct 20, W 5:04-6:23)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	80	183	0	0	167	76
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	80	183	0	0	167	76
Proportion of heavy vehicles, P_{HV}	1	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	61	0	35
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	61	0	35
Proportion of heavy vehicles, P_{HV}	10	0	10	11	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	80					61		35
Capacity, c_m (vph)	1329					453		813
v/c ratio	0.06					0.13		0.04
Queue length (95%)	0.19					0.47		0.13
Control Delay (s/veh)	7.9					14.2		9.6
LOS	A					B		A
Approach delay (s/veh)	--	--				12.5		
Approach LOS	--	--				B		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20 (in Charmco)
Agency/Co.	PHE	Jurisdiction	Charmco, Greenbrier Co., WV
Date Performed	JAN 2005	Analysis Year	NO BUILD 2008
Analysis Time Period	AM		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	27	234	0	0	176	63
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	27	234	0	0	176	63
Proportion of heavy vehicles, P_{HV}	7	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	77	0	59
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	77	0	59
Proportion of heavy vehicles, P_{HV}	10	0	10	3	0	3
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	27					77		59
Capacity, c_m (vph)	1299					520		830
v/c ratio	0.02					0.15		0.07
Queue length (95%)	0.06					0.52		0.23
Control Delay (s/veh)	7.8					13.1		9.7
LOS	A					B		A
Approach delay (s/veh)	--	--				11.6		
Approach LOS	--	--				B		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	CMO
Agency/Co.	PHE
Date Performed	JAN 2005
Analysis Time Period	MID

Site Information

Intersection	F: US60 & WV20 (in Charmco)
Jurisdiction	Charmco, Greenbrier Co.,
Analysis Year	NO BUILD 2008

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	95	158	0	0	135	72
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	95	158	0	0	135	72
Proportion of heavy vehicles, P_{HV}	5	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	59	0	68
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	59	0	68
Proportion of heavy vehicles, P_{HV}	10	0	10	11	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	95					59		68
Capacity, c_m (vph)	1346					467		850
v/c ratio	0.07					0.13		0.08
Queue length (95%)	0.23					0.43		0.26
Control Delay (s/veh)	7.9					13.8		9.6
LOS	A					B		A
Approach delay (s/veh)	--	--				11.6		
Approach LOS	--	--				B		

Two-Way Stop Control

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	CMO
Agency/Co.	PHE
Date Performed	JAN 2005
Analysis Time Period	PM

Site Information

Intersection	F: US60 & WV20 (in Charmco)
Jurisdiction	Charmco, Greenbrier Co., WV
Analysis Year	NO BUILD 2008

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	90	206	0	0	188	86
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	90	206	0	0	188	86
Proportion of heavy vehicles, P_{HV}	1	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	69	0	39
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	69	0	39
Proportion of heavy vehicles, P_{HV}	10	0	10	11	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	90					69		39
Capacity, c_m (vph)	1295					408		786
v/c ratio	0.07					0.17		0.05
Queue length (95%)	0.22					0.61		0.16
Control Delay (s/veh)	8.0					15.6		9.8
LOS	A					C		A
Approach delay (s/veh)	--	--				13.5		
Approach LOS	--	--				B		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Charmco, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	AM (source: Anj/JK/Donegan)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: WV20 (in Charmco)
Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	28	245	0	0	193	66
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	28	245	0	0	193	66
Proportion of heavy vehicles, P_{HV}	7	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	77	0	62
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	77	0	62
Proportion of heavy vehicles, P_{HV}	10	0	10	3	0	3
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	28					77		62
Capacity, c_m (vph)	1277					499		811
v/c ratio	0.02					0.15		0.08
Queue length (95%)	0.07					0.54		0.25
Control Delay (s/veh)	7.9					13.5		9.8
LOS	A					B		A
Approach delay (s/veh)	--	--				11.9		
Approach LOS	--	--				B		

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Two-Way Stop Control Page 1 of 1

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Charmco, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	MID (source: Anj/JK/Donegan)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: WV20 (in Charmco)
Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	96	169	0	0	146	72
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	96	169	0	0	146	72
Proportion of heavy vehicles, P_{HV}	8	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	59	0	69
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	59	0	69
Proportion of heavy vehicles, P_{HV}	10	0	10	26	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	96					59		69
Capacity, c_m (vph)	1317					428		838
v/c ratio	0.07					0.14		0.08
Queue length (95%)	0.24					0.47		0.27
Control Delay (s/veh)	7.9					14.8		9.7
LOS	A					B		A
Approach delay (s/veh)	--	--				12.0		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Charmco, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	PM (source: Anj/JK/Donegan)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	93	223	0	0	199	86
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	93	223	0	0	199	86
Proportion of heavy vehicles, P_{HV}	1	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	69	0	40
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	69	0	40
Proportion of heavy vehicles, P_{HV}	10	0	10	11	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	93					69		40
Capacity, c_m (vph)	1283					389		775
v/c ratio	0.07					0.18		0.05
Queue length (95%)	0.23					0.64		0.16
Control Delay (s/veh)	8.0					16.2		9.9
LOS	A					C		A
Approach delay (s/veh)	--	--				13.9		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Charmco, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	AM (Green Valley source)		

Project Description: WGC EIS

East/West Street: US60 | North/South Street: WV20 (in Charmco)

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	35	238	0	0	186	66
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	35	238	0	0	186	66
Proportion of heavy vehicles, P_{HV}	16	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	77	0	69
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	77	0	69
Proportion of heavy vehicles, P_{HV}	10	0	10	16	0	3
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	35					77		69
Capacity, c_m (vph)	1236					474		818
v/c ratio	0.03					0.16		0.08
Queue length (95%)	0.09					0.58		0.28
Control Delay (s/veh)	8.0					14.1		9.8
LOS	A					B		A
Approach delay (s/veh)	--	--				12.1		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Charmco, WV
Date Performed	apr 2005	Analysis Year	BUILD 2008
Analysis Time Period	MID (Green Valley source)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: WV20 (in Charmco)
Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	103	162	0	0	139	72
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	103	162	0	0	139	72
Proportion of heavy vehicles, P_{HV}	8	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	59	0	76
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	59	0	76
Proportion of heavy vehicles, P_{HV}	10	0	10	26	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	103					59		76
Capacity, c_m (vph)	1325					426		846
v/c ratio	0.08					0.14		0.09
Queue length (95%)	0.25					0.48		0.30
Control Delay (s/veh)	7.9					14.8		9.7
LOS	A					B		A
Approach delay (s/veh)	--	--				11.9		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CMO	Intersection	F: US60 & WV20
Agency/Co.	PHE	Jurisdiction	Charmco, WV
Date Performed	apr 2006	Analysis Year	BUILD 2008
Analysis Time Period	PM (Green Valley source)		

Project Description: WGC EIS
East/West Street: US60 | North/South Street: WV20 (in Charmco)
Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	100	216	0	0	192	86
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	100	216	0	0	192	86
Proportion of heavy vehicles, P_{HV}	4	--	--	10	--	--
Median type	Undivided					
RT Channelized?			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	0	0	0	69	0	47
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate (veh/h)	0	0	0	69	0	47
Proportion of heavy vehicles, P_{HV}	10	0	10	24	0	11
Percent grade (%)		0			0	
Flared approach		N			Y	
Storage		0			1	
RT Channelized?			1			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Control Delay, Queue Length, Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
Volume, v (vph)	100					69		47
Capacity, c_m (vph)	1273					369		782
v/c ratio	0.08					0.19		0.06
Queue length (95%)	0.26					0.69		0.19
Control Delay (s/veh)	8.1					17.0		9.9
LOS	A					C		A
Approach delay (s/veh)	--	--				14.1		
Approach LOS	--	--				B		

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Appendix K
Noise Study

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NOISE MONITORING AND PREDICTIVE MODELING TECHNICAL REPORT

WESTERN GREENBRIER CO-PRODUCTION DEMONSTRATION PROJECT
GREENBRIER COUNTY,
WEST VIRGINIA

May 26, 2006

Prepared for:
U.S. Department of Energy
National Energy Technology Laboratory
Morgantown, West Virginia

Prepared by:
Potomac-Hudson Engineering, Inc.
Bethesda, Maryland

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1. EXECUTIVE SUMMARY

Western Greenbrier Co-Gen, LLC (WGC) is proposing to design, construct, and operate a 92 megawatt net electric output (MWe) atmospheric circulating fluidized bed power plant that would generate electricity and steam by burning approximately 2,700 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site immediately on the east side of Sewell Creek and immediately south of the city limits of Rainelle in the extreme western corner of Greenbrier County. This noise report has been prepared for the WGC project in order to provide information needed to assess the potential for impacts of the proposed facility on the local community from a noise perspective.

This report includes information on baseline noise data for the project area, as well as results of predictive modeling conducted using standard techniques for predicting noise from transportation and industrial sources. The noise analyses that is the basis for this report includes monitored noise levels for the 2004 Existing Conditions and predicted noise levels for the 2008 No Build and Build conditions (i.e., construction and operation of the facility). The primary noise sources, which may increase ambient noise levels in the community that are associated with the proposed project, include:

- Mobile sources – additional truck and auto traffic to and from the site due to employees and transport of materials, and
- Stationary sources – equipment operating at the plant site.

To evaluate the potential for significant noise-related impacts from the power plant, an upper limit criterion at the boundaries of the plant site was established. In the absence of applicable local requirements, an L_{dn} of 60 dBA was selected to be the upper limit threshold. An L_{dn} of 60 dBA would be equivalent to a continuous noise level of 53.6 dBA. An increase of baseline noise levels greater than 10 dBA was used to assess the potential for significant impacts on transportation corridors. A 10 dBA increase was selected because it represents a perceived doubling of noise level and the maximum threshold for a significant increase used by state departments of transportation. This report does not assess the noise exposure for workers at the cogeneration plant, quarries, or coal refuse sites because this exposure is controlled under workplace regulations established by the Occupational Safety and Health Administration (OSHA). Blasting is addressed qualitatively. Although blasting activities are anticipated during site preparation, the details of the blasting plans are not yet available, so predictive modeling cannot be carried out.

Noise monitoring was conducted to establish baseline conditions for assessing both transportation and facility operation impacts. Transportation-related monitoring was conducted to be coincident with peak traffic hours and other representative time frames as is typical for transportation-related projects. These measurements were typically collected using 15-minute intervals with corresponding traffic counts. Long-term (24 hour) noise monitoring was conducted based on consultation with the West Virginia Public Services Commission to characterize areas adjacent to the proposed facility. The day-night noise levels (L_{dn}s) were then estimated or calculated for these areas based on the monitored values.

Predictive noise modeling for transportation-related noise impacts was completed using the FHWA's traffic noise model (TNM). Baseline noise data that was collected was used to calibrate the model. Predictive noise modeling for noise generated by the operation of the proposed facility was completed using the Computer Aided Noise Abatement (CADNA 3.4) Model which was specifically developed for modeling power plant and other industrial facility noise. Outputs from both models are based on design and operational related information that was available at the time the modeling was completed, and is subject to change as design and operational plans for the facility evolves.

Predictive modeling outputs indicate that traffic noise during the peak AM, Midday, and PM periods at locations along the proposed transportation corridors in Rainelle, Rupert, Charmco, Green Valley, Quinwood, Anjean, and Hillsboro would fall below the identified impact increment of 10 dBA. Most of the predicted increases are below a 5 dBA increase. The exceptions are a maximum predicted increase of 6.3 dBA on Anjean Road, and 5.7 along the road between the Anjean and Donegan coal refuse areas. No truck traffic is anticipated during nighttime periods between the sources of materials and the power plant.

Without noise controls for significant noise sources incorporated into the power plant design (base plant), noise levels at the site boundary and residences in the vicinity of the site would exceed an L_{dn} of 60 dBA. Base plant modeling results indicate that resulting L_{dn}s at monitored sites would range from 61.5 to 71.3 dBA. This modeling was based on an earlier site plan configuration that represents a worse case than the current site plan. The base plant modeling does not include the full range of available noise attenuation and mitigation measures that may be incorporated in the plant design, as detailed specifications and equipment vendors on which these measures are dependent have not yet been finalized.

Based on the noise level increases predicted for the "base plant," it is expected that the incorporation of reasonably available mitigation measures can reduce the noise levels at the site's property line to 60 L_{dn} or less. To achieve the 60 L_{dn} noise target at the sensitive sites, mitigation would need to incorporated into the facility design to reduce noise levels of key noise contributors to below 53.6 dBA (more specifically to approximately 20.0 to 40.0 dBA). It is expected that this objective could readily be accomplished with available methods such as fan silencers, acoustic enclosures, absorptive material on interior walls, acoustic ducts and louvers, fan deck barriers, air inlet barriers, and more robust structural materials. Based on the results of the predictive modeling, it is expected that WGC will need to ensure that contractors and vendors are contractually obligated to provide equipment that will meet the specified noise levels at the plant's property lines.

Construction noise and blasting were addressed in a qualitative manner as more detail on the phasing and equipment is needed to prepare a more detailed analysis. Potential mitigation measures for construction noise and blasting are outlined.

2. PROJECT OVERVIEW

2.1 INTRODUCTION

This noise technical study has been prepared for the Western Greenbrier Co-Generation (WGC) project in order to provide information to assess the proposed facility's potential to cause noise impacts on the local community. It includes basic information on noise principles, baseline noise data for the project area, and results of predictive modeling using standard techniques for predicting noise from industrial sources. This technical study has been prepared by Potomac-Hudson Engineering, Inc. (PHE) under contract to the US Department of Energy as part of the efforts to prepare an Environmental Impact Statement (EIS) to assess overall project impacts. The configuration of buildings and activities evaluated for this report are based on the August 2005 site plan, which constitutes a "worst-case" for determining potential impacts. Thus, future design changes may not require further analysis if they reduce the potential for noise impacts.

2.2 WESTERN GREENBRIER CO-GEN PROJECT

WGC is proposing to design, construct, and operate a 92 megawatt net electric output (MWe) atmospheric circulating fluidized bed power plant that would generate electricity and steam by burning approximately 2,700 tons per day (tpd) of waste coal as the primary fuel. The power plant would be located on a 26-acre site immediately on the east side of Sewell Creek and immediately south of the city limits of Rainelle in the extreme western corner of Greenbrier County. The confluence of Sewell Creek and the Meadow River is roughly 1.5 miles northeast of the proposed plant site. A coal-fired rotary kiln associated with the power plant would combine coal ash and limestone into a cement-like material for use with wood wastes to manufacture structural building blocks. Currently, plans show the ash byproduct manufacturing plant located on the north side of Sewell Creek adjacent to the Eco Park. The power plant would serve as the anchor for future tenants at the Eco Park by providing a source of steam and hot water supply for building heat and other industrial activities. Without the power plant, the Eco-Park may not be developed.

Waste coal (coal refuse) initially would be obtained from abandoned waste coal piles located on CR 1 on Anjean Mountain. Both the Anjean coal mine and the Donegan mine further north on CR 1 in Nicholas County are anticipated sources of coal refuse (see Figure 2-1).

Excess combustion ash not needed for manufacturing the ash byproduct would be used to remediate acid drainage from the source waste coal piles. WGC is in the process of determining additional waste coal pile sites for obtaining a fuel source when the Anjean piles are depleted (currently estimated at 6 to 7 years). Generally, potential future waste coal pile sites would be within 20 to 30 miles of the power plant site. The most likely candidate to be used as a second source of fuel by WGC is the Green Valley Site, located north of Quinwood on Route 20. The Green Valley site is adjacent to an active coal mine, and the site is highly disturbed from mining activities. In its current state, the site consists of waste-coal piles that were placed on steep ridges, contoured, and covered with planted pines.

Both rail and truck were initially considered as transportation options for the waste coal fuel, raw materials (e.g., limestone), and waste removal. However, considerations for rail transport by WGC were abandoned due to economic considerations and the associated feedback received from the local community.

The fuel extraction and transportation methods would be the same for both waste coal sources. Mobile equipment would scrape waste fuel material from a pile or deposit and dump it into a 3-axle, 40-ton truck. These trucks would transport coal refuse and pond fines from Anjean Mountain and/or Green Valley to

nearby beneficiation plants, where the coal refuse material would be crushed and screened, while the pond fines would be deslimed, dewatered, and separated into low-ash and high-ash cakes. .

Limestone from a local quarry, most likely the Alta Quarry in the Lewisburg area, would be transported to the WGC facility in 20-ton trucks, stored in an enclosed building, and subjected to primary and secondary crushing. The limestone is used in firing the boiler, in a scrubber to reduce the plant's air pollutant emissions, and in the manufacture of ash byproduct. An alternative source for the Limestone is the Mill Point Quarry on WV 219 in Hillsboro, in Pocahontas County.

At the WGC site, low-ash cakes and crushed coal refuse would be mixed with limestone and a higher quality of coal and burned as fuel in the cogeneration plant's boiler. High-ash cakes from the pond fines would be mixed with boiler ash for return by truck to the waste pile of origin (Anjean or Green Valley), where it would be used to remediate acid drainage from the waste coal piles.

Fly ash resulting from the plant's combustion of coal refuse and pond fines would be mixed with limestone and baked in a coal-fired rotary kiln to create a cementitious ash byproduct. Additional materials transported to the site for the kiln operation include alumina, gypsum, and other additives. The cementitious product would be mixed with wood chips from waste wood sources to manufacture a molded building block that can be used for building construction and insulation. This plant is one of the anticipated tenants in the Eco Park. Although the kiln for this plant would be operated 24 hours per day, at a location near the power plant, the manufacturing of the ash byproduct would occur in the Eco Park area during a typical day shift. Other ventures may find the Eco Park a desirable location at some future point. They could include such operations as an aquaculture fishery or a hydroponic greenhouse.

2.2 SITE DESCRIPTION

The WGC plant would be located on an 89-acre site on the south side of Rainelle near the intersection of U.S. Route 60 and State Route 20. Route 20 and the CSX rail tracks lie to the west and north of the site, a residential neighborhood borders the site to the east, and a mountain ridge borders the site to the south. Sewell Creek and its associated floodway run through the site on an east-west alignment, dividing the site into two major sections. Approximately 20 acres lie north of the creek. A portion of this area is occupied by the existing Rainelle Industrial Park (the "Eco Park"). Further development of this area would occur, as part of an Eco Park concept, by industries using steam and other byproducts from the power plant.

Approximately 69 acres of contiguous tracts lie south of the creek, including portions of a mountain ridge. Approximately half of this southern area (34 acres) would be developed for the power plant. The ridge is approximately 2,200 feet southeast of the intersection of US 60 and WV 20. It varies from an elevation of approximately 2,395 feet at the base to 2,535 at its highest point. Portions of the ridge would be excavated for the plant, resulting in a base elevation of 2,416 feet for the cogeneration facilities. A plateau 20 feet above the floodplain (i.e., an elevation of 2,420 feet with the floodplain at 2,400 feet) will be formed for a power island and ash processing equipment associated with the cogeneration plant. Materials handling for the power plant would occur on the south side of the power plant site. This includes truck loading and unloading, and trucks idling. Conveyor belts would transport materials from the delivery area on the southwest portion of the site to various buildings in the central portion of the site..

Tom Raine Drive currently provides access to the developed portion of the industrial park from Route 20. The West Virginia Department of Transportation intends to extend Tom Raine Drive, including a bridge spanning the Sewell Creek floodway, to provide access to the south section of the site. Figure 2-1 shows the site location, and Figure 2-2 shows the layout of the site in relation to the surrounding area.

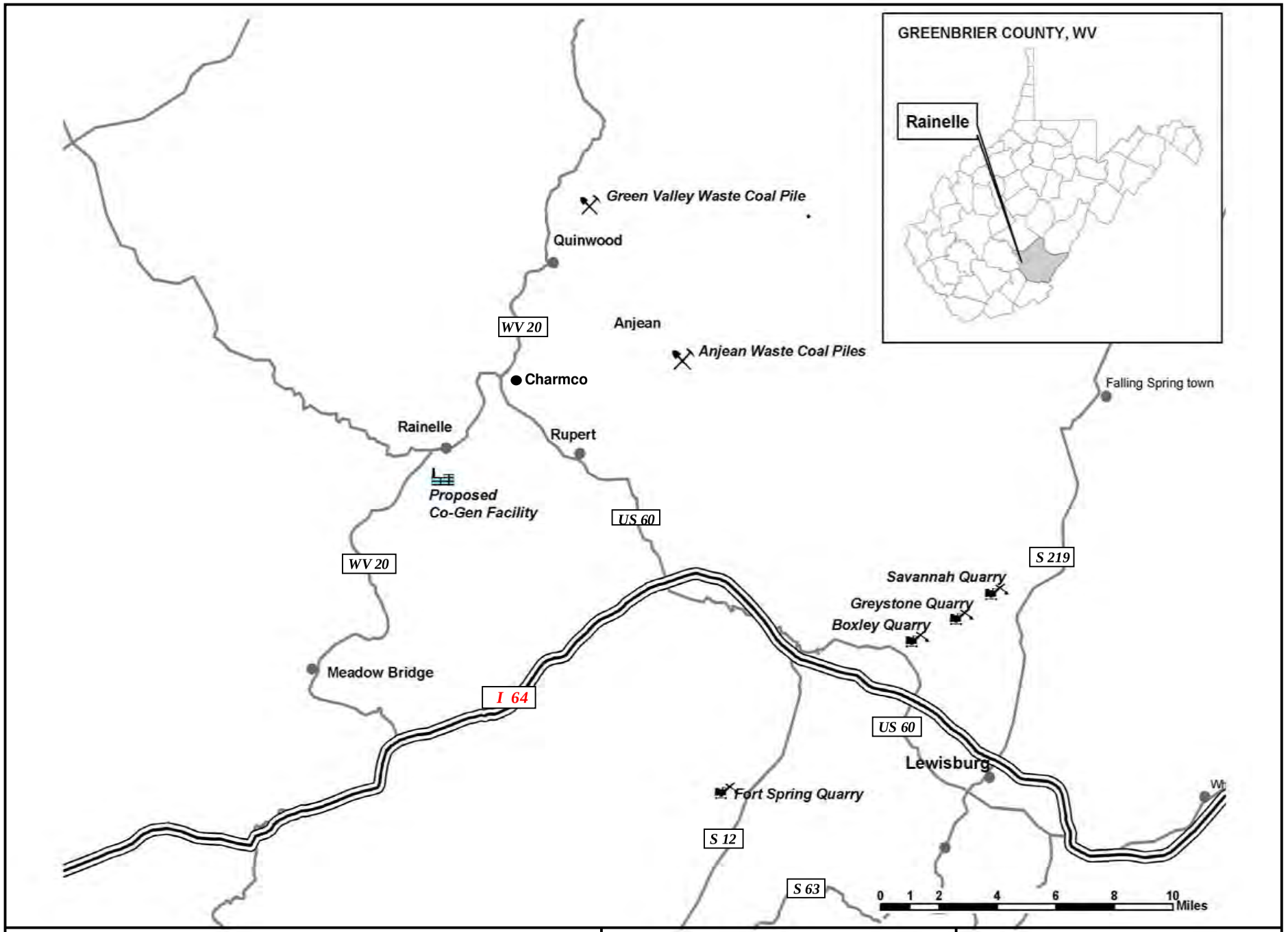


Figure 2-1
WGC General Project Location Map

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Figure 2-2
WGC Power Plant Site Layout (Rainelle, WV)

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Western Greenbrier Co-Production Demonstration Project

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2.3 SCOPE OF STUDY

The scope of this study included the collection of baseline noise data for the project area, as well as conducting predictive modeling using standard techniques for roadway and industrial sources. The primary project-generated noise sources that may increase ambient noise levels in Rainelle and the transportation corridors are:

- Mobile Sources – additional truck and auto traffic to and from the site due to employees and transport of materials, and
- Stationary Sources – equipment operating at the plant site.

Potential impacts from these sources were assessed for the plant's property line and sensitive receptor points such as schools, parks, and residences in the vicinity of the roadways and plant site. Only noise sources associated with the project that were expected to substantially contribute to noise levels were considered in this analysis. Worker exposures to high noise levels at the cogeneration plant, quarries, or coal refuse areas are not included in this analysis because they are covered under workplace regulations established by OSHA and are beyond the scope and purpose of this report. Construction noise, especially blasting, is addressed because blasting activities are anticipated for site preparation. Freight rail noise is not included in this technical report because freight trains pass through Rainelle once or twice per day, without a fixed schedule, and they currently are not a proposed transportation mode for the coal refuse or manufactured products. Although the ash byproduct manufacturing plant is an integral part of the project concept, other potential tenants may not occupy the Eco Park until after the 2008 Build year. Because the sizes and traffic generation characteristics of other Eco Park tenants are speculative at this time, these potential sources were not included in the analysis of impacts for the cogeneration plant. Only traffic for the power plant and ash byproduct facility are included this study.

To evaluate the potential noise impacts, a noise monitoring program was carried out to establish existing noise levels along transport roadways, as well as at locations near the plant site. This information also was used to calibrate industry standard models and methods subsequently used to determine existing and future noise levels based on worst-case projections of traffic volumes and plant noise. Increases in trucks and autos along traffic corridors were analyzed using the FHWA's Traffic Noise Model (TNM) 2.5. Noise from the plant's proposed operating equipment was analyzed using CADNA, a software model designed for analyzing industrial noise.

2.4 NOISE STUDY AREA

The noise study area includes locations in Rainelle as well as communities along the transportation corridors to the coal refuse piles or limestone quarries. The study area was defined based on professional judgment and consultation with the West Virginia Public Services Commission. Two study areas, described below, have been defined according to the project-generated noise source: either traffic or the power plant. Some sensitive receptor points in Rainelle may fall into both noise study areas.

2.4.1 Traffic Noise

Motor vehicle traffic through Rainelle, Charmco, Rupert, Quinwood, Green Valley, and Anjean would increase because trucks would transport coal, coal refuse, limestone, and waste wood to the site. Additional Trucks would pass by on CR1 north of Anjean if the Donegan quarry is used as a coal refuse source. If the Mill Point Quarry becomes a source of limestone, then communities along CR 219 between CR 60 and CR 39 in Hillsboro would also experience increased truck traffic. Trucks also would transport the commercial ash byproduct to markets outside of Rainelle; these trucks are expected to travel east to

Interstate 64. Additional traffic also would occur due to employee vehicles traveling to and from the site. Employees at the cogeneration plant and the kiln for the ash byproduct would work primarily in one 8-hour daytime shift, although some employees would provide minimal staffing during the remaining 16 hours. Employees at the ash byproduct manufacturing plant, the administrative office, and other buildings, are expected to work the daytime shift.

Therefore, the relevant study area related to potential noise impacts from traffic generated by the project includes sensitive receptors on:

- Route 1 between Donegan Quarry on Anjean Mountain and Route 60 in Rupert,
- Route 60 from the intersection with Route 1 in Rupert to the intersection with Route 20 in Charmco,
- Route 20 between Green Valley and Route 60 in Charmco, and
- Route 20/60 from Charmco through Rainelle.
- Route 219 between Route 60 in Lewisburg and CR 39 in Hillsboro.

2.4.2 Power Plant Noise

The cogeneration plant includes the operation of heavy industrial equipment that would represent a new noise source in the area local to the proposed site. Detailed information on the specific equipment and operations that relate to noise levels is provided in the section on Build Conditions. Sensitive receptors that could be affected by noise from the proposed cogeneration plant include homes that currently experience low levels of noise due to their distance from highways and rail tracks. A radius of 1,000 feet from the plant site was used to define the study area for noise from the plant operations. Locations beyond this distance would be influenced more by local traffic noise than by plant noise. Within the 1,000-foot study radius, the primary focus is on noise levels at the site boundaries and at nearby homes. Therefore, the study area does not have to encompass a larger radius in order to identify potential impacts if noise levels at nearby sensitive receptors are below the impact criteria.

3. NOISE PRINCIPLES

3.1 INTRODUCTION

Noise is defined as any unwanted sound. Quantitative information on the adverse effects of airborne noise on people is well documented. For example, noise may interfere with human activities, such as sleep, speech communication, and tasks requiring concentration or coordination. If sufficiently loud, it may also cause hearing damage, and other physiological problems. The threshold of discomfort is 120 dB, and the threshold of pain is about 140 dB. Although the stated effects of noise on people vary greatly with the individual, several noise scales and rating methods are used to quantify the effects of noise on people. These scales and methods consider such factors as loudness, duration, time of occurrence, and changes in noise level with time.

3.2 NOISE FUNDAMENTALS

3.2.1 Hertz

The human ear experiences sound as a result of pressure variations or vibrations in the air. Thus, sound is generally defined as any pressure variation that the human ear can detect. Sound pressure is measured in micropascals. Although humans can detect a range from 20 to 20 million micropascals, the variations may not register as sound. For example, air pressure changes as a result of weather — high pressure and low pressure systems — are not perceived as sound because they happen too slowly. The air pressure variations must be more frequent. If the variations, or oscillations, in pressure occur between 20 and 20,000 times per second, then they are audible to humans. For example, piano strings vibrate at 27.5 times per second at the lowest notes and 4,186 times per second at the highest notes. This rate of variation or oscillation per second is called frequency and the unit of measurement is called Hertz (Hz).

3.2.2 Sound Pressure Level

The human ear is designed to function in the 20 to 20,000 Hz range. In terms of hearing, however, humans are less sensitive to low frequencies (< 250 Hz) than mid-frequencies (500-1,000 Hz). The human ear is most sensitive to higher frequencies in the 1,000 to 5,000 Hz range (US Department of Transportation, September 1980). High frequency noise is generally more annoying to people than low or mid-frequency noise.

Because humans can detect such a wide range of sound pressures, the numbers are too unwieldy to handle. Therefore, sound pressure is converted to a term known as sound pressure level (SPL), which is based on a logarithmic scale that reflects *relative* changes from a particular reference point (20 micropascals). This logarithmic unit of measure for sound pressure level is called the decibel (dB). 0 dB is the threshold of hearing.

Because noise typically contains a lot of different frequencies, a weighting system has been devised that gives less importance to the low frequencies. Of the different weighting schemes, the one that best corresponds to the response of the human ear is the A-weighted sound level. Decibels on the A-weighted scale are termed "dBA."

3.2.3 Decibel Addition

Because they are logarithmic, decibels cannot be added and subtracted arithmetically. The formula for adding together SPLs is:

$$L_{total}\ dB = 10 \log \sum_{Li=1}^{N} 10^{(Li/10)}$$

where: Li is an individual SPL and L_{total} is the sum of the SPLs.

Based on this formula, adding together two noise levels that are equally loud would result in a noise level that was 3 dBA higher. Thus, if the noise from a fan on an industrial site is 60 dBA at a residential property line, and a second fan was added at the industrial site, the total noise level at the property line would be 63 dBA, not 120 dBA.

In most cases, where the addition of decibels only needs to be accurate by +/- 1 dB, the following rule of thumb can be used to add decibels:

When two decibel values differ by:	Add the following amount to the higher value:
0 or 1 dB	3 dB
2 or 3 dB	2 dB
4 or 9 dB	1 dB
10 dB or more	0 dB

3.2.4 Human Perception of Noise Level Increase

Because the scale is logarithmic, a relative increase of 10 decibels represents a sound pressure level that is 10 times higher. However, humans don't perceive a 10 dBA increase as 10 times louder; they perceive it as twice as loud. The following is typical of human response to relative changes in noise level:

- 3 dBA change is the threshold of change detectable by the human ear,
- 5 dBA change is readily noticeable, and
- 10 dBA increase is perceived as a doubling of noise level.

Table 3-1 shows the range of noise levels for a variety of indoor and outdoor activities.

3.2.5 Noise Descriptors

The SPL that humans experience typically varies from moment to moment. Therefore, a variety of descriptors are used to evaluate noise levels over time. Some typical descriptors are defined below:

- L_{eq} is the continuous equivalent sound level. The sound energy from the fluctuating sound pressure levels is averaged over time to create a single number to describe the mean energy or intensity level. High noise levels during a monitoring period will have greater effect on the L_{eq} than low noise levels. The L_{eq} has an advantage over other descriptors because L_{eq} values from different noise sources can be added and subtracted to determine cumulative noise levels. The formula for the L_{eq} is:

$$L_{eq} = 10 \log 1/n \sum_{i=1}^{N} 10^{(Li/10)}$$

Table 3-1
Sound Pressure Level and Loudness of Typical Noises in Indoor and Outdoor Environments

Noise Level (dBA)	Subjective Impression	Typical Sources		Relative Loudness (Human Response)
		Outdoor	Indoor	
120-130	Uncomfortably Loud	Air raid siren at 50 feet (threshold of pain)	Oxygen torch	32 times as loud
110-120	Uncomfortably Loud	Turbo-fan aircraft at take-off power at 200 feet	Riveting machine Rock band	16 times as loud
100-110	Uncomfortably Loud	Jackhammer at 3 feet		8 times as loud
90-100	Very Loud	Gas lawn mower at 3 feet Subway train at 30 feet Train whistle at crossing Wood chipper shredding trees Chain saw cutting trees at 10 feet	Newspaper press	4 times as loud
80-90	Very Loud	Passing freight train at 30 feet Steamroller at 30 feet Leaf blower at 5 feet Power lawn mower at 5 feet	Food blender Milling machine Garbage disposal Crowd noise at sports event	2 times as loud
70-80	Moderately Loud	NJ Turnpike at 50 feet Truck idling at 30 feet Traffic in downtown urban area	Loud stereo Vacuum cleaner Food blender	Reference loudness (70 dBA)
60-70	Moderately Loud	Residential air conditioner at 100 feet Gas lawn mower at 100 feet Waves breaking on beach at 65 feet	Cash register Dishwasher Theater lobby Normal speech at 3 feet	2 times as loud
50-60	Quiet	Large transformers at 100 feet Traffic in suburban area	Living room with TV on Classroom Business office Dehumidifier Normal speech at 10 feet	1/4 as loud
40-50	Quiet	Bird calls, Trees rustling, Crickets, Water flowing in brook	Folding clothes Using computer	1/8 as loud
30-40	Very quiet		Walking on carpet Clock ticking in adjacent room	1/16 as loud
20-30	Very quiet		Bedroom at night	1/32 as loud
10-20	Extremely quiet		Broadcast and recording studio	
0-10	Threshold of hearing			

Sources: Noise Assessment Guidelines Technical Background, by Theodore J. Schultz, Bolt Beranek and Newman, Inc., prepared for the US Department of Housing and Urban Development, Office of Research and Technology, Washington, D.C., undated; Sandstone Environmental Associates, Inc.; Highway Noise Fundamentals, prepared by the Federal Highway Administration, US Department of Transportation, September 1980; Handbook of Environmental Acoustics, by James P. Cowan, Van Nostrand Reinhold, 1994

- L_{dn} is the day-night equivalent sound level. It is similar to a 24-hour L_{eq}, but with 10 dBA added to SPL measurements between 10 pm and 7 am to reflect the greater intrusiveness of noise experienced during these hours. L_{dn} is also termed DNL.
- L_{max} is the highest SPL measured during a given period of time. It is useful in evaluating L_{eq}s for time periods that have an especially wide range of noise levels.
- L_{min} is the lowest SPL measured during a given period of time.
- L_{10} is the SPL exceeded 10% of the time. Similar descriptors are the L_{50}, L_{01}, and L_{90}.

3.2.6 Octave Bands

Although the SPL heard in the environment typically is composed of many different frequencies, it can be broken down into numerous individual frequencies. These frequencies are grouped into octave bands. An octave band is a group of frequencies in the interval between a given frequency (such as 350 Hz) and twice that frequency (e.g., 700 Hz). The standard octave bands are each named by their center frequencies. Thus, each octave band will be represented by a single SPL. When the representative SPLs from the individual octave bands are added together, they are weighted so that the resulting total SPL will represent dBA. Octave bands are used in some noise models because the different components of a noise source will have different frequencies. For example, a truck traveling downhill will have a different set of frequencies than a truck traveling uphill.

3.2.7 Sound Power Level

Another term used in noise analysis, which also can be termed SPL and which also can be measured in decibels, is sound power level (PWL or L_w). Whereas sound pressure level is relative to a reference level of 20 micropascals, sound power level is the total sound power emitted by a source in all directions. Typically, sound power level is measured in picowatts (10^{-12} watt). The formula for converting sound power level to decibels is:

$$L_w = 10 \log_{10} (W/W_o)$$

where: L_w is the sound power level,
W is the measured sound power in watts, and
W_o is a reference power, usually 1×10^{-12}W

Sound power level is often used in models of stationary noise sources, such as industrial equipment. Like sound pressure level, sound power level usually is composed of multiple frequencies.

3.2.8 Transmission Loss

Transmission loss is the reduction in noise between source and receiver that occurs when noise cannot penetrate a wall, window, or other intervening object. The difference between the noise level on one side of a barrier and the noise level on the other side of a barrier is the transmission loss (TL). A 22-gauge steel exterior wall in an industrial building may have an overall transmission loss of 25 dBA. Thus, total noise from equipment located inside the building would be 25 decibels lower outside the building due to the intervening wall. The TL is different for each octave band, and the individual TLs are logarithmically summed to obtain a single number in dBA that represents the overall TL for a given intervening surface.

TL is calculated from a transmission coefficient (tau, or *t*) that varies with frequency. *t* can vary from a value of 0, where the material blocks all noise, to 1, where the material does not block any of the noise. "Break-out" noise occurs when noise escapes through an opening in a building, such as a duct or opening for a conveyor belt, that has a transmission coefficient of 1 for that portion of the wall. The formula for calculating TL is:

$$TL = 10 \times \log(1/t)$$

Conversely, if the TL is known, then *t* can be calculated by the following equation:

$$t = 1/(10^{(TL/10)})$$

t typically increases with the octave band frequency; thus, noise levels at the higher frequencies are more easily blocked than noise levels at the lower frequencies. This is another reason why power plant noise in the octave bands of 500 and lower are of greatest concern in projecting potential impacts.

Where the exterior of a building is composed of walls, windows, doors and openings with different TLs, a composite TL for one side of the building can be calculated as shown by the following equation from Cowan (1994):

$$t_{composite} = (t_1S_1+t_2S_2+t_3S_3 \ldots t_nS_n)/S_{total}$$

Where: $t_1, t_2, \ldots\ldots t_n$ = transmission coefficients for each different component of the wall,
$S_1, S_2 \ldots\ldots Sn$ = the surface areas for each of the different components of the wall, and
S_{total} = the total surface area for the wall.

3.3 NOISE SOURCES

3.3.1 Sources of Truck Noise

Truck noise includes noise from the wheel-road interface as well as the engine and brakes. Engine noise includes exhaust noise, casing-radiated noise from the engine block and covers, and engine cooling-fan noise. The dominant component of truck noise depends on the engine speed, engine load, and muffler. However, engine cooling-fan noise typically dominates, particularly in new trucks outfitted with more efficient mufflers (Cavanaugh and Tocci, 1998). Engine noise typically dominates at lower speeds, and old trucks are much noisier than newer trucks. The difference between a truck that is more than 10 years old and a new, high-end truck is as much as 30 dBA at high speeds, because most new trucks have standard sound packages. Truck engines typically are noisier during acceleration and deceleration than when traveling at a constant speed.

Tire noise tends to dominate at higher speeds unless the truck is operating with a poorly maintained muffler. Studies have found that engine noise increases about 5 dB as speed increases from 10 mph to 40 mph, regardless of pavement type. However, noise from the rear tires of a heavy truck can increase by as much as 20 dBA as speed increases from 10 mph to 40 mph (Mackenstrum et al 2002).

Some pavements reduce truck tire noise. New asphalt is quieter than old asphalt because small pockets at the surface of the road trap air as the tires roll over it. After a few weeks of use, the pavement becomes smoother, and the air between the tires and smoother roadway is rapidly trapped, compressed, and released, resulting in louder tire noise (Cavanaugh and Tocci, 1998). At night, truck tire noise is more

noticeable because fewer autos are in the traffic mix to help mask the noise. Research is currently underway in the US and other countries to experiment with roadway surfaces that would help reduce noise from the tire/road interface.

Another source of noise for trucks is the use of Jake Brakes. These brakes may be responsible for some of the peak noise levels from passing trucks. Jake Brakes, manufactured by Jacobs Vehicle Systems, are mounted on the engine overhead above the valves, where they turn the engine into a giant air compressor that acts as a supplemental braking system. Typically, they are used on the larger class 7 and 8 trucks. They control vehicle speed with minimal use of wheel brakes on downhill grades, reducing the potential for overheated brakes, reducing wheel brake maintenance frequency and increasing the life of the tires. Because the engine brake noise is a component of exhaust noise, it can be controlled with a properly functioning muffler. Although some communities claim that Jake Brakes substantially increase the noise levels, Jacobs Vehicle Systems claims that truckers tampering with mufflers is the primary source of the increased noise levels. High performance mufflers have been developed to further reduce the noise from the engine and engine brake system.

3.3.2 Sources of Equipment Noise

Sources of noise from equipment include the sound of motors and engines, high-frequency back-up alarms, and materials handling. Conveyors used to transport materials onsite may generate noise through the cable and pulleys as well as the engine. Conveyor noise can also be caused by impacts and scraping at locations along the conveyor structure. Other noise from materials handling occurs when trucks dump stones or other material onto piles, when the material is moved from one location to another by front loaders, and when materials are crushed.

3.4 NOISE ATTENUATION AND MITIGATION

Noise from a given source attenuates (diminishes) with distance. A roadway or railway is considered a line source because a motor vehicle or diesel engine moves from one point to another along a fixed linear route, and the receiver experiences noise from all points along the line. Noise from a line source typically attenuates at the rate of 3 dBA per distance doubling, based on a reference distance of 50 feet. Thus, a traffic noise level of 65 dBA at a distance of 50 feet from the roadway would be 62 dBA at a distance of 100 feet from the roadway. It would be 59 dBA at a distance of 200 feet from the roadway. The 3 dBA attenuation rate is used for noise traveling through the air or over a hard surface. Noise traveling over a soft surface, such as grass, may attenuate at a more rapid rate of about 4.5 dBA.

Noise from industrial equipment at a fixed location is termed a stationary source or point source. It attenuates at a rate of 6 dBA when noise is traveling through air or over a hard surface, and up to 7 or 8 dBA when traveling over a soft surface. These attenuation rates are general rules for total noise levels from a given source. For the individual octave bands that comprise the total noise, the attenuation rate is greater for high frequencies (4000 – 8000 Hz) than for lower frequencies. Noise in the octave bands of 500 and lower are of particular concern in the analysis of noise from power plants due to their slower attenuation rate with distance.

4. NOISE LEGISLATION AND EVALUATION CRITERIA

4.1 FEDERAL

4.1.1 Environmental Protection Agency

Studies carried out by the Environmental Protection Agency (EPA) on the effects of noise are the basis of standards and legislation at federal, state, and local levels of government. Prior to the Federal Noise Control Act of 1972, most states and municipalities regulated noise under general ordinances for creating a nuisance or disturbing the peace. In 1973, the EPA published a "Criteria Document" that established criteria for assessing the effects of noise on public health and welfare. In 1974, EPA published the "Levels Document," a summary of noise levels identified as requisite to protect public health and welfare with an adequate margin of safety. For the purposes of hearing conservation, EPA determined that an $L_{eq(24)}$ of 70 dBA would be sufficient to protect people.

EPA's recommended 70 dBA criterion for public health and welfare is not low enough to prevent people from being annoyed by noise. Noise causes annoyance when activities such as talking, watching TV, or sleeping are interrupted. EPA found that when the background noise level is 55 dBA, conversation between two individuals is 95% intelligible at a distance of about 10 feet. As background noise increases, they must move closer to maintain 95% intelligibility. At 65 dBA, the distance decreases to about five feet.

EPA determined that an indoor L_{dn} of 45 dBA permits normal speech communication in the home. At night, an indoor background noise level of 32 dBA is needed for most people to sleep without interference. Most homes, can provide an exterior to interior noise level reduction of 15 dBA, even if the windows are partially open. Thus, an outdoor noise level of 60 dBA would result in an indoor noise level of 45 dBA. However, EPA allowed for a 5 dBA margin of safety in recommending an outdoor noise level of 55 dBA in residential areas. These noise levels recommended by EPA are guidelines. They are not federally enforceable regulations.

In addition to recommending guidelines for total noise in residential areas, the Noise Control Act of 1972 also gave the EPA the authority to establish noise regulations to control major sources of noise, including transportation vehicles and construction equipment. Pursuant to this legislation, EPA established regulations that set noise emission level standards for newly manufactured medium and heavy trucks that have a gross vehicle weight rating (GVWR) of more that 4,525 kilograms (10,000 lbs) and are capable of operating on a highway or street. Table 4-1 shows the maximum noise emission levels allowed by the EPA noise regulations for these vehicles.

Table 4-1
Maximum Noise Emission Levels as Required by EPA for Newly Manufactured Trucks with GVWR over 4,525 Kilograms (10,000 lbs)

Effective Date	Maximum Noise Level 15 Meters (50 feet) from Centerline of Travel*
January 1, 1988	80 dBA

*Using the Society of Automotive Engineers, Inc. (SAE), test procedure for acceleration under 56 kph (35 mph)
Source: US Environmental Protection Agency

For existing (in-use) medium and heavy trucks with a GVWR of more than 4,525 kilograms, the federal government has authority to regulate the noise emission levels only for those that are engaged in interstate commerce. Regulation of all other in-use vehicles must be done by state or local governments. The EPA emission level standards for in-use medium and heavy trucks engaged in interstate commerce are shown in Table 4-2 and are enforced by the FHWA Office of Motor Carrier Safety (OMCS).

Table 4-2
Maximum Noise Emission Levels as Required by EPA for In-Use Medium and Heavy Trucks with GVWR Over 4,525 Kilograms (10,000 lbs) Engaged in Interstate Commerce

Effective Date	Speed	Maximum Noise Level 15 Meters (50 feet) from Centerline
January 8, 1986	< 56 kph (35 mph)	83 dBA
January 8, 1986	> 56 kph (35 mph)	87 dBA
January 8, 1986	Stationary	85 dBA

Source: US Environmental Protection Agency

4.1.2 Federal Interagency Committee on Urban Noise

Many urban areas already exceed a background L_{dn} of 55 dBA. In 1980, the Federal Interagency Committee on Urban Noise developed land use compatibility guidelines that included federal agencies' consideration of general cost and feasibility factors, as well as past community experiences and the objectives of various programs. These guidelines permitted an L_{dn} of 55 to 65 dBA in residential areas. The upper limit, an L_{dn} of 65, has been used by federal agencies in establishing a threshold noise level for identifying areas that are considered to be significantly impacted by noise levels.

4.1.3 U.S. Department of Housing and Urban Development

Based on the EPA reports, the Department of Housing and Urban Development published regulations establishing standards for HUD-assisted projects in 1979. HUD categorized noise levels for proposed residential development as acceptable, normally unacceptable, and unacceptable, as shown in Table 4-3. HUD assistance for construction of new noise sensitive uses is generally prohibited for projects with unacceptable noise exposures, and is discouraged for projects with normally unacceptable noise exposure.

Table 4-3
HUD Acceptability Standards for Noise

Category	Noise Level (L_{dn})
Acceptable	$\leq$ 65 dBA
Normally Unacceptable	>65 dBA $\leq$ 75 dBA
Unacceptable	> 75 dBA

Source: U.S. Department of Housing and Urban Development, March 1985

The assumption is that standard construction provides an average of 20 L_{dn} of attenuation. At 65 L_{dn} or below, this amount of attenuation would be sufficient to meet an interior level of 45 L_{dn}. HUD-financed buildings constructed in Normally Unacceptable or Unacceptable areas must provide sufficient sound attenuation, as specified by HUD, to reduce interior noise levels to an L_{dn} of 45 dBA.

The Noise Guidebook, published by HUD in 1985, states that sites in the vicinity of federally funded highways are subject to the noise analysis procedures of the Federal Highway Administration (FHWA). To convert the FHWA analyses to relevant HUD criteria, the Guidebook recommends the following rules of thumb:

- L_{dn} ≈ the peak-hour L_{10} – 3 decibels, or
- L_{dn} ≈ the peak-hour $L_{eq.}$

These formulas assume that off-peak noise levels are lower than peak noise levels, and that nighttime noise levels are lower than daytime noise levels. In addition, heavy trucks must not exceed 10% of the 24-hour traffic volume, and traffic flow between 10 pm and 7 am must not exceed 15% of the average daily traffic flow. Another rule of thumb used in analyzing environmental noise levels is that nighttime noise levels are approximately 10 dBA lower than daytime noise levels.

4.1.4 Federal Highway Administration

The FHWA has standards that govern the analysis and definition of impacts for traffic noise for projects using federal-aid funds for highway projects. They are described in FHWA's *Procedures for Abatement of Highway Traffic Noise and Construction Noise* contained in 23 CFR 772. FHWA established Noise Abatement Criteria (NAC), shown in Table 4-4, to be used in defining traffic noise impacts. An impact is defined when projected traffic noise levels: 1) approach or exceed the NAC, or 2) substantially exceed existing noise levels. FHWA did not intend the NAC to be used as federal standards, desirable noise levels, or design goals for noise barriers. They are only to be used as absolute values that, when approached or exceeded, require consideration of traffic noise mitigation measures.

The FHWA regulations do not specify noise levels that approach or exceed the NAC; state departments of transportation (DOTs) develop their own definitions. However, FHWA guidelines require state DOTs to use a definition of "approach" that is at least 1 dBA less than the applicable NAC. State DOTs also develop their own criteria for determining a “substantial” increase in noise levels. Table 4-5 shows some of the criteria that state DOTs have used to define a substantial increase in noise levels. These state DOT criteria fall into 3 general groupings. All groupings identify relative noise level increases of up to 5 dBA as having little or no effect on perceptions of noise. All groupings also identify an impact (i.e., a substantial increase in noise) as a relative increase of at least 10 dBA, and some place that level at 15 dBA or more.

A noise level that exceeds the NAC under Build Conditions is defined as an impact, *even if the noise exceeded the NAC under Existing or No Build conditions*. This comparison of Build and Existing conditions is appropriate for a federally-funded highway improvement project where the highway itself is a predominant source of noise under Existing and No Build conditions, as well as Build conditions. In addition, the difference in traffic volumes between No Build and Build conditions may be small where the highway is being improved to alleviate congestion .

The FHWA criteria are not applicable for private development projects, which have no influence on existing conditions. In addition, no barriers can be constructed along state and county roads where homes and businesses require driveway access at frequent points along the road. Nevertheless, the FHWA criteria occasionally have been used to evaluate noise levels from project-generated traffic in urban areas where no other standard applies. In these cases, the threshold for considering mitigation measures is based on state DOT interpretations of FHWA guidelines, except that the comparison is between No Build and Build conditions rather than Existing and Build conditions.

4.1.5. Federal Energy Regulatory Commission

In its *Guidance Manual for Environmental Report Preparation*, published in August 2002, the Federal Energy Regulatory Commission recommended that compressor facilities not exceed an L_{dn} of 55 dBA at noise-sensitive areas.

Table 4-4
FHWA Noise Abatement Criteria

Activity Category	Hourly Sound Level (dBA)*		Description of Activity Category
	L_{eq}(h)	L_{10}(h)	
A	57 (Exterior)	60 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve it
B	67 (Exterior)	70 (Exterior)	Picnic areas, recreation areas, playgrounds, sports acres, parks, residences, motels, hotels, schools, churches, libraries, and hospitals
C	72 (Exterior)	75 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above
D	--	--	Undeveloped lands
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums

**Either L_{10} (h) or L_{eq} (h) (not both) may be used on a project. Hourly sound levels are expressed in dBA (decibels on the A-weighted scale), which correlate with human perception of loudness.*
Source: 23 CFR 772

Table 4-5
State Criteria to Define Substantial Increases in Noise Level

Criteria Group	Relative Increase (dBA)	Subjective Descriptor
1	0-5	Little increase
	5-15	Some increase
	>15	Substantial increase
2	<10	Little increase
	>10	Substantial increase
3	0-5	No increase
	5-10	Minor increase
	10-15	Moderate increase
	>15	Substantial increase

Source: 23 CFR 772

4.2 STATE OF WEST VIRGINIA

4.2.1 West Virginia Department of Environmental Protection

The West Virginia Department of Environmental Protection (WVDEP) currently has no noise guidelines that would address noise concerns for the proposed power plant.

4.2.2 West Virginia Department of Transportation

The West Virginia Department of Transportation (WVDOT), Division of Highways, has a design directive (DD-207) dated February 6, 1998, entitled “Noise Analysis and Abatement Guidelines.” Applicable to highway projects, it states that existing noise levels should be determined according to FHWA’s “Sound Procedures for Measuring Highway Noise, Final Report” as a guide. Future noise level

predictions are to be determined using the FHWA highway traffic noise prediction model as a guide. In identifying traffic noise impacts, DD-207 indicates that an impact would occur when predicted noise levels approach (are within 1 dBA (L_{eq})) of the FHWA NAC or substantially exceed the existing noise levels by at least 16 dBA.

4.2.3 Public Service Commission of West Virginia

Under Title 150 of the West Virginia Code, the Public Service Commission is in the process of promulgating Series 30: Rules Governing Siting Certificates for Exempt Wholesale Generators. The definition of an exempt wholesale generator (EWG) includes the proposed WGC facility. When the requirements for a siting certificate have been finalized, and if they are applicable to the ongoing WGC facility, they will be considered as an addition to this report document.

4.3 LOCAL ORDINANCES

No local ordinances apply to this study. Neither Greenbrier County nor the City of Rainelle has a local ordinance that addresses noise from new development or construction activities. Traffic volumes on state and county roadways are outside the jurisdiction of local noise ordinances.

4.4 EVALUATION CRITERIA FOR WGC PROJECT

4.4.1 Transportation Corridors

A review of noise levels for Existing Conditions indicates that many locations along the Route 20/60 corridor currently experience a peak hour L_{eq} of 65.0 dBA or higher. Using the peak-hour L_{eq} as an approximation of the L_{dn} indicates that these locations have L_{dn}s that exceed the HUD guideline of 65 dBA, as well as L_{eq}s that exceed the FHWA guideline of 67 dBA. Therefore, the HUD and FHWA guidelines that specify an absolute noise level for determining potential impacts would not be applicable along the transportation corridors. Instead, a more appropriate impact criterion would be a relative increase in noise between No Build and Build conditions. In determining an appropriate impact criterion, the following perceptions of noise level increases were considered, based on Table 4-2:

- 0 to 5 dBA – Minor increase in noise level
- 5 to 10 dBA – Readily noticeable increase in noise level
- 10 or more dBA – Significant increase in noise level

The proposed criterion for determining project-generated impacts at sensitive receptors dominated by traffic noise along the transport roadways is a relative increase of 10 dBA. This criterion is lower than the WVDOT increment of 16 dBA, but was selected because it is perceived as a doubling of noise level, and is typical of impact criteria used by many state DOTs.

4.4.2 Sites in Vicinity of Plant

A review of Existing Conditions for monitored sites in the vicinity of the plant site indicates that L_{dn} noise levels range from 41.4 dBA to 54.0 dBA. It is important to note that these levels are based on baseline measurements that occurred during the winter months, and baseline conditions are expected to be higher during seasons when birds and insects are present and actively making noise. In the absence of applicable local requirements for the project, an L_{dn} of 60 dBA was selected to be the threshold for significant impacts at noise sensitive sites in the vicinity of the plant. An L_{dn} of 60 dBA would be equivalent to a continuous noise level of 53.6 dBA. The 60 L_{dn} level would be up to 12 dBA higher at some sites but it is

similar to existing conditions at some of the other monitored sites. HUD's criterion of a 65 L_{dn} would be equivalent to a constant noise level of 58.6 dBA.

5. PREDICTIVE NOISE MODELS

5.1 TRAFFIC NOISE MODEL (TNM)

The FHWA Traffic Noise Model (TNM), Version 2.5, calculates noise levels based on traffic volume, vehicular mix, vehicular speed, roadway and receptor elevations, rows of buildings, and terrain features. The model also accounts for:

- Slow-speed and accelerating vehicles
- Bus and motorcycle data
- Vehicles on grade
- Vehicles on different pavement types

Other aspects of the noise emission data include energy apportioned to two source heights: one at the pavement level and one at 1.5 meters (5 feet) above the pavement, except for heavy trucks, where the upper height is 3.66 meters (12 feet) above the pavement.

The effects of traffic acceleration away from traffic signals, stop signs, toll booths, and on-ramp start points are included in the model, and the TNM computes vehicle speeds and noise levels accordingly. The TNM incorporates state-of-the-art sound propagation and shielding algorithms over ground of different types, atmospheric absorption, and the shielding effects of barriers, berms, ground, buildings, and trees. The TNM propagation algorithms assume neutral atmospheric conditions but do not account for atmospheric variables such as wind or temperature gradients.

To ensure that the modeled results accurately reflect the site conditions, the TNM model typically is calibrated by using the traffic counted concurrently during the noise monitoring as input. The resulting modeled noise levels for the monitored sites were within 1 dBA of the monitored noise levels except where the sites were affected by conditions other than traffic. This included sites somewhat distant from the roadway so that traffic noise attenuated to levels below background levels. Thus, the modeled noise levels were much lower than monitored noise levels. It also included situations where barking dogs or noisy birds contributed to the monitored noise level, resulting in modeled traffic noise levels that were lower than the monitored noise levels.

After calibration of the monitored sites, the TNM model was run using the volumes, vehicular mix, and speeds provided by the traffic analysis for Existing, No Build, and Build conditions. This traffic information is based on worst-case conditions, which may not have been present during the monitoring periods.

5.2 CADNA MODEL

The Computer Aided Noise Abatement (CADNA 3.4) Model quantifies industrial noise sources using The International Environmental Noise Directive and ISO guidelines to accurately describe ambient noise in community environments. CADNA integrates aircraft, rail, and motor vehicle traffic, as well as industrial noise sources, into a seamless platform to predict A-weighted L_{dn}, L_{eq}, and SPL values. Noise results can be analyzed one-dimensionally at receptors, two-dimensionally through contour grids, and three-dimensionally using profile and digital terrain perspectives. Noise remediation measures are assessed using several program capabilities including barriers, natural embankments, and on-site attenuation measures such as sound reducing materials and equipment silencers.

Based on available site layout and design data, the following parameters were emphasized in the model developed for the WGC project:

- Terrain – All other objects (buildings, roads, railways, etc.) were configured.
- Ground – A concrete reflective surface was defined for the power plant site.
- Structures – The geometries, materials, and in some cases overall noise spectra, were assigned to each building based on their internal noise sources.
- Machinery – Exposed noise sources were defined with minimal or no shielding.

Additional factors addressed for the structures and machinery emitting noise were elevations, points of noise breakout or transmission (windows, openings, louvers, doorways), and known attenuation measures that were associated with specific pieces of equipment.

On-site noise sources for the WGCP were modeled point sources (an unenclosed stationary source) or area sources (a group of noise sources within a building or enclosure). The stationary sources are directly modeled by CADNA. For the area sources, however, the user must provide average noise levels at the interior walls of a building, calculate the composite TL for each wall, then subtract the composite TL from the average interior wall noise to determine the average exterior wall noise level. The average exterior noise level for each wall is then modeled as an area source with a size equal to the surface of the wall. Additional information on the use of the CADNA model is provided in the discussion of Build Conditions.

6. NOISE MONITORING PROGRAM

6.1 SELECTION OF MONITORING SITES

A noise monitoring program was designed and implemented for sites along arterial roadways and sites near the proposed power plant location. Sites in Rainelle would be affected by both increased traffic noise and power plant noise. Five other municipalities that could be affected by project-generated traffic noise include Charmco, Rupert, Anjean, Quinwood, Green Valley, and Hillsboro. Monitoring sites along the arterials were selected to represent typical sensitive receptor points in the affected municipalities, while sites in the vicinity of the proposed power plant were selected to identify baseline conditions in noise sensitive areas that are not dominated by traffic noise.

Noise monitoring was carried out during site visits on 5/11/04 to 5/13/04, 10/19/04 to 10/21/04, 1/12/05 to 1/13/05, and 11/03/05. Monitoring of the Hillsboro area, which is near the Millpoint Quarry, occurred on 11/3/05. Three sound level meters were used in this study: a Brüel & Kjær 2236 and Larson-Davis 820 (both ANSI Type 1), and a Quest 2200 (Type 2). Noise monitoring included peak AM, Midday, PM, off-peak, and late night periods on weekdays. Some weekend periods also were monitored. Table 6-1 shows the list of monitored sites, and Figure 6-1 depicts their locations.

6.2 TRAFFIC NOISE SITES

In Rainelle, traffic noise sites were monitored in four residential areas (designated A, B, C, and D). Representative receptor sites in six areas (designated E through J) in five additional towns along the arterials for site-generated truck traffic were also selected. These are shown in Figures 6-1 through 6-2. Multiple locations within an area were sometimes monitored to ensure that TNM modeling would account for the complexity of different roadway-receptor configurations at an intersection. Monitoring sites at points selected solely for the purposes of assisting in model calibration, or selected for evaluation of rail noise (no longer included in the proposed action), are not included in the discussion. A 15-minute

monitoring period was used, which corresponded with the traffic counts conducted by the traffic analysis team. In some cases, however, monitoring had to be stopped after a 10- to 12-minute period due to the start-up of extraneous noises such as a barking dog or freight rail passby.

The following standard field procedures were observed when collecting noise measurements:

- Field notes documented instrument range, weather conditions, time of day, monitoring period, unusual occurrences (e.g., aircraft flyovers), and site characteristics,
- B&K 2236 noise analyzer and Quest 2200 noise analyzer were used
- Free field microphone mounted approximately 5 feet (1.5 meters) high and at least 4 feet (1.2 meters) from any reflecting surfaces,
- Monitors calibrated every hour,
- Wind screen used on microphone,
- Traffic counts and vehicle classifications taken concurrently (when possible),
- Distance from receptor to edge or middle of road was measured (when possible),
- Roadway speed limit, geometry, and grade (on special occasions) were recorded,
- No monitoring during periods of precipitation, wet pavement, snow or ice cover, and
- No monitoring in winds of 15 mph (24 kph) or more.

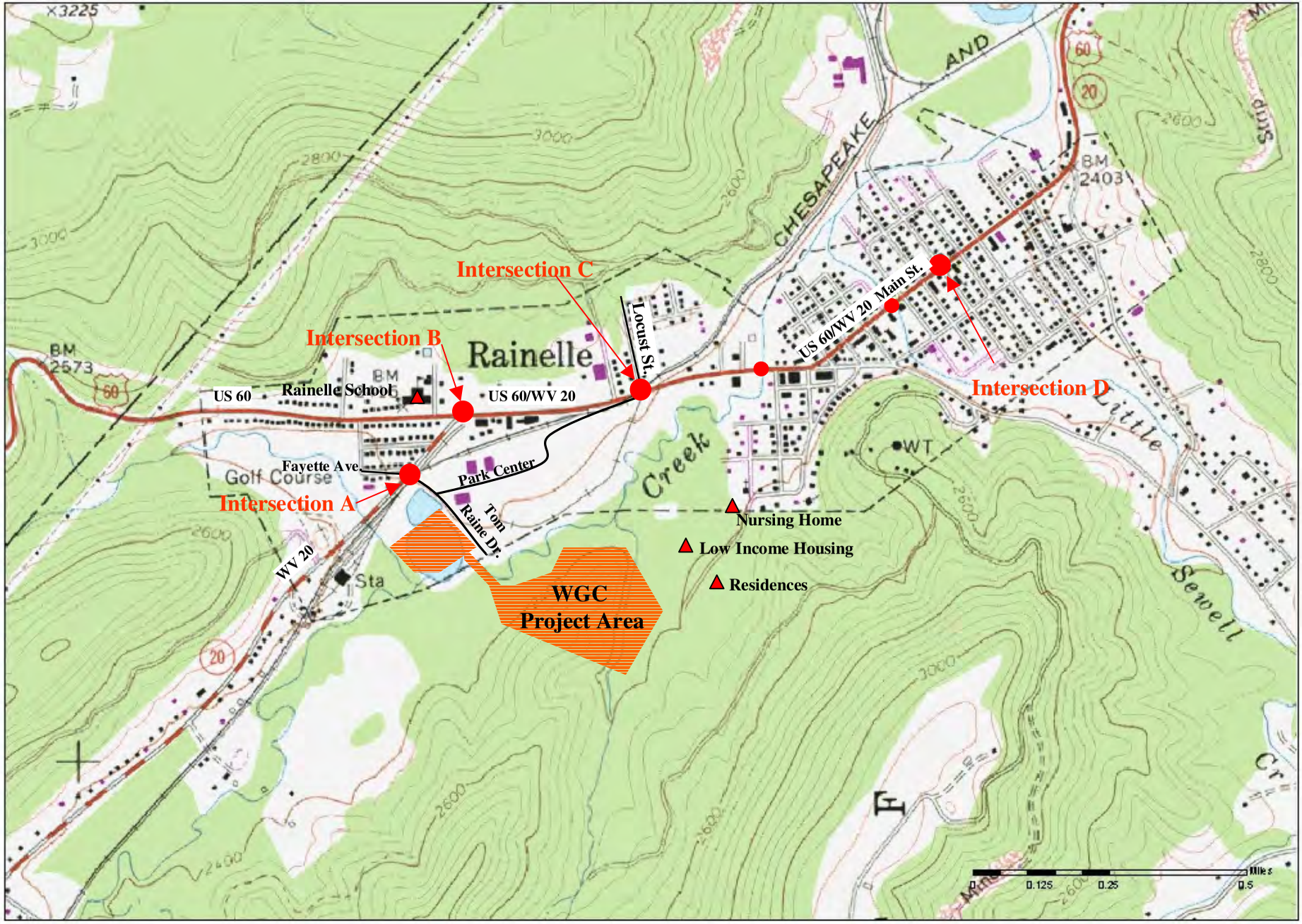
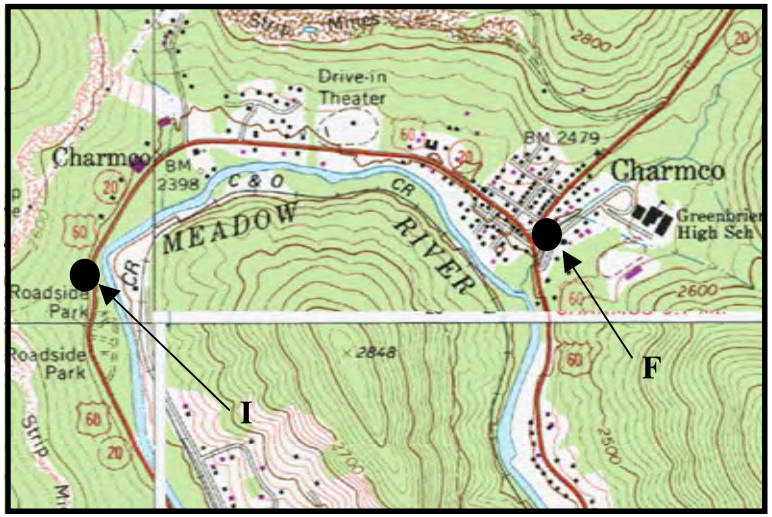


Figure 6-1
WGC Noise Monitoring Locations A through D (Rainelle, WV)

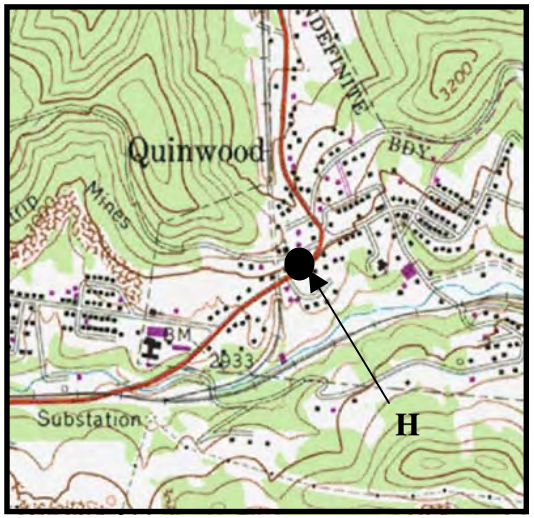
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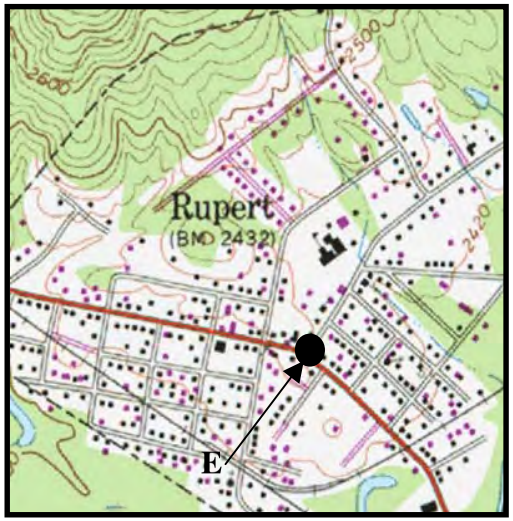
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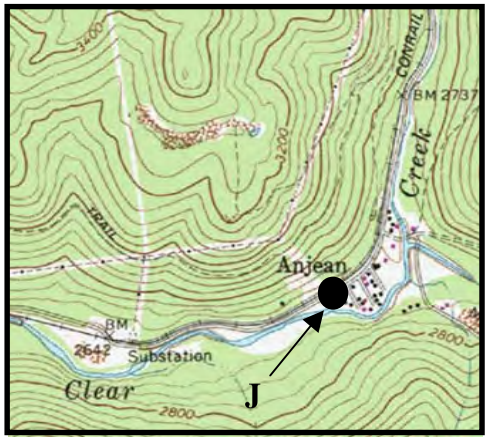
I and F - Charmco



H - Quinwood



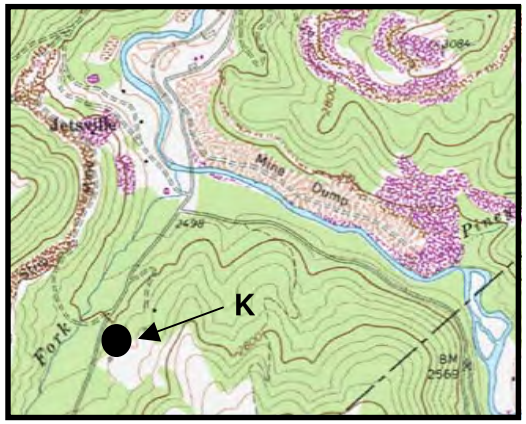
E - Rupert



J - Anjean



G – Green Valley



K – Donegan Site



L – Mill Point

NOT TO SCALE

Figure 6-2
Noise Monitoring Locations – E through L
Map Source: USGS Topo (1:24,000) Rainelle (1976), Quinwood (1981), Rupert (1981), Duo (1981)

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Table 6-1
Noise Monitoring Sites

Short-Term Noise Monitoring Locations							
			Type	Monitoring Periods			
Area	ID	Location / Landmark	T/P	Peak	Off-Peak	Late Night	Week-end
A	1	State police barracks	T	X	X	X	X
A	3	Playground	T	X	X	X	X
A	5	Golf Course	T	X	-	-	-
A	6	Greenbrier Ave./Rte 20	T	-	X	-	-
A	7	Walnut Street	T	X	X	-	X
A	8	Grace Baptist Church	T	X	X	-	-
B	1	Rainelle Medical Ctr.	T	X	-	X	-
B	2	Rainelle Elementary	T	X	-	-	-
C	1	North Sewell Street	T	X	-	X	-
C	4	Cherry Street	T	X	-	-	-
C	5	Nicholas Street	T	X	-	-	-
C	7	Retirement Community	P	X	X	X	-
C	8	Nursing Home	P	-	X	X	X
C	9	ADA housing	P	X	X	X	X
C	10	Mobile Home Park	P	-	X	X	X
D	0	Seventh Street	T	X	X	X	-
E	0	Route1, Rupert	T	X	X	X	-
F	0	Route 60, Charmco	T	X	X	X	-
G	0	Route 20, Green Valley	T	X	X	X	-
H	0	Route 20, Quinwood	T	X	X	X	-
I	0	Route 20, Youth Park	T	X	X	X	-
J,K	0	Anjean Mountain, Donegan	T	X	X	-	-
L	0	Hillsboro, Route 219 north of Lewisburg (Mill Point)					
Long-Term Noise Monitoring Locations							
Site	LT1	Plant - Southeast Side	P	X	X	X	X
Site	LT2	Plant - East Side	P	X	X	X	X
Site	LT3	Plant - North Side	P	X	X	X	X
Site	LT4	Plant - West Side	P	X	X	X	X
Site	LT5	Eco-Park	P	X	X	X	X
Site	LT6	Pennsylvania Avenue	P	X	X	X	X

Type – 'T' sites are dominated by traffic noise; 'P' sites are dominated by rural background noise in the vicinity of the power plant site;
Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
Off Peak – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
Late Night – Time frames after 10 pm, Monday through Thursday
Weekend – Time frames during off peak periods on the weekend
Source: Potomac Hudson Engineering, Inc.

Area A lies north and west of the power plant site, and it represents noise levels along Route 20 between the intersection with Route 60 near the Rainelle Medical Center and the CSX Railroad facility further to the south on Route 20. These sites are influenced primarily by vehicular traffic. Site A1, the WV State Police barracks at the intersection of Route 20 and Fayette Avenue, is representative of the single-family home at the corner of Route 20 and Fayette Avenue. Additional sites representing land uses that may be adversely affected by noise level increases on Route 20 include the playground at A3, the golf course at A5, the residence at A6 and the Grace Baptist Church at A8. Site A7 on Walnut Street represents residences on local streets in the triangle between Route 20 and Route 60.

Area B also is north and west of the power plant site. It includes homes near the Rainelle Medical Center at the intersection of Routes 20 and 60 (B1), as well as homes and the Rainelle Elementary School further west on Route 60 (B2).

Area C is at the intersection of Route 20/60 and Locust/North Sewell Streets. The dominant noise source is traffic on Route 20/60, including traffic in and out of the shopping center. Site C1 is a residence at the corner of the intersection. Sites C4 and C5 represent additional locations, further from the highway, in the Locust/North Sewell Streets neighborhood.

The remaining monitoring locations include Area D, which represents noise levels in downtown Rainelle; Area E, which represents residences at the intersection of Route 1 (Anjean Road) and Route 60 in Rupert; Area F, which represents the homes at the intersection of Route 60 and Route 20 in Charmco; Area G, which represents homes along Route 20 in Green Valley; Area H, which represents homes along Route 20 in Quinwood; Area I, which is at the Western Greenbrier Youth Park on Route 20/60; Area J, which represents the residences on Route 1 near the entrance to the mining site; and.Area L, which represents homes near Route 219 in the vicinity of Mill Point. Area K (Donegan) was not monitored because the noise sources and noise levels would be similar to Area L.

6.4 WGC PLANT NOISE SITES

Both short-term and long-term monitoring was carried out at locations representing sites that could be affected by noise from the power plant. Sites C7 through C10 are short-term sites within Area C. They are in a quiet residential area that is not affected by highway noise, but could be affected by noise from the power plant.

Long-term monitoring of ambient noise was carried out at the boundaries of the power plant site, as well as at nearby residences. These monitoring locations are depicted in Figure 6-3. Traffic noise from the highway is not significant at these long-term monitoring locations. Due to the overall quiet nature of these sites, these areas may be especially sensitive to future industrial noise generated by the plant. For this reason, the sites were monitored for consecutive periods of 24 hours. The long-term monitoring used six Larson-Davis 820 meters: four placed on three sides of the future plant location, one at the future Eco Park, and one in the adjacent neighborhood. The following field procedures were observed for each long-term monitoring site:

- Field notes documented instrument range, weather conditions, internal device temperature, time of day, and normal/abnormal noise observations;
- Larson-Davis Environmental Noise Monitoring Systems were used, which included environmental shroud with silica-gel desiccant chamber for guarding against humidity and wet weather conditions, weatherproof casing, outdoor microphone preamplifier, stainless steel tilt-down tripod, and a 12V 17 Ah external power source;

- Field microphone mounted approximately 8 feet high and at least 4 feet from any reflective surfaces;
- Monitoring was suspended during periods of stormy weather;
- Monitoring was continued in mildly windy or flurry conditions;
- Monitor locations were surveyed using GPS;
- Monitors' power supplies, hardware setup and downloaded reports were periodically checked; and
- Mobile meteorological stations were used to document weather conditions.

6.5 USE OF MONITORED DATA

The monitoring program produced a large volume of data. After reviewing the data, some readings were discarded due to influence from extraneous noises, short (less than 10 minutes) monitoring periods due to extraneous noise or inclement weather, or equipment malfunction. Data from the traffic sites was used to calibrate the TNM model prior to running the model with traffic for Existing Conditions. Because the traffic observed in the field may not be indicative of typical worst-case traffic volumes, monitored values typically are not used for Existing Conditions. For the non-traffic sites, however, the monitored values were used to characterize the Existing Conditions. Data from the long-term monitoring sites was converted to 24-hour L_{eq}s and L_{dn}s for this purpose.

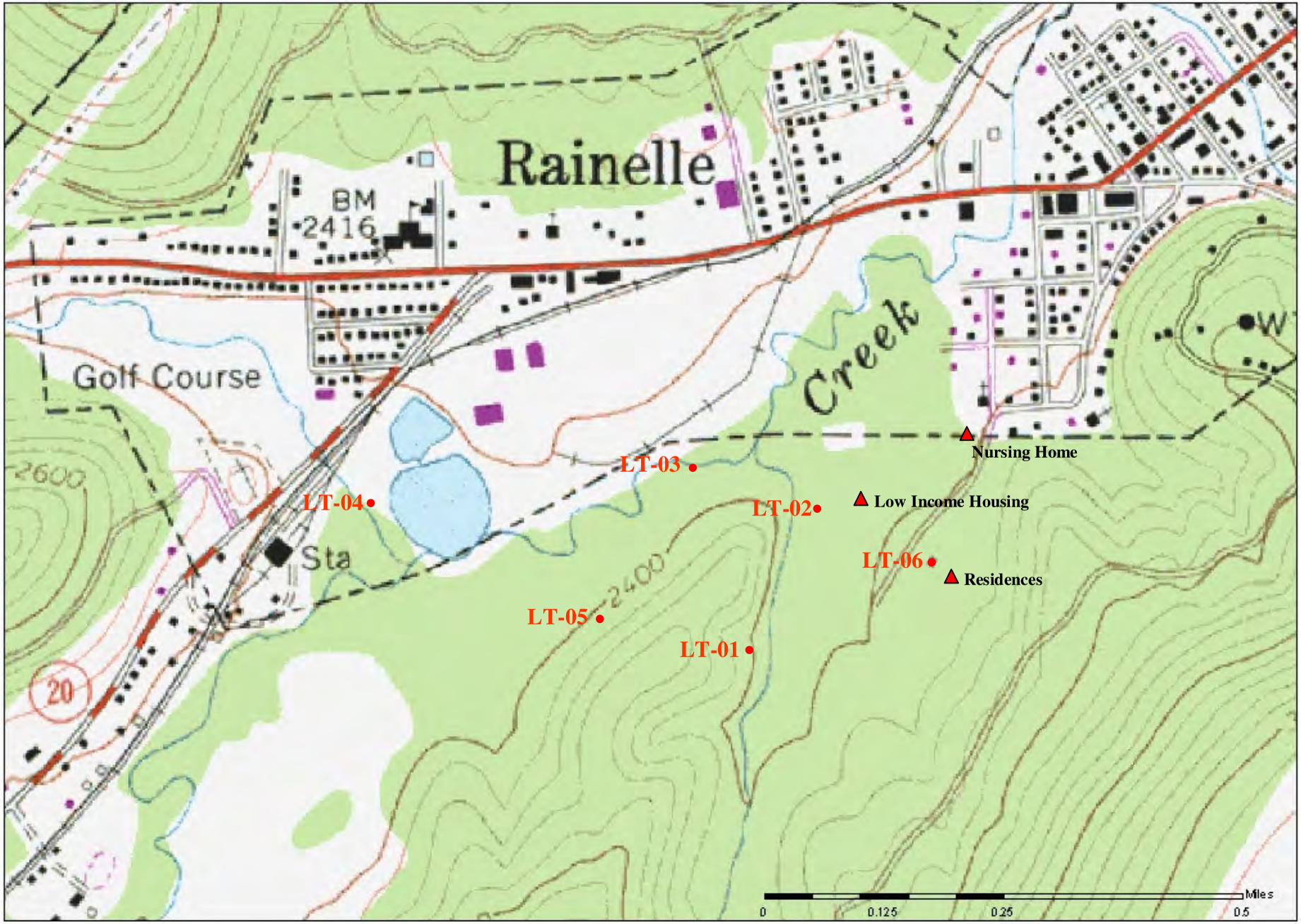


Figure 6-3
WGC Long-Term Noise Monitoring Locations (Rainelle, WV)

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7. EXISTING CONDITIONS

7.1 TRAFFIC SITES

Table 7-1 shows the noise levels for Existing Conditions for sites influenced by traffic noise. All of the traffic sites are short-term (10-15 minutes) monitoring sites. Most of the peak period noise levels were modeled with TNM using traffic volumes developed for Existing Conditions. Noise levels for the other periods are based on monitored values.

Within a given area, noise levels varied with a site's distance from the highway noise source. For each site, noise levels for the weekday AM, Midday, and PM peaks were similar. The peak period L_{eq}s are approximately equivalent to an L_{dn}, and the approximate L_{dn} is indicated in the discussions below.

Table 7-1
Existing Noise Levels at Traffic Sites

Area	ID		Peak Periods			Off-Peak Periods		
		Location / Landmark	AM	MID	PM	OP	LN	WE
A	1	State police barracks	60.3	60.2	60.7	-	51.4	-
A	3	Playground	58.2	58.2	58.8	51.2	43.7	50.7
A	5	Golf Course	36.3	34.3	34.4	-	-	-
A	6	Greenbrier Avenue	64.0	63.4	62.6	-	-	-
A	7	Walnut Street	-	51.7	-	48.3	-	44.9
A	8	Grace Baptist Church	49.6	48.5	49.6	53.6	-	55.6
B	1	Rainelle Medical Center	61.9	62.4	60.6	-	57.3	-
B	2	Rainelle Elementary	62.0	61.8	60.4	-	-	-
C	1	North Sewell Street at Route 20/60	63.9	64.0	63.4	-	56.7	-
C	4	Cherry Street	52.4	51.8	50.6	-	-	-
C	5	Nicholas Street	55.9	51.5	52.4	-	-	-
D	1	Seventh Street at Main St.	67.8	68.6	67.3	-	58.0	-
E		Route 1 @ Route 60, Rupert	69.1	69.1	68.0	-	62.2	-
F		Route 60 at Route 20, Charmco	66.1	65.3	65.3	-	63.6	-
G		Route 20, Green Valley	64.7	67.3	65.7	-	68.1	-
H		Route 20, Quinwood	68.1	67.9	66.3	-	65.5	-
I		Route 20/60, Youth Park, Rainelle	59.3	59.8	58.3	-	55.7	-
J		Route 1, Anjean Mtn.	60.5	62.1	58.7	-	-	-
K		Donegan, Route 1 north of Anjean Mtn.	62.6	59.2	56.5			
L		Hillsboro, Route 219 north of Lewisburg	52.9	63.5	59.5			

Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
OP (Off Peak) – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
LN (Late Night) – Time frames after 10 pm, Monday through Thursday
WE (Weekend) – Time frames during Off-Peak periods on the weekend
Source: Potomac Hudson Engineering, Inc.

Homes in Area A are close to Route 20. The property line for A6 is only 7.5 feet from the roadway, and the peak hour L_{eq} ranges from 62.6 to 64.0 dBA. Due to vegetation and other site characteristics, the monitor could not be placed further back on the lot. The L_{dn} for this site was estimated to be approximately 63 dBA. At A1, the monitor could be placed about 15 feet from Route 20, and the L_{eq}s are about 3 decibels lower than for A6, ranging from 60.2 to 60.7 dBA. The late night L_{eq} of 51.4 dBA supports the rule of thumb that nighttime noise levels are about 10 dBA lower than daytime noise levels. The estimated L_{dn} at this site would be about 61 dBA.

The lower noise levels at Sites A3 through A6 and A8 are consistent with their distances from the roadway. Site A3 (playground) is about 30 feet from the roadway. Modeled noise levels for the golf course are very low because this site is so far from the highway that the modeled traffic noise falls below background levels. This site had a monitored L_{eq} of about 44 dBA for the Midday peak. The site on Walnut Street is a monitored noise level. Grace Baptist Church shows modeled noise levels that are about 8 dBA lower than monitored noise levels. This shows the influence of noise from the CSX rail facility across the street. It also explains the relatively small difference between peak (modeled) and off-peak (monitored) noise levels.

Homes in Area B are close to the highway, although site conditions generally allowed the noise monitor to be placed 15 to 25 feet from the roadway. Near the driveway to the Rainelle Medical Center, Route 20/60 divides, with some traffic headed south on Route 20 and the remainder headed west on Route 60. Thus, noise levels in the vicinity of the intersection are slightly higher, due to the higher traffic volume, than noise levels a little further west. The peak period L_{eq}s for both sites are in the low 60s, and the estimated L_{dn}s are estimated as approximately 62 dBA. A late night reading at Site B1 was only 3 to 5 dBA lower than a peak period L_{eq} due to traffic and vehicles idling at the service station on the corner, as well as voices from patrons at the service station.

The monitoring location for the home at Site C1 was approximately 12 feet from the roadway. This is a fairly busy intersection due to traffic in and out of the shopping center. The peak period L_{eq}s ranged from 63.4 to 64.0 dBA, and the estimated L_{dn} is approximately 64 dBA. Noise levels at Sites C4 and C5 are consistent with their distances from the highway. Sites on Cherry Street and Nicholas Street indicated that homes in this neighborhood are somewhat protected from highway noise through both distance and topography. This indicates that background noise levels (brooks, birds, trees) are also significant at this location. The late night noise level at Site C1 was 56.7 dBA.

The monitoring location at Site D1 is nearly 12 feet from the roadway. Peak period L_{eq}s ranged from 67.3 to 68.6 dBA, with a late night noise level of 58.0 dBA. The estimated L_{dn} for this site would be approximately 68 dBA.

Noise levels at Areas E through H are similar to those for Site D1 in downtown Rainelle. Monitoring locations in these areas are generally about 15 feet from the road. Route 20, from Green Valley to Route 60 in Charmco, shows little difference between peak period noise levels and late night noise levels. This is due to the relatively constant volume of truck traffic throughout the day. The 8% roadway grades on this section of Route 20 also contribute to traffic noise levels, as trucks must downshift when traveling uphill. Due to the closeness of the peak and late night noise levels, the L_{dn}s for these sites are expected to be higher than the values for the peak period L_{eq}s.

For the Western Greenbrier Youth Park (Area I), the modeled site is approximately 100 feet from the edge of the roadway due to the sloping close to the road. Peak period L_{eq}s were 58.3 to 59.8 dBA, with a late night monitored reading of 55.7 dBA. The late night reading is relatively high compared to the peak hour noise levels due to noise from frogs and insects. The L_{dn} at this site is estimated as approximately 59 dBA.

At Area J, the monitor was approximately 15 feet from the roadway. The comparatively low volumes at this site result in L_{eq}s of 58.7 to 62.1 dBA. No noise levels were monitored during a late-night period because very little traffic passes by the site after 7 pm. The estimated L_{dn} at this site would be approximately 62 dBA.

Area L was approximately 22 feet from the edge of the roadway. Only the peak PM period was monitored because the peak PM traffic volumes are very low. As a result, the TNM model would underpredict noise levels at this site because background noise levels would be greater than traffic noise. No noise levels were monitored during a late night period. The estimated L_{dn} at this site would be around 60 dBA.

7.2 POWER PLANT SITES

Table 7-2 shows the results of the consecutive 24-hour monitoring periods at six sites in the vicinity of the power plant site that were collected in January of 2005. The noise monitors logged L_{eq}s and other parameters at 15-minute intervals. This data was reduced by placing the data in a spreadsheet and calculating 24-hour L_{eq}s and L_{dn}s. Where possible the 24-hour period ran from midnight to midnight. However, inclement weather and machine malfunctions caused gaps in the data, and some 24-hour periods have a different time frame. This is also the reason why some sites have more days of information than other sites. Information for both weekday and weekend days are shown in Table 7-2.

Existing noise levels for the four short-term monitoring sites, C7 through C10, are shown in Table 7-2. They are affected by local traffic and background noise levels rather than highway noise. Local traffic may not correspond to commuter traffic patterns. Consequently, the noise levels for typical "peak" traffic periods are similar to the various off-peak periods. In some cases, the off-peak noise levels are higher than the "peak" periods. The L_{eq}s at these sites are generally in the upper 30s to upper 40s. Because the peak and off-peak readings are so close, the estimated L_{dn}s for these sites would be higher than the peak L_{eq}s, but well below 65.

Table 7-2
Existing Noise Levels at Short-Term Monitoring Sites in Vicinity of Power Plant

			Peak Periods			Off-Peak Periods		
Area	**ID**	**Location / Landmark**	**AM**	**MID**	**PM**	**OP**	**LN**	**WE**
C	7	Retirement Community	-	35.2	-	42.7	38.0	-
C	8	Nursing Home	-	47.0	-	46.4	45.3	48.2
C	9	ADA housing	-	38.9	-	41.6	43.5	40.2
C	10	Mobile Home Park	-	-	-	45.6	43.7	39.1

Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
OP (Off Peak) – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
LN (Late Night) – Time frames after 10 pm, Monday through Thursday
WE (Weekend) – Time frames during Off-Peak periods on the weekend
Source: Potomac Hudson Engineering, Inc.

As shown in Table 7-3, noise levels at LT1 through LT6 are low in comparison to readings observed in the downtown area and at sites influenced by roadway traffic. The minimum noise levels monitored range from 27.1 to 33.0 dBA. Although the maximum noise levels are substantially higher, ranging from 60.2 to 73.9 dBA, the calculated 24-hour L_{eq}s and L_{dn}s are still relatively low. The 24-hour L_{eq}s are generally in the mid 30s to mid 40s, while the L_{dn}s are in the upper 30s to low 50s. Weekends appear to be lower than weekdays. The L_{eq}s and L_{dn}s for these sites are approximately 20 dBA lower than the noise levels for the

traffic sites. However, it is important to note that the long-term monitoring was conducted during the winter months, and that baseline noise levels would be expected to be higher from spring through fall when wildlife and insects (e.g., chirping birds and insects) would be active noise sources. It is also important to note that no rail traffic was observed over the weekend during this monitoring event, which is atypical for this area.

Table 7-3
Existing Conditions, Long-Term Monitoring Sites

Site ID	Location	Date	Time	Day	Min.	Max.	L_{eq} (24)	L_{dn}
LT1	Plant - Southeast Side	1/12/05	3:00p - 3:00p	Wed.-Thurs.	27.1	66.3	39.3	42.6
		1/15/05	12:00a - 12:00a	Saturday	29.1	68.2	37.0	41.4
		1/16/05	12:00a - 12:00a	Sunday	27.7	60.5	39.7	44.6
		1/17/05	12:00a - 12:00a	Monday	31.0	64.3	42.2	48.7
LT2	Plant - East Side	1/16/05	12:00a - 12:00a	Sunday	26.2	69.9	41.7	46.7
		1/17/05	12:00a - 12:00a	Monday	30.0	70.3	45.8	51.6
LT3	Plant - North Side	1/14/05	10:15p - 10:15p	Fri.-Sat.	28.0	66.9	38.8	41.9
		1/17/05	12:00a - 12:00a	Monday	31.5	71.6	41.2	46.5
LT4	Plant - West Side	1/15/05	12:00a - 12:00a	Saturday	30.4	64.9	42.0	46.1
		1/16/05	12:00a - 12:00a	Sunday	30.1	68.3	42.9	48.0
		1/17/05	12:00a - 12:00a	Monday	31.0	70.2	44.8	51.3
LT5	Eco-Park*	1/12/05	4:30p - 4:30p	Wed.-Thurs.	24.9	73.1	44.4	45.9
		1/15/05	12:00a - 12:00a	Saturday	24.0	60.9	36.5	39.6
		1/16/05	12:00a - 12:00a	Sunday	24.3	67.9	42.0	47.3
		1/17/05	12:00a - 12:00a	Monday	28.0	73.4	45.2	52.6
LT6	Pennsylvania Avenue	1/15/05	12:00a - 12:00a	Saturday	33.0	73.9	40.8	45.2
		1/16/05	12:00a - 12:00a	Sunday	31.2	65.4	43.5	49.2
		1/17/05	12:00a - 12:00a	Monday	36.0	70.5	47.4	54.0

Source: Potomac Hudson Engineering, Inc.
** No rail traffic observed over the weekend monitoring event*

8. NO BUILD CONDITIONS

8.1 TRAFFIC SITES

Table 8-1 shows the noise levels for No Build Conditions for the short-term monitoring sites. For the traffic sites, for the peak AM, Midday, and PM periods, the values were obtained by running the TNM model with traffic for No Build Conditions. This resulted in projected increases of 0.2 to 1.1 dBA. Because no traffic volumes were available for off-peak and late-night noise periods, these relative differences were added to the monitored values to derive noise levels for No Build Conditions during those periods. As can be seen from Table 8-1, the L_{eq}s and L_{dn}s for No Build Conditions are similar to those for Existing Conditions.

Table 8-1
No Build Conditions, Traffic Noise Levels (dBA)

Area	ID	Location / Landmark	Peak Periods			Off-Peak Periods		
			AM	MID	PM	OP	LN	WE
A	1	WV State Police Barracks	60.8	60.8	61.3	-	52.0	-
A	3	Playground	58.8	58.7	59.3	51.7	44.2	51.2
A	5	Golf Course	36.6	34.3	35.2	-	-	-
A	6	Greenbrier Avenue	64.0	64.0	62.6	-	-	-
A	7	Walnut Street	-	51.9	-	48.5	-	45.1
A	8	Grace Baptist Church	50.2	49.0	50.0	54.1	-	56.0
B	1	Rainelle Medical Center	62.4	62.9	61.2	-	57.9	-
B	2	Rainelle Elementary	62.2	62.0	60.6	-	-	-
C	1	North Sewell Street	64.2	64.4	63.9	-	57.2	-
C	4	Cherry Street	52.4	52.2	51.2	-	-	-
C	5	Nicholas Street	49.4	51.8	51.4	-	-	-
D	1	Seventh Street	68.5	69.1	67.7	-	58.4	-
E		Route1, Rupert	69.6	69.7	68.5	-	62.7	-
F		Route 60, Charmco	67.1	66.2	65.8	-	64.1	-
G		Route 20, Green Valley	65.4	67.9	66.2	-	68.6	-
H		Route 20, Quinwood	69.2	68.4	66.4	-	65.6	-
I		Route 20, Youth Park	59.8	60.4	58.8	-	56.2	-
J		Route 1, Anjean	61.3	62.7	59.3	-	-	-
K		CR 1, Donegan	63.6	63.4	60.3			
L		CR 219/CR 39, Hillsboro	53.6	64.2	59.5			

Peak Period – Time frames 7-9 am, 11-1 pm, or 4-6 pm, Monday thru Thursday
OP (Off Peak) – Time frames 7 am-10 pm, Monday thru Thursday, not within the peak period
LN (Late Night) – Time frames after 10 pm, Monday through Thursday
WE (Weekend) – Time frames during Off Peak periods on the weekend
Note: Monitored off-peak, late night, and weekend values for traffic sites(T) have been adjusted to reflect the relative increase in noise due to increases in background traffic for the peak periods.
Source: Potomac Hudson Engineering, Inc.

8.2 POWER PLANT SITES

For the areas near the proposed site, the No Action noise levels would be the same as the existing noise because no changes in background noise levels (e.g., local traffic, birds, insects, occasional freight train passbys, etc.) are anticipated. Therefore, the noise levels shown in Tables 7-2 and 7-3, which were

obtained for the winter months, would be applicable to No Action conditions for the same season. During spring and summer, Existing and No Action noise levels would be higher due to higher background noise levels. However, for the purposes of preparing a worst case analysis, the relatively quiet winter time noise levels are the most appropriate.

9. BUILD CONDITIONS

9.1 TRAFFIC

9.1.1 Traffic Noise Sources

Employee Vehicles: It is expected that the power plant would employee 26 people. Twenty-four employees would staff the plant 7 days per week, 24 hours per day, with sixteen of them working the daytime shift from 8 am to 5 pm. Two additional employees would work at the power plant during the daytime shift from 8 am to 5 pm. Forty-four additional employees would work in the administration building, the ash byproduct manufacturing facilities, and other buildings during the day shift from Monday through Friday. Because all employees are expected to arrive or depart in their own vehicles, this is a total of 70 employees and 140 vehicular trips to or from the site, as shown in Table 9-1. For the purposes of determining peak hour traffic trips, only 62 employees (124 trips) were used because the 16 trips (8 arriving, 8 departing) during the late night shift change do not occur during a peak traffic hour. Half of the 124 daytime employee trips would occur during a peak AM or PM traffic period.

Table 9-1. Anticipated Number of Employees During the Dayshift

Facility	Day Shift Totals
Power Plant	18
Overhead – Power	7
General – Admin	3
Ash Byproducts (by a third party)*	10
Cementitious Structural Products*	14
Tilapia/Greenhouse*	10
TOTAL	**62**

**Not part of the Proposed Action; however, included to capture worst-case scenario for traffic analysis*

Source: WGC, 2004

Truck Trips: Truck trips would be associated with the power plant and the kiln and manufacturing facilities for the ash byproduct. Although the ash byproduct facilities are not a proposed component of the WGC project, ash byproduct associated vehicles were used in this noise analysis in anticipation of Eco Park tenants and to capture worst-case scenarios. Most of the truck traffic to transport materials to or from the site would occur during the daytime shift, Monday through Friday from 8 am to 5pm. The coal beneficiation/ash return trucks at the power plant would be 40-ton, 3-axle dump trailers that would operate from Monday through Friday from 8 am to 5 pm. Trucks delivering limestone or hauling other materials to or from the kiln and ash byproduct manufacturing buildings would be 20-ton, 2-axle dump trailers operating during the daytime shift only. Table 9-2 shows that 111 trucks would make round trips to the site from 8 am to 5 pm each weekday. For analysis purposes, a peak number of 15 one-way trips was used as a conservative worst case analysis for the TNM model.

Traffic volumes and work shifts modeled for the analysis in this report are based on one daytime shift, Monday through Friday. Deliveries may be interrupted in the morning and afternoon to accommodate school buses and children. Therefore, the peak traffic periods in the AM, Midday, and PM, which are not school arrival/departure times, were the periods modeled as the worst case for project-generated truck traffic.

Table 9-2 Worst-Case Trucking Requirements to Power Plant Facility during Operation

Material	Truck Size (ton)	Weekly Requirement (tons/wk)	Shift* Requirement (tons/shift)	# Trucks per Shift*	# Trips IN/hr	# Trips OUT/hr
Co-Production Facility						
Processed Fuel/Ash Return	40	12,600	2,520	66	8	8
Limestone (Boiler)	20	689	138	7	1	1
Cement Production Facility**/*Kiln Facilities*+						
Raw Material Delivery	20	163	33	1.6	---	
Alumina source	20	95	19	1	---	
Gypsum source	20	354	70	3.5	---	
Kiln Fuel	20	117	23	1.2	---	
Limestone++ (Kiln)	20	980	196	10	---	
Cement	20	700	140	7	---	
Cement Total				*24*	*3*	*3*

Note: Number of trucks shown reflects number of round trips per shift. To convert tons to metric tonnes, multiply value by 0.907.

**Shift means Eight-hr shift (Mon-Fri)*

***Associated kiln/cement production trucks were analyzed to capture worst-case scenarios in anticipation of planned cement-related deliveries.*

+ Source: Daily Requirements of Materials taken from Hazen's Flowstream Summary (CDR Book2 "04_02_02HazenFlowStreamSummary 12-22-04 CWK")

++ Source: Hazen (If WGC identifies pure CAO source, volume requirement is substantially reduced.)

9.1.2 Build Noise Levels at Traffic Sites

Traffic noise was modeled using the FHWA's TNM model. Two alternatives were modeled. Alternative 1 assumes that all coal refuse and pond fines would arrive from Anjean Mountain or Donegan. Under this alternative, traffic on Route 20 between Green Valley and Route 60 would be the same as for No Build Conditions except for additional employee vehicles. Traffic on Route 1 (Anjean Road) would increase, and traffic on route 60 between Rupert and Route 20 in Charmco would increase. Traffic on Route 20/60 between Charmco and the WGCP site would also increase.

Alternative 2 assumes the coal refuse materials would be taken from the Green Valley waste coal pile. Under this alternative, traffic on Anjean Road and on Route 60 between Rupert and Route 20 in Charmco would be the same as for No Build Conditions except for additional employee vehicles. However, traffic on Route 20 between Green Valley and Charmco would increase, along with traffic on Route 20/60 between Charmco and the power plant site.

Table 9-3 shows the noise levels at the traffic noise sites when Anjean Mountain is the source of coal refuse and pond fines. Peak hour noise levels at sites along the proposed truck routes would fall below the impact criterion of an incremental increase of 10 dBA. The highest increases in noise levels occur on Anjean Mountain. Peak period noise levels would increase by up to 6.3 dBA near the entrance to the coal mine on Anjean Mountain (Area J) and up to 5.7 dBA along CR1 to Donegan (Area K). This is the highest relative increase and it occurs because traffic volumes are low under No Action conditions.

Noise levels along WV 20 in Green Valley (Area G) and Quinwood (Area H) would show almost no increase under the Anjean alternative because project-generated traffic would include employee vehicles, but no trucks. Peak period L_{eq}s would continue to be in the 60s and 70s (see Section 4.1.4 for definition of the FHWA Noise Abatement Criteria).

From CR 1 in Rupert through downtown Rainelle (Areas B through I), the relative increases in noise during the peak traffic periods would fall below 3 dBA. Peak period L_{eq}s would continue to be in the 60s and 70s.

The receptor points along WV 20 from the Rainelle Medical Center south past the site entrance (Site IDs A1-A8) would experience noise level increases of up to 2.9 dBA depending on their distance from the highway. The location outside of the police barracks (A1) would have the highest increase in noise (2.9 dBA) because all of the project-generated traffic would converge at this intersection to turn into the roadway leading to the plant. Most of this traffic would also pass the intersection of Greenbrier Avenue and WV 20, where noise levels would increase by up to 2.4 dBA. South of the power plant entrance, at the playground (Site A3), noise levels would increase by up to 0.8 dBA. Although the golf course would experience a relative increase of up to 1.3 dBA, the modeled noise levels in the mid 30s still fall below ambient noise levels; thus the increase would not be noticeable.

Table 9-3
Traffic Noise Levels, Build Conditions, Anjean Mountain Coal Refuse Source

Area	ID	Location / Landmark	Peak Periods			Difference (Build – No Build)		
			AM	MID	PM	AM	MID	PM
A	1	WV State Police Station	63.7	63.7	63.9	2.9	2.9	2.6
A	3	Playground	59.5	59.5	60	0.7	0.8	0.7
A	5	Golf Course	37.4	35.9	36.3	1.1	1.3	1.1
A	6	Greenbrier Avenue	65.9	65.8	65	1.9	1.8	2.4
A	7	Walnut Street	Interior location surrounded by homes					
A	8	Grace Baptist Church	50.4	49.5	50.2	0.2	0.5	0.2
B	1	Rainelle Medical Center	63.1	63.4	62.1	0.7	0.5	0.9
B	2	Rainelle Elementary	62.5	62.3	61.1	0.3	0.3	0.5
C	1	North Sewell Street	65.5	65.6	65.2	1.3	1.2	1.3
C	4	Cherry Street	53.7	53.5	52.9	1.3	1.4	1.7
C	5	Nicholas Street	49.8	52	51.6	0.4	0.2	0.2
D	1	Seventh Street	69.5	70	68.8	1	0.9	1.1
E		Route1, Rupert	70.4	70.5	69.5	0.8	0.8	1
F		Route 60, Charmco	67.8	67.1	66.7	0.7	0.9	0.9
G		Route 20, Green Valley	65.4	67.9	66.2	0	0	0
H		Route 20, Quinwood	69.2	68.4	66.4	0	0.0	0
I		Route 20, Youth Park	61	61.4	60.3	1.2	1	1.5
J		Route 1, Anjean	66.1	66.6	65.6	4.8	3.9	6.3
K		CR 1, Donegan	66.5	67.1	66.0	2.9	3.7	5.7
L		CR 219 at CR 39 in Hillsboro	53.6	64.2	59.5	0	0	0.0

Source: Potomac Hudson Engineering, Inc., May 26, 2006

Table 9-4 shows the relative noise level increases when Green Valley is the source of coal refuse and pond fines. Under these conditions, the noise levels on Anjean Mountain and Donegan (Areas J and K) would show almost no increase while the noise levels in Green Valley (Area G) and Quinwood (Area H) would increase by up to 1.7 dBA. Although the additional number of trucks passing these sites on WV 20 is the same as for CR 1 on Anjean Mountain, the relative noise level increase is lower due to the volume of trucks on Route 20 under No Action Conditions. Noise levels on these two roadways constitute the only difference in noise levels between the two scenarios. Relative increases in noise levels at the other sites are the same because the traffic under Build Conditions is the same. The noise levels for the Mill Point Quarry in Hillsboro would increase only if that source is used for limestone. Otherwise noise levels would be the same as No Action alternative.

Short-term peak noise levels from coal trucks accelerating or decelerating would be similar to noise levels from the coal and lumber trucks currently operating on the roadways. Because a higher number of trucks would be on the roads under Build Conditions, these peak truck noises would occur more frequently. An hourly average of 11 (daytime) to 17 (nighttime) additional truck passbys would occur under Build Conditions. Short-term peak noise levels from the additional trucks would be greatest at hills and intersections where heavy trucks must accelerate, decelerate, or brake, as well as at locations where trucks hit bumps or potholes in the roadway surface.

Table 9-4
Traffic Noise Levels, Build conditions, Green Valley Coal Refuse Source

Short-Term Noise Monitoring Locations (L_{eq})									
Area	ID	Location / Landmark	Type	Peak Periods			Difference (Build – No Build)		
			T/P	AM	MID	PM	AM	MID	PM
A	1	WV State Police Barracks	T	63.7	63.7	63.9	2.9	2.9	2.6
A	3	Playground	T	59.5	59.5	60	0.7	0.8	0.7
A	5	Golf Course*	T	37.4	35.9	36.3	0.8	1.3	1.1
A	6	Greenbrier Avenue	T	65.9	65.8	65	1.9	1.8	2.4
A	7	Walnut Street	T	Interior location surrounded by buildings					
A	8	Grace Baptist Church	T	50.4	49.5	50.2	0.2	0.5	0.2
B	1	Rainelle Medical Center	T	63.1	63.4	62.1	0.7	0.5	0.9
B	2	Rainelle Elementary	T	62.5	62.3	61.1	0.3	0.3	0.5
C	1	North Sewell Street	T	65.6	65.6	65.2	1.4	1.2	1.3
C	4	Cherry Street	T	53.7	53.5	52.9	1.4	1.3	1.7
C	5	Nicholas Street	T	49.8	52	51.6	0.4	0.2	0.2
D	1	Seventh Street	T	69.5	70	68.8	1	0.9	1.1
E		Route1, Rupert	T	69.7	69.8	68.7	0.1	0.1	0.2
F		Route 60, Charmco	T	67.3	66.5	66.1	0.2	0.3	0.3
G		Route 20, Green Valley	T	66.8	68.8	67.5	1.4	0.9	1.3
H		Route 20, Quinwood	T	70.2	69.6	68.1	1	1.2	1.7
I		Route 20, Youth Park	T	61	61.4	60.3	1.2	1	1.5
J		Route 1, Anjean	T	61.3	62.7	59.3	0	0	0
K		CR 1, Donegan	T	63.6	63.4	60.3	0	0	0
L		CR 219 at CR 39 in Hillsboro	T	53.6	64.2	59.5	0	0	0.0

*Modeled noise levels are below background noise levels; N/A = not available
Source: Potomac Hudson Engineering, Inc., May 26, 2006

9.1.3 Late Night Noise

Late-night noise levels are not a source of concern under Build Conditions because the trucks would not travel along the routes between the sources and the power plant during these hours. However, trucks may travel from the coal refuse sources to nearby beneficiation plants. Because late-night noise levels are generally much lower than daytime noise levels due to the lower traffic volumes, the potential for the project-generated trucks to cause a noise impact at residences near the coal refuse sources may need evaluation at a future date.

9.2 WGC CO-PRODUCTION FACILITY

9.2.1 Site Layout

Figure 9-1 depicts the layout of buildings and yard activities used in modeling noise levels for the power plant, which would be on a plateau approximately 20 feet higher than the surrounding terrain. The fence delineating the property boundary also is evident on Figure 9-1. This fence line includes the planned acquisition of a residential property east of the site. The power plant would be accessed by Tom Raine Drive from Route 20 to the west. Vehicles would enter at the Guard and Scale House. Figure 9-2 shows the locations of the on-site equipment and activities used in modeling the noise levels with the CADNA model. The information in Figures 9-1 and 9-2 is slightly different from the information presented in the EIS sections, which show a more recent site plan. However, the modeled results in this technical report constitute a worst case for modeling purposes. Preliminary CADNA runs that included some of the major updates to the site plan showed that noise levels at nearby receptor points would be substantially similar to the results in this technical report.

9.2.2 Administration/Warehouse Building

No significant sources of noise are located in the vicinity of the administration/warehouse building, which would be heated with electricity. Employee parking and the administration/warehouse building would be on the western side of the site, close to the access gate and truck scale. This area is separated from the rest of the site by a triangular-shaped grassy knoll.

9.2.3 Motor Vehicles

The hourly volume of employee vehicles would be the same as described in Table 9-1 under the discussion of traffic noise. For the power plant, eight employees would enter and eight would exit during a peak AM, PM, or late night period. For the administration building, as well as the ash byproduct manufacturing facility and greenhouse/tilapia farm that may be located in the Eco Park to the west, an additional 42 employees would arrive during the peak AM period and depart during the peak PM period. As previously noted, traffic noise was not included in the CADNA modeling. The volume of employee vehicles at the site is not considered to be a source of concern for surrounding residents. This traffic was included in the modeling of highway noise as previously discussed, but was not included in the CADNA modeling.

9.2.4 Materials Handling and Truck Deliveries

Materials handling for the power plant would occur on the southern and western portions of the site, which are the most distant from nearby residences. Although the beneficiation plants would reduce the number of truck trips to the power plant, this analysis is based on previous plans, in which delivery trucks with coal refuse or limestone proceed to the one-day coal refuse storage pile or the 3.5-day limestone storage pile. Trucks with wood chips for the ash byproduct manufacturing facility would make their

deliveries at the northern end of the site. The hourly volume of trucks would be the same as described in Tables 9-1 and 9-2 under the discussion of traffic noise. Beneficiation plant trucks would be on site for approximately 10 minutes each, and limestone trucks for approximately 5 minutes each. The hours for truck deliveries would be limited to daytime hours. These trucks were not included in the CADNA modeling due to their small size (relative to the operations buildings), intermittent nature, and distance

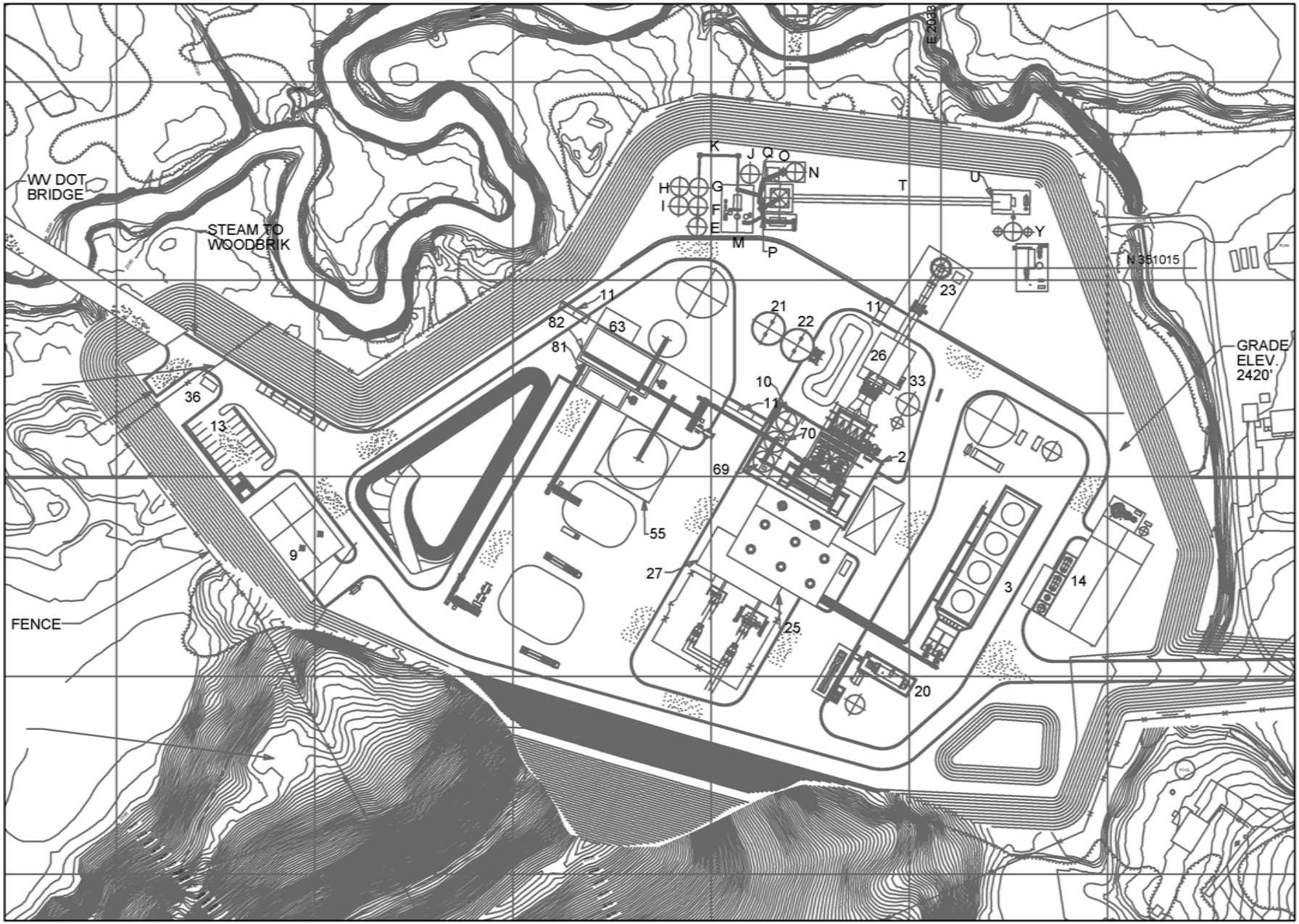


Figure 9-1
WGC Site Building Layout

Source: Parsons E&C DWG No. WGC1-1-SK-111-002-006 Rev F and WGC1-1-SK-047-002-001 Rev B

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Legend for Figure 9-1: Site Buildings Layout	
Building or Area ID Number	**Building or Area Use**
1	Steam Turbine Generator Building
2	Boiler Building
3	Cooling Tower
9	Admin/Warehouse/Maintenance
10	Limestone Day Silo
11	Utility Bridge
13	Parking
14	Water Treatment Building
20	Ammonia Storage
21	Fly Ash Silo
22	Bottom Ash Silo
23	Cems Enclosure
25	Electric Room
26	Baghouse
27	Control Complex
33	Lime Unloading and Storage Silo
36	Guard and Scale House
55	Prepared Fuel Pile Storage Building
63	Coal Prep System Byproduct Beneficiation Facility
69	Coal Day Silo A
70	Coal Day Silo B
81	Limestone Preparation Building
82	Coal Preparation Building
E	Limestone Bin 1
F	Limestone Bin 2
G	Bottom Ash Bin
H	Synthetic Gypsum Slurry Tank
I	Fly Ash Bin
J	Homogenizing Silo
K	Peg Mill
M	Raw Mill
N	Raw Coal Bin
O	Coal Mill
P	Preheater Conditioning Tower
Q	Preheater Fan
T	Rotary Kiln
U	Clinker Cooler
Y	Off Spec. Clinker Bin
a.	Finish Mill

Source: Parsons, April 2005

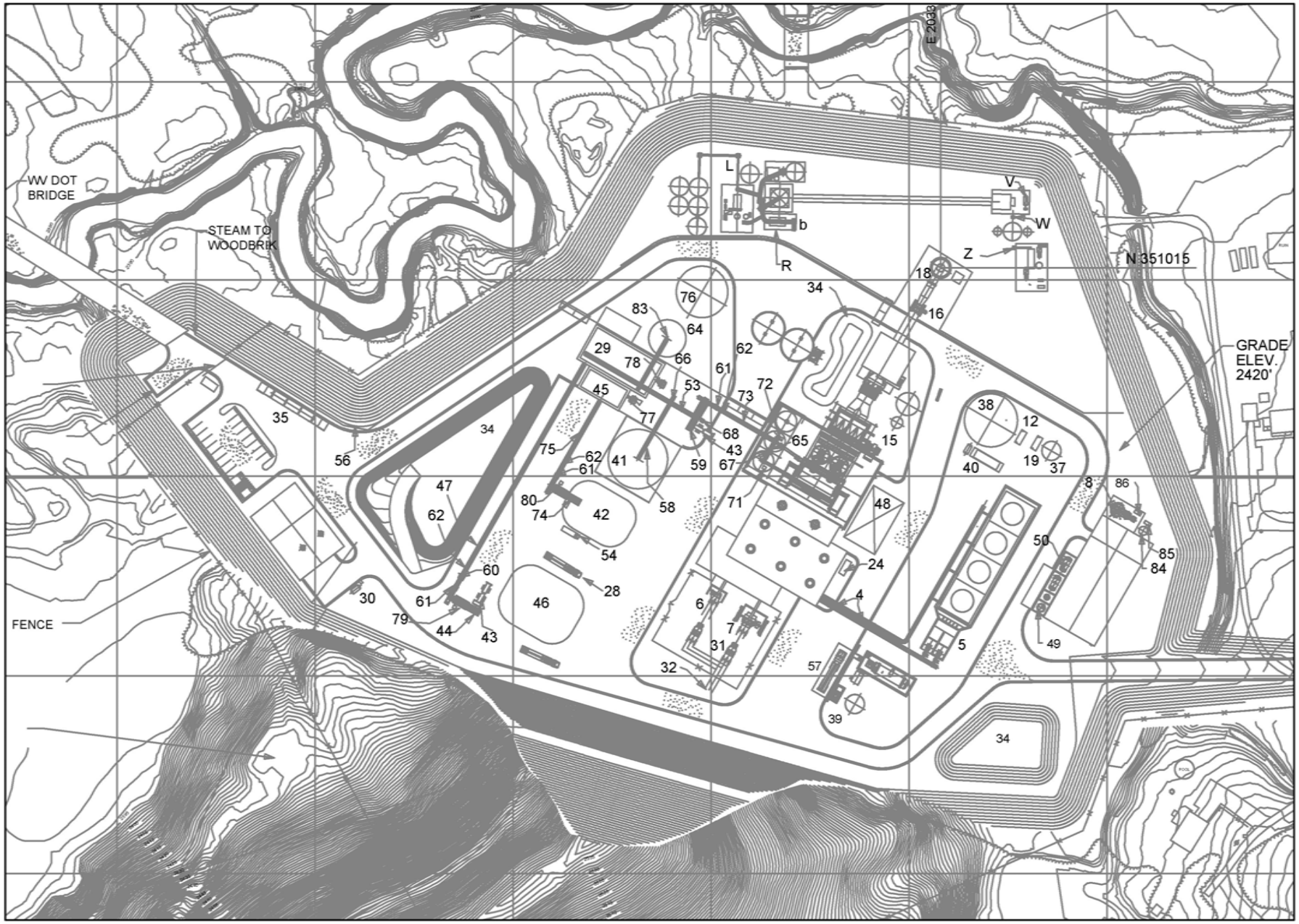


Figure 9-2
WGC Site Equipment Layout

Source: Parsons E&C DWG No. WGC1-1-SK-111-002-006 Rev F and WGC1-1-SK-047-002-001 Rev B

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Legend for Figure 9-2: Site Equipment Layout			
Equipment ID Number	**Description**	**Equipment ID Number**	**Description**
4	Circulating Water Piping	53	Fuel Product Collecting Conveyer Tripper
5	Circulating Water pumps	54	Limestone Truck
6	Unit Auxiliary Transformer	56	Steam Pipe to Woodbrik Facility
7	Step-up Transformer	57	Ammonia/Fuel oil Truck Unloading
8	Clarifier	58	Prepared Fuel Stacking Conveyer
12	Clarified Water Supply Pumps	59	Prepared Fuel Loading and Transfer w/ Hopper & Grizzly
15	Primary Air Fan	60	Metal Detector
16	ID Fan	61	Magnetic Separator
17	Not Used	62	Belt Scale
18	Stack	64	Coal Prep System Byproduct Pile
19	Cycle Make-up Pumps	65	Coal Day Silo Feed Conv Dust Collector
24	Oil Water Separator	66	Prepared Fuel Stacking Conveyer Dust Suppression System
28	Coal Truck	67	Coal Day Silo Distribution Conveyer
29	Coal Preparation	68	Prepared Fuel Loading & Transfer Feeder Dust Suppression System
30	Diesel Refueling Area	71	Coal Day Silo A Dust Collector
31	Switchyard	72	Coal Day Silo B Dust Collector
32	69kv Line	73	Coal Day Silo Feed Conveyor
34	Site Drainage Basin	74	Limestone Reclaim Feeder
35	Truck Scale	75	Limestone Reclaim Conveyor
37	Demin/Condensate tank (100,000 Gal)	76	Thickener
38	Clarified/Fire Water Tank (1,000,000 Gal)	77	Limestone Prep System Dust Collection System
39	Fuel Oil Tank (100,000 Gal)	78	Coal Prep System Dust Collection System
40	Service/Fire Water Pump Hose	79	Coal Loading Feeder Dust Suppression System
41	Prepared Fuel Pile (12 hours)	80	Limestone Reclaim Feeder Dust Suppression System
42	Limestone Pile (3.5 days)	83	Coal Preparation System Byproduct Conveyor (Reversible)
43	980G Wheel Loader	84	Raw Water Storage Tank
44	Coal Loading feeder w/Hopper & Grizzly	85	Raw Water Forwarding Pumps
45	Limestone Preparation System	86	Calcified Water Forwarding Pumps
46	Coal Refuse Storage Pile (1 day)	L	Raw Materials Belt Conveyor
47	Coal Prep Plant Feed Conveyer	R	Main Fabric Filter
48	Crane Setting Area	V	Clinker Cooler Fabric Filter
49	Cooling Tower Chemical Feed Area	W	Bucket Elevator
50	Acid Storage Tank and Feed Skid	X	Clinker Bin
51	Fly Ash Piping (Later)	Z	Bucket Elevator
52	Bottom Ash Piping (Later)	b.	Kiln Flue Gas Duct

Source: Parsons E C, April 2005.

from sensitive receptors. The volume of trucks at the site, based on information available at the time of this report, is not considered to be a source of concern for surrounding residents.

Limited information is available on the potential impacts from back-up alarms. These sounds are pure tones in the 1350 or 4000-5000 range, and they would attenuate quickly with distance. Additional modeling is planned to determine whether they would create noise impacts to the surrounding community. No information is available on noise spectra associated with trucks dumping materials at this site. Additional noise monitoring and modeling are needed to further evaluate this noise source.

Conveyor belts are not considered to be a significant source of noise because they typically do not cause noise problems unless the rollers or belts are squeaking; which is expected to be prevented with proper maintenance. However, the motors for the conveyors were included in the modeling for individual buildings.

9.2.5 Power Plant and Ash Byproduct Buildings

A review of the processes and equipment associated with the worst-case site plan for the proposed power plant indicated that the following buildings and equipment could be a significant source of increased noise levels at the site boundary due to the configuration of fans, conveyor motors, crushers, pumps, and compressors within the buildings:

Coal preparation building. The coal preparation plant is included in the CADNA modeling, although its functions are currently planned to occur at the off-site beneficiation plants. Originally, coal refuse would have been screened, crushed, and dewatered in the coal preparation building. The processed coal, which would be ready for burning, would then be transported to the CFB coal day silos or to a fuel storage pile. The CADNA modeling for this report includes simultaneous use of both of the coal crushers in the building, although the likelihood is that only one at a time would be in use.

Limestone preparation building. Limestone would be dried and sized to meet the limestone sizing specifications in the limestone preparation building. The prepared limestone would then be transported pneumatically to the CFB limestone day bin and the kiln limestone day bin. The building can process up to 55 tons of limestone per hour. Both of the limestone crushers were modeled even though they are not expected to be in use simultaneously. The pressure blower was also included in the CADNA model.

Boiler building. Coal and limestone from the day silos and storage pile would be burned in a fluidized bed combustor (CFB) in the boiler building to create heat for steam for the steam turbine generator. Residual ash would be removed, and some of it would be used in the rotary kiln for the Woodbrik process. The CADNA modeling for this building includes conveyor motors, compressors, fluidized air blowers, and building roof fans. An induced draft fan would be connected to the boiler's stack vent to help exhaust gases from combustion. This fan would be located outdoors, adjacent to the boiler building, and it also was included in the CADNA model.

A forced draft fan would operate to ensure sufficient air supply for the coal combustion in the boiler building. Frequently, forced draft fans are placed outdoors. Due to the fan's high noise levels and the power plant's proximity to residential areas, a building to reduce the level of noise reaching the site boundary would enclose the forced draft fan. Both the forced draft and induced draft fans were modeled with silencers and acoustic lagging because these noise attenuation measures would be needed to achieve OSHA standards for employees.

Steam turbine generator building (STG). In this building, high-pressure steam would turn the blades of the turbine to create electric energy. At the end of the turbine, the steam enters a condenser to recapture

the water. Key equipment used to model the noise from the STG includes pumps, air compressors, the steam turbine generator itself, and building roof fans. The step-up transformer located in the yard adjacent to the STG also was modeled.

Cooling towers. The purpose of the cooling tower is to reduce the temperature of the steam in the condenser at the end of the STG. Liquid droplets that are entrained in the steam would be carried out of the tower, where they will evaporate. A cooling tower with four cooling tower cells was included in the modeling. Noise sources in the CADNA model also included the circulating water pumps, cooling tower fans, and cooling tower inlet. A splash attenuation and inlet barrier wall to reduce noise levels were included in the CADNA modeling for the cooling towers.

Buildings associated with the ash byproduct manufacturing process that could be a significant source of noise under the worst-case site plan include:

Coal mill. Approximately 55 tons per hour of coal from the coal preparation building would be further pulverized for use as fuel for the kiln. The pulverizer is the primary source of noise from the mill.

Clinker cooler building. Raw meal is fed to a long, dry kiln where limestone is decomposed and the various mineral components chemically combine to form the desired new compounds, called clinker. The hot clinker formed in the kiln burning zone passes into a grate-type air-swept cooler. The air cools the clinker from about 2,300^{o} F to 250^{o} F. Noise from the fan and other equipment were included in the CADNA modeling.

Finish mill. The cooled clinker is conveyed to a 210-ton storage bin, then conveyed to an air-swept ball mill for grinding. The grinding mill product is collected and pneumatically conveyed to the Woodbrik manufacturing plant, where it is stored in a 1,000-ton capacity bin. Noise from the kiln equipment was included in the CADNA modeling.

9.2.6 CADNA Modeling

For each of the noise sources, information on the equipment noise, by octave band, was obtained from industry specifications provided by vendors and is typical of the equipment that would be installed for the operations. For sources where vendor data was not provided, available algorithms were used to estimate the spectral data. As specific vendor specifications have not yet been developed, many vendor-specific noise control measures have not yet been identified or incorporated into the model. Buildings were assumed to have metal walls with insulation. The forced draft and induced draft fans, as well as the cooling towers, were modeled with representative noise attenuation measures as previously described.

Table 9-5 presents the results of the CADNA modeling for the worst-case base plant (i.e., without additional mitigation measures). The model predicts daytime noise levels ranging from 55.1 to 64.9 dBA, which results in L_{dn}s that range from 61.9 to 71.3 dBA. Thus, without further mitigation, all sites would be expected to exceed the impact criterion of a 60 dBA L_{dn}. The highest noise levels are at the property line north of the site (LT3).

Table 9-5
Build Noise Levels at Base Plant Power Plant Sites

Receptor Points		Modeled Results (dBA)			Build L_{dn}-60 L_{dn}
Site ID	Location	Daytime	Nighttime	L_{dn}	
LT1	Plant - Southeast Side	57.2	67.2	63.6	3.6
LT2	Plant - East Side	Not applicable, property to be acquired			
LT3	Plant - North Side	64.9	74.9	71.3	11.3
LT4	Plant - West Side	56.9	66.9	63.3	3.3
LT5	Eco-Park*	55.1	65.1	61.5	1.5
LT6	Pennsylvania Avenue	55.5	64.5	61.9	1.9
C7	Retirement Community	61.9	71.9	68.3	8.3
C8	Nursing Home	55.5	65.5	61.9	1.9
C9	ADA housing	56.0	66.0	62.4	2.4
C10	Mobile Home Park	55.2	65.2	61.6	1.6

Source: Potomac Hudson Engineering, Inc., October 7, 2005

CADNA provides information on the contributions of each source to the noise levels at a given receptor point. To identify the sources of noise that need mitigation, the contributing sources for each receptor point were ranked from highest to lowest noise level. The top three sources for each receptor point are presented in Table 9-6. The base plant modeling does not include the full range of potential noise attenuation and mitigation measures that may be incorporated in the plant design, because the detailed specifications and equipment vendors on which these measures are dependent have not yet been finalized. Primary noise contributors identified in the model are shown in Table 9-6. Although other types of equipment contributed lesser amounts of noise at each site, they could still contribute to an exceedance of the 60 dBA L_{dn} due to the number of such sources. Approximately 65 sources of noise were modeled at the power plant site. To achieve an L_{dn} of 60 dBA, the daytime noise levels from each individual source must be well below 60.0 dBA at the property line. For example, if one source creates a noise level of 50 dBA at a given receptor point, then a maximum of 10 sources may have a noise level of 40 dBA, an additional 30 may have a noise level of 30 dBA, and the remaining 24 must have a noise level of 20 dBA or lower to maintain an L_{dn} of 60 dBA at the receptor point.

9.2.7 System Startup and Maintenance

During facility startup, the steam must be conditioned. This means that it must be free of minerals or other impurities that could plug the lines or cause deposition on the turbine blades. Typically, the operators start up the boiler, but have the steam bypass the turbine and enter the condenser. This is done repeatedly until the quality of the steam is suitable for the turbine. If a line or valve becomes plugged during this process, the pressure relief (blow-off) can generate notable amounts of noise. To avoid noise impacts, temporary silencers can be installed on all drain lines and vents. These pieces of equipment are typically removed after the steam has been conditioned. Another means of minimizing impacts during this process is to perform venting, flushing, and cleaning during daytime hours. However, some steam must be generated during the overnight period so that the equipment can be brought into operation the next day.

Table 9-67
Build Conditions, Power Plant Sites

Receptor Points		Daytime L_{dn}	Highest Contributing Sources of Noise (dBA)		
Site ID	Location		1	2	3
LT1	Plant - Southeast Side	63.6	49.5 DE aerator	48.4 STG – east	48.0 STG - east
LT2	Plant - East Side	Not applicable. Property to be acquired.			
LT3	Plant - North Side	71.3	58.2 ID fan	56.8 coal mill – west	56.8 coal mill - east
LT4	Plant - West Side	63.3	50.4 coal conveyor	50.4 clinker cooler – north	47.6 limestone prep – south
LT5	Eco-Park	61.5	48.0 limestone prep – east	44.5 limestone prep – south	44.4 coal/limestone conveyor
LT6	Pennsylvania Avenue	61.9	49.3 ID fan	44.8 FD – east	43.9 raw material conveyor
C7	Retirement Community	68.3	59.6 raw material conveyor	56.7 ID fan	46.2 FD – east
C8	Nursing Home	61.9	51.6 raw material conveyor	50.5 ID fan	42.5 FD – east
C9	ADA housing	62.4	50.2 ID fan	48.7 raw material conveyor	47.3 FD – east
C10	Mobile Home Park	61.6	51.1 ID fan	47.4 coal/limestone conveyor	42.2 coal prep - north

Notes: FD = forced draft building east, west, or north wall
FM= finish mill east, west, or north wall
STG= steam turbine generator building east, west, or south wall
Source: Potomac Hudson Engineering, Inc., October 7, 2005

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10. CONSTRUCTION NOISE AND BLASTING

10.1 CONSTRUCTION EQUIPMENT NOISE

Table 10-1 presents typical noise levels due to various types of construction equipment. Noise levels may temporarily increase due to construction-related traffic and on-site use of construction equipment. Construction is regulated by EPA noise emission standards for construction equipment. The duration and magnitude of any impacts will depend on the type of equipment in use and the particular phase of construction. Potential impacts from construction activities can be minimized by using properly maintained and muffled equipment. Coordination with local officials in order to minimize or alert residents in advance to especially noisy activities is also recommended. In addition, construction materials should be handled and transported in a manner that avoids unnecessary noise. Adherence to these procedures should be specified in the bid documents.

Table 10-1
Typical Noise Levels For Various Types Of Construction Equipment

Type of Equipment	Noise Level (dBA) at 50 Feet	Type of Equipment	Noise Level (dBA) at 50 Feet
Clearing		**Grading and Compacting**	
Bulldozer	80	Grader	80-93
Front end Loader	77-84	Roller	73-75
Dump Truck	83-94	**Paving**	
Jackhammer	81-98	Paver	86-88
Crane with ball	75-87	Truck	83-94
Excavation and Earth Moving		Tamper	74-77
Bulldozer	80	**Landscaping and Clean-Up**	
Backhoe	72-93	Bulldozer	80
Front end loader	73-84	Backhoe	72-93
Dump truck	83-94	Truck	83-94
Jackhammer	81-98	Front end loader	72-84
Scraper	80-93	Dump truck	83-94
		Paver	86-88
Structure Construction			
Crane	75-87	Pneumatic Tools	81-98
Welding generator	71-82	Bulldozer	80
Concrete mixer	74-88	Pile Driver	91-105
Concrete pump	81-84	Front end loader	72-84
Concrete vibrator	76	Dump truck	83-94
Cement and dump trucks	83-94	Paver	86-88
Air compressor	74-84		

Source: U.S. Environmental Protection Agency, "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances," NJID 300.1, December 31, 1971.

Note: Noise levels from equipment can vary according to the engine size. Thus, the table may show a different range of typical noise levels for some types of equipment during different construction phases,

10.2 CONSTRUCTION BLASTING

10.2.1 Need for Blasting

Some blasting may be required to loosen rock as part of site preparation activities. Blasting would occur on an intermittent basis over a relatively short period for the construction phase.

10.2.2 Fundamentals of Blasting and Vibration

Blasting and rock drilling can produce noise levels greater than 90 dBA at the source. Rock blasting includes planning, execution, and closure phases. As part of the planning for construction work, specifications are usually developed to ensure blasting is done safely and in conformance with the requirements of the project. Before blasting begins in new areas, it is important to define how blasting might impact neighbors, animals, structures, utilities and the environment in general.

Ground vibration is commonly viewed as the major concern for off-site damage resulting from blasting (ODOT, 2005). The measurement of ground vibration is Peak Particle Velocity (PPV), which is the maximum speed (measured in inches/second or mm/second) at which a particle in the ground is moving relative to its inactive state.

Extensive research has been conducted over the last 40 years by the U.S. Bureau of Mines and the Office of Surface Mining (OSM) to develop acceptable vibration standards, vibration damage criteria, and techniques to predict and control blast vibrations that greatly reduce the risk of off-site impacts from blasting.

The principal factors that affect ground vibration levels at a given point are:

- Weight of the explosive fired per delay period
- Distance from blast to point of concern (house, well, etc.)
- Blast configuration (existence of a free face, trench, confined area, etc.)
- Geology (sites with a thick layer of soil have been known to produce vibrations 10 times as great as locations with a thin layer of soil over rock).

The first two factors are the most influential to ground vibration. The distance from the blast to the point of concern cannot be controlled by the blasting contractor, but the weight of the explosives fired per delay can be.

10.2.3 Blasting Legislation

Federal Guidelines

The OSM initially found that if PPV were limited to 1 inch/second, then 95% of the damage to (surrounding) houses and structures would be prevented. After more recent research, the PPV limit is now 0.5 inches/second to avoid off-site damage. A PPV of 0.5 is generally equivalent to the vibration caused by a loaded truck or bus passing by 50 to 100 feet away. As a general rule, a person will begin to feel blast vibrations at levels as low as 0.02 inches/second. This is well below the level at which research has shown that damage may occur.

State Legislation

The WVDEP's Office of Explosives and Blasting (OEB) is responsible for regulating surface mine blasting operations. Blasting activities are required to comply with the Citizens Guide to Blasting published by WVDEP in March 2002. Some of the main provisions of the OEB regulations are:

- Blasting may not be conducted with 300 feet of a dwelling unless permission is granted by the owner of the structure.
- Blasting may not be conducted within 300 feet of a school, church, or hospital and not within 100 feet of a cemetery.
- The blaster will define and control access to all areas (blast area) where flyrock may injure people.
- A pre-blast survey must be offered prior to initiation of blasting. This includes contacting owners and/or occupants of dwellings within one-half (0.5) mile of the permitted area.
- Operators that will detonate 5 pounds or more of explosives at any given time must publish a blasting schedule in a newspaper of general circulation in all the counties of the proposed blasting area. Copies of the schedule shall be distributed by certified mail to local governments, public utilities and each resident within 0.5 miles of the permit area.
- Unless otherwise specified by the DEP, detonation blasts may only occur between the hours of sunrise and sunset, Monday through Saturday.

Because the proposed blasting does not relate to mining, the OEB's regulations do not strictly apply.

Local Legislation

A zoning ordinance in the city of Lewisburg, WV, has provisions covering blasting operations (Section 55). (Lewisburg, 2005) However, neither Greenbrier County nor Rainelle have ordinances that cover blasting activities. Under the Lewisburg ordinance, blasting shall be considered in compliance if the following measures are followed:

1. The weight in pounds of explosive charge detonated at any one time shall conform with the following scaled distance formula: $W = (D/50)^2$. Where W = weight in pounds of explosive detonated at any one instant time, D = distance in feet from the nearest point of blast to nearest residence, building or structure: that explosive charges shall be considered to be detonated at one time if their detonation occurs within eight milliseconds of each other.

2. Where blast size would be exceeded under Subdivision (1) of this ordinance, blast shall be detonated by the use of delay detonators to provide detonation times separated by nine milliseconds or more for each of the blasts complying with the scaled distance of the formula.

3. A plan of each blasting operations' methods for compliance with this section (blast delay design) for typical blast which shall be adhered to in all blasting within the City of Lewisburg, shall be submitted to the City of Lewisburg with the application for a permit. It shall be accepted if it meets the scaled distance formula established in Subdivision (1) of this ordinance.

4. Records of each blast shall be kept in a log to be maintained for at least 3 years, which will show for each blast other than secondary (boulder breaking) blasts the following information:
   - date and time of blast,

   - number of holes,
   - typical explosive weight per delay,
   - total explosives and blast at any one time,
   - number of delays used,
   - weather conditions, and
   - signature of operator/employee in charge of the blast.

10.2.4 Evaluation Criteria

The Proposed Action or an alternative may have a significant impact from blasting and vibration under any one of the following conditions:

- Conflict with a jurisdictional noise ordinance
- Cause a blasting PPV greater than 0.5 inches/second at off-site structures
- Cause an airblast in excess of 133 dB

10.2.5 Predictive Modeling

Potential blasting impacts are discussed qualitatively in this document because no details of the blasting plans are available at this time. For informational purposes, the predictive modeling techniques are discussed below.

The *Scaled Distance Equation* method is a mathematical equation, which allows an operator to prove compliance with the vibration limits without using a seismograph. To determine the weight of explosives that can be detonated without off-site damage, the following formula is used that relates PPV to distance and weight of explosives.

$$\mathbf{PPV = k * (d / \sqrt{w})^a}$$

where **k** and **a** are constants that vary depending on site conditions. Ideally, values for **k** and **a** are generally derived from blast vibration monitoring at a site, and define a line that represents a relationship between PPV and the weight of explosives for those conditions. In the absence of vibration monitoring from previous shots in the quarry and to take into account variations in geologic conditions and blast patterns, the values for **k** and **a** are set to represent an upper limit to peak particle velocities relative to scaled distance (shown as Upper Limit on Figure 4, which is based on over 10,000 measurements recorded worldwide). The following values for **k** and **a** were developed by the FHWA:

k = 100
a = -1.6

Thus, if a structure is 530 feet (1/10 of a mile) away from a blast and the peak particle velocity at that point is limited to 0.5 inches per second, then according to the formula above, the maximum weight of explosives that can be detonated during a single delay period, and still be under the limit to avoid off-site damage, is approximately 370 pounds (ODOT, 2005).

11. MITIGATION MEASURES

11.1 TRAFFIC NOISE

No noise level increases would exceed the 10 dBA impact criterion; therefore no noise mitigation measures are necessary. However, no information is currently available on truck traffic associated with the beneficiation plants. In the event that their volumes or hours of operation are sufficient to cause noise level impacts to local residents, the following discussion addresses the potential for mitigation.

Mitigation measures can focus on the source, the receiver, or the path from the source to the receiver. Noise barriers block the path from the source to the receiver. However, noise barriers are not a viable mitigation measure at the impact locations because the barriers must provide a long, unbroken wall to be effective. A quick way of estimating the required noise barrier length is to multiply the distance between the house and the travel lanes by 8, then assume that the noise barrier must extend out to a distance on either side of the home. Breaks in the noise barrier for driveway access or roadways would compromise its effectiveness. In addition, the roadway rights-of-way do not appear to be wide enough to permit construction of noise barriers without encroaching on residential property. Because the noise barriers must be high enough to block the line of site from source to receiver, they would have to be at least 10 feet high to reduce noise from truck engines and exhaust. To ensure that noise is reduced in second-floor bedrooms, they may have to be even higher. Therefore, noise barriers are not recommended as a mitigation measure.

Mitigation measures for the noise source include use of trucks with state-of-the art sound reduction packages and adherence to using properly maintained mufflers. Use of quiet pavements when resurfacing roadways may be helpful, although this technology is still in the experimental stage, and it would not reduce engine or brake noise.

Noise mitigation measures for the receivers could include provision of air conditioning so that residents have an alternate means of ventilation and can keep their windows closed during warm months.

11.2 WGC PLANT NOISE

A variety of reasonably available mitigation measures would be needed to reduce the noise levels at the site boundary and sensitive sites to 60 L_{dn} or less. Some were incorporated into the baseline modeling because they would be required in order to comply with OSHA workplace standards for employees. The forced draft and induced draft fans were modeled with silencers that can reduce the noise levels by 25 dBA or more. As stated previously, the cooling towers were modeled with splash attenuators and inlet silencers.

To achieve the 60 L_{dn} noise target at the site's property line, noise attenuation features would need to reduce the combined daytime noise levels of key noise contributors to below 53.6 dBA at these locations. Because multiple noise sources are being considered, contribution from individual noise sources should target a range of 20.0 to 40.0 dBA at the property line. Potential means of achieving this objective include methods such as:

- acoustic enclosures
- absorptive material on interior walls
- acoustic ducts and louvers
- noise curtains for conveyor motors, and
- more robust structural materials.

Placing acoustic walls around specific pieces of equipment, such as the conveyor motors, in order to increase the transmission loss, can also reduce noise. A similar approach is to place cladding around the steam turbine, which can be designed to allow visual inspection and maintenance of equipment. In addition, louvers and ducts in the walls of buildings permit more noise to pass through than solid steel walls. Acoustic louvers, packless silencers, and duct silencers can be installed to reduce the noise that is transmitted through these openings. Similarly, doors and windows can be designed to meet specific noise reduction criteria.

The available mitigation methods and strategies needed to reduce the noise levels from specific equipment to the desirable design criteria will depend on final design and selection of equipment. The specific suite of mitigation measures for the buildings and equipment, as supplied by the vendors, should be incorporated into the CADNA model to ensure that collective targeted noise levels will be achieved. After the CADNA model and mitigation measures have been fine-tuned for the final design, the WGC contract documents should specify that vendors and suppliers provide equipment that will meet the noise specifications. Operational procedures should include proper maintenance of equipment to prevent noise and vibration from equipment, such as conveyor belts, that may become noisy due to poor maintenance.

An example of the potential results from use of acoustic curtains around the conveyor motors for the worst-case site plan is shown in Table 11-1. The L_{dn}s are lower at all sites, and the nursing home location is now below the 60 L_{dn} criteria. Table 11-2 shows the top three contributors to noise levels at these sites.

Table 11-1.
Build Noise Levels at Plant Power Plant Sites with Acoustic Curtains for Conveyor Motors

Receptor Points		Modeled Results (dBA)			Build L_{dn}-60 L_{dn}
Site ID	Location	Daytime	Nighttime	L_{dn}	
LT1	Plant - Southeast Side	56.8	66.8	63.2	3.2
LT2	Plant - East Side	Not applicable, property to be acquired			
LT3	Plant - North Side	64.7	74.7	71.1	11.1
LT4	Plant - West Side	53.9	63.9	60.3	0.3
LT5	Eco-Park*	54.3	64.3	60.7	0.7
LT6	Pennsylvania Avenue	55.1	65.1	61.6	1.6
C7	Retirement Community	57.9	67.9	64.3	4.3
C8	Nursing Home	52.9	62.9	59.3	-0.7
C9	ADA housing	55.1	65.1	61.5	1.5
C10	Mobile Home Park	54.2	64.2	60.6	0.6

Source: Potomac-Hudson Engineering, Inc., 10/7/05

Table 11-2.
Major Sources of Noise at Power Plant Sites with Acoustic Curtains for Conveyor Motors

Receptor Points			Highest Contributing Sources of Noise (dBA)		
Site ID	Location	Daytime L_{dn}	1	2	3
LT1	Plant - Southeast Side	63.2	49.5 DE aerator vent	48.4 STG east	48.0 STG east
LT2	Plant - East Side	Not applicable. Property to be acquired.			
LT3	Plant - North Side	71.1	58.2 ID fan	56.8 Coal mill east	56.8 Coal mill west
LT4	Plant - West Side	60.3	47.6 LP south	45.1 DE aerator vent	44.8 LP west
LT5	Eco-Park	60.7	48.0 LP east	45.6 CP south	44.5 LP south
LT6	Pennsylvania Avenue	61.6	5.0 DE aerator vent	49.3 ID fan	44.8 FD east
C7	Retirement Community	64.3	56.7 ID fan	46.2 FD east	41.3 CT inlet E
C8	Nursing Home	59.3	50.5 ID fan	42.5 FD east	40.2 STG east
C9	ADA housing	61.5	50.2 ID Fan	47.3 FD east	42.9 STG east
C10	Mobile Home Park	60.6	51.1 ID fan	43.4 Coal mill north	42.2 Coal prep north

Notes: FD = forced draft building east, west, or north wall
STG = steam generator building east, west, or south
LP = limestone preparation building east, west, or south
CP = coal preparation building east, west, or south
CT = cooling tower inlet
FM = finish mill east, west, or north wall
Source: Potomac-Hudson Engineering, Inc., 10/07/05

Some other sources of on-site exterior noise include the on-site truck and materials handling activities outdoors. In general, newer equipment is less noisy than older equipment due to better engine mufflers, refinements in fan design, and improved hydraulic systems. Therefore, the recommendation is that all vehicles and construction/yard equipment on-site represent the state-of-the art in terms of noise reduction. Other potential mitigation measures are as outlined below:

Conveyors and hoppers

- Proper maintenance to prevent squeaking and squealing of conveyors
- Retrofit chain conveyor with a urethane coating or urethane sleeve on the chain flights
- Use a urethane coating or urethane sleeve on the conveyor tail roller
- Line hoppers and bins with resilient material such as high-density polyurethane sheeting to reduce impact noise
- Where feasible, replace metal screens with rubber screens

Truck loading/unloading

- Maintain smooth surfaces to reduce tire noise and airborne vibration
- Maintain a 25 mph speed limit on-site to help minimize engine noise

Slamming tailgates

- Use rubber gaskets
- Decrease speed of closure
- Use bottom dump trucks
- Establish truck cleanout staging areas

Back-up alarms

- Replace alarms with strobe lights
- Replace alarms with rear-view back-up camera and/or back-up sensors
- Use lower sound levels late at night
- Use self-adjusting alarms that are 5 decibels louder than background noise levels (works best on smaller equipment such as backhoes and trucks and must be mounted as far to the rear of the machine as possible)
- Use an observer
- Configure traffic patterns to minimize backing movements
- Use manually adjustable alarms

Equipment use

- Restrict the use of pile drivers, jackhammers, and other very noisy equipment during nighttime hours
- Use local power grid to limit noise from generator use
- Use solar powered message/sign boards to limit noise from generator use
- Use smallest generators possible
- Where feasible, operate equipment at the lowest possible power levels
- Where feasible, use hydraulic powered or electric equipment instead of diesel-powered equipment
- Construct enclosures or use portable noise shields or acoustic curtains to reduce noise from specific activities

11.3 BLASTING

Recommended noise mitigation measures for blasting operations could include:

- No blasting on Sundays, legal holidays and between the hours of 8 pm and 8 am.
- Notifying nearby residences whenever blasting work will be occurring.
- Installing temporary or portable acoustic barriers around construction noise sources.

If blasting is planned, a pre-blast survey should be carried out to document the conditions prior to blasting. Coordination with local officials and residents should also be carried out to alert residents, including specifying the times of day when blasting activities would occur and a horn signal to alert the surrounding community of impending blasting activities. Any blasting activities would need to comply with the state guidelines such as the *Citizens Guide to Blasting* published by the WV Department of Environmental Protection in March 2002.

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Appendix L
Transmission Line Corridor Study

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Western Greenbrier Co-Generation LLC

Electrical Transmission Line

Cultural and Ecological Evaluations

September 2, 2005

URS Corporation
501 Holiday Drive, Suite 300
Foster Plaza 4
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1.1 PROJECT SUMMARY

Western Greenbrier Co-Generation, LLC (WGC) is proposing to construct a 90 MWe power-generating plant (on net basis) demonstrating an advanced atmospheric pressure fluidized-bed boiler developed by ALSTOM Power based on a compact inverted cyclone configuration. The power island will operate in tandem with a calciner to create a cementitious ash product. The organizational structure for WGC is a joint development entity formed as a limited liability company owned by three small municipalities (Rainelle, Rupert, and Quinwood).

Rainelle, West Virginia, has been selected as the site for the proposed demonstration project in a location adjacent to a planned new eco-park. The initial waste coal fuel source is located at Anjean, 18 miles by truck from the co-production facility. Anjean is a 400-acre abandoned coal mining area with approximately 4 million tons of coal waste concentrated in a 40-acre "black mountain." There are multiple other available coal waste sites within a similar distance from Rainelle assuring an ample supply of fuel for the operational life of the proposed power plant.

1.2 STUDY SCOPE

The proposed facility would be constructed and operated by WGC, with U.S. Department of Energy (DOE) providing financial support through a cooperative agreement with WGC under the DOE Clean Coal Power Initiative (CCPI) Program. The DOE is preparing an Environmental Impact Statement (EIS) for the Western Greenbrier Co-Production Demonstration Project. As part of the EIS, cultural resource and ecological studies were conducted of the project area including the initial transmission corridors and fuel supply locations. The project had proposed an original electrical transmission route approximately 8.5 miles long paralleling an existing American Electric Power (AEP) right-of-way from near a golf course south of Route 60 in Rainelle northeasterly to the McClung substation near Quinwood, WV. As a result of additional analysis, WGC is proposing an "alternate" transmission corridor route (Alternate Route). The Alternate Route would follow the same AEP line from the golf course at Route 60 to a point

approximately 3,000 feet north of the Meadow River and then proceed directly north to the Grassy Falls substation near Nettie, WV.

As part of its analysis of the Alternate Route, WGC has contracted with URS Corporation ("URS") to conduct initial cultural resource and ecological evaluations of the section of the proposed "Alternate" electrical transmission corridor not part of the initial EIS studies (i.e. north of Meadow River to Grassy Falls - see Figure 1). At this point, the Alternate Route has not been surveyed and therefore global positioning system (GPS) points provided by WGC were utilized to identify the route and study corridor. The intent and scope of this initial evaluation work was to identify potential significant/sensitive resources located within the proposed corridor. Section 2 of the report addresses the cultural resource evaluation for the Alternate Route and Section 3 presents the results of the ecological study (wetlands and threatened and endangered species) Alternate Route.

Prior to commencement of fieldwork, WGC provided URS with a Microsoft Excel spreadsheet containing geographic coordinates for the Alternate Route. URS converted the Excel spreadsheet into a database format (*.dbf) to plot the points on United States Geographic Survey (USGS) topographic maps and aerial photography using ESRI ArcMAP software to construct a Geographic Information System (GIS). Each point was given a unique identification number beginning with "PR" and a numeric value beginning with "PR1" and ending at "PR154" signifying "Proposed Right-of-Way." USGS topographic maps, aerial photography and other background GIS data were obtained from http://gis.wvdep.org and http://www.wvgis.wvu.edu. The PR points were imported into a handheld GPS unit to assist in field orienteering. All GPS points were used to develop the GIS to identify the possible archaeological and environmental impacts discussed in this report.

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2-1 CULTURAL RESOURCES INVESTIGATIONS

URS conducted a Pedestrian Reconnaissance of the proposed Alternate Route in Greenbrier and Nicholas Counties (Figure 1). The goal of the Pedestrian Reconnaissance was to identify any previously recorded and unrecorded cultural resources in or adjacent to the area of potential effect (APE) for the project, and assess whether the proposed project will have any effect on cultural resources. For this study, the APE for archaeological sites includes the 17-mile alignment and 150-foot corridor where the proposed construction of the Alternate Route will occur. The field survey was conducted between August 2 and 11, 2005.

2.2 BACKGROUND RESEARCH

As part of the investigations, URS conducted background research to collect information on previously recorded cultural resources within a 2-mile (3.2-kilometer) radius of the APE. This review was conducted to evaluate the potential of the project for containing unrecorded archaeological sites to and determine if any portion of the proposed project area had been subjected to previous cultural resource investigations.

Examination of the West Virginia Archaeological Site files for Corliss, Nettie, Quinwood, and Rainelle 7.5-Minute Quadrangles, indicated that no previously recorded archaeological sites are located in the proposed project area. The nearest recorded site includes 46NI12, located approximately 2 miles northwest of the proposed transmission corridor. Site 46NI12 is situated on a ridge saddle and consists of two prehistoric mounds that probably date to the Early Woodland period. Because this site has not been subject to evaluation, its National Register status remains undetermined. The proposed project will have no effect on this resource.

Review of National Register of Historic Places (NRHP) files and West Virginia Historic Resource Survey (WVHRS) forms indicated that no National Register sites or recorded historic structures are present in the project area. Review of the resources indicates a number of other structures within a one-mile radius of the project area. These consist primarily of late nineteenth through mid-twentieth century residential and commercial

structures located east of the project area in Hominy Falls and Leivasy. These historic resources will not be impacted by the proposed project.

Previous archaeological investigations in the proposed project area are limited to work conducted by John Milner Associates, Inc. (JMA) for the proposed Western Greenbrier Co-Production Plant in Rainelle, Greenbrier County (Stevens and Chadwick 2005). Surveys consisting of shovel testing, soil auguring, and backhoe trenching on alluvial and upland landforms associated with Sewell Creek and the Plum Creek tract (area south of the property fence line) produced a single flake fragment of gray chert. Additional shovel test excavations around the original positive find failed to produce any artifacts. The single flake is classified as an isolated find and does not qualify as an archaeological site. Based on these results, JMA concluded that the proposed plant site had no potential to contain significant cultural resources and that construction should proceed as planned.

Other studies in the project vicinity consist of abandoned mine-land reclamation projects and smokeless coal mine and surface mine permit applications. Because most of these proposed undertakings involved areas occupied by steep gradients or areas previously disturbed by mining or timbering activities, the West Virginia State Historic Preservation Office (WVSHPO) designated the activities as No Effect Projects, clearing the applicants from further Section 106 responsibilities. One such permit application (01-817-MULTI) for an Incidental Boundary Revision (IBR) project involved areas located within the proposed project corridor. Previous disturbances related to timbering operations have impacted the area; as a result, the WVSHPO cleared the project.

2.3 PREHISTORIC ARCHAEOLOGICAL SENSITIVITY

URS calculated the archaeological sensitivity and the potential of the project area for unrecorded prehistoric sites by reviewing the findings of previous cultural resource investigations in the project vicinity by considering locational data on previously-recorded sites. As noted, one archaeological site has been recorded; though not determined, the site probably dates to the Early Woodland period. Additionally, the one

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archaeological survey in the project vicinity failed to document any archaeological sites, suggesting that prehistoric settlement was sparse in the upper reach of the Meadow River drainage. While this review suggests a limited potential for prehistoric archaeological sites in the proposed project vicinity, unrecorded sites could be found in upland settings.

For upland settings in the proposed project area, unrecorded prehistoric sites are most likely to occur on ridgetops, benches, and saddles, as well as in stream valley bottoms that have not been disturbed by prior mining, timbering, or construction activities. These areas are considered to have a moderate potential for containing unrecorded prehistoric sites. All other project settings that run along steep slopes with gradients well in excess of 15 percent; these areas are concluded to have little or no potential for prehistoric archaeological sites.

2.4 HISTORIC ARCHAEOLOGICAL SENSITIVITY

The potential for the project area to contain unrecorded historic archaeological sites was evaluated primarily on the basis of historic structures on file at the WVSHPO and review of historic maps; given the project's isolated rural setting, however historic map coverage is limited. The project area is illustrated on a map for Greenbrier County (Harrison and Handley 1887) and on an economic geology map for Greenbrier County (Price and Heck 1937). Neither map indicates any historic settlement in the project area.

Data on recorded historic structures in the project vicinity indicate that most historic resources in the region relate to historic lumber camps and small late nineteenth- to early twentieth-century settlements east of the project alignment along Hominy Creek and to the south along Meadow River. Based on this review, there is no evidence of historic occupation in or adjacent to the proposed project area. Past historic land-use was probably limited to timbering and mining of the area. Consequently, historic archaeological potential in the project area is estimated to be low.

2.5 FIELD SURVEY

The field survey had two goals: (1) to document the existing condition of the project area; and (2) to evaluate the likelihood of encountering buried prehistoric and historic archaeological resources. Ground conditions in the APE were examined and limited soil auguring was conducted during initial walkover of the project area. The southwest-northeast-tending proposed transmission alignment traverses several ridge spurs and side slopes, crosses six named streams (Meadow Creek, Burdette Creek, Angline Creek, Kern Branch, Roaring Creek, and Hominy Creek), of the total 32 streams identified and then runs up slope and along a sinuous ridge north of Hominy Creek.

Walkover revealed that most (95 percent) of the project alignment is highly disturbed by previous timbering and mining activities; ongoing subsurface mining activities were noted east of PR 47 along Burdette Creek. Additionally, two overhead transmission lines cross the proposed alignment; one, located in the south, extends east-west across the alignment between PR 38 and 39. The second utility corridor begins at the alignment's northern terminus (PR154) and extends southwest immediately adjacent to the proposed alignment before it shifts to the east slightly at PR 141. From here, the existing transmission line continues in a southwesterly direction to PR 128, at which point it runs due south away from the proposed project alignment. Surface disturbances over most of the proposed alignment were indicated by large clear-cut areas subject to surface mining and overhead utility line installation, evidenced by irregular topography, exposed soils and bedrock. Vegetation over these areas consists of invasive secondary scrub plants, including tall grasses, saplings, and briers. Portions of the northern and southern most sections (PR 1-15 and PR 139-154) were originally thought to be prehistorically sensitive, although reconnaissance revealed surface disturbances attributed to timbering operations. Disturbances in these areas were indicated by irregular topography, old road cuts, deflated soils, and immature forests suggestive of grading activities. Large clear-cut areas that lacked vegetation indicated more recently disturbed timbering areas. Due to disturbances and steep gradients documented during the pedestrian reconnaissance, 95 percent of the proposed alignment is concluded to have limited to no potential for archaeological remains.

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Despite the large amount of surface disturbances documented during the walkover, seven areas (five percent) still retain some potential for unrecorded archaeological sites. Of these, four include stream crossings (see below). The other three segments traverse ridge spurs (PR 1-2 and PR 12-13) and a ridge saddle (PR 83-84). Regarding the ridge spurs near the southern project terminus, although recent timbering activities documented above may have disturbed these landforms, the level wooded areas where the proposed alignment crosses may still retain some potential for unrecorded prehistoric archaeological sites.

Reconnaissance between PR 83 and 84 confirmed that the ridge saddle setting was sensitive for prehistoric archaeological sites (Figures 5 and 12). This setting is similar to the one documented for previously recorded site 46NI12. Disturbances in the vicinity of PR 83 and 84 are limited to minimal clearing for small residential construction, an adjacent gravel road, and All Terrain Vehicle (ATV) trails that traverse the ridge. Given the similar topographic settings for the area between PR 83 and 84 and Site 46NI12, as well as the lack of disturbances, the initial assessment of moderate prehistoric sensitivity for upland saddles remains unchanged.

As noted, the proposed alignment crosses six named streams. Except for Hominy and Roaring Branch Creeks, the remaining watercourses comprise the headwaters of first- and second-order tributaries consisting of shallow bedrock streams with limited to moderate flow. The floodplain along most of these streams comprises hummocky terrain with exposed bedrock and is occupied by secondary mixed deciduous and coniferous growth. Limited soil auguring at these locations revealed shallow soils of dark brown silts representing recent colluvium/alluvium. Steep slopes flank the floodplains of these streams. Based on these observations, URS concluded that portions of the proposed alignment that crossed Meadow Creek, Burdette Creek, Anglne Creek, Kern Branch, and the unnamed intermittent stream (between PR 122 and 123) have limited to no potential for archaeological sites.

Hominy Creek consists of a first-order tributary to the Gauley River, while Roaring Branch serves as a tributary to Hominy Creek. Pedestrian reconnaissance of areas where the proposed alignment crosses or runs adjacent to these creeks confirmed that three floodplain/lower terrace settings (PR 92-95, PR 98-99, and PR 132-134) and one ridge spur setting (PR 112-114) was sensitive for prehistoric archaeological sites (Figures 6 through 9 and 13 through 16). Walkover and limited soil auguring at these areas indicated that both creeks flow at depths ranging from approximately three to six feet. Observation of shoreline and soil augur profiles revealed intact, well-drained soils, suitable for small encampments where such activities as hunting or tool manufacturing/maintenance would have occurred. Based on these observations, the initial assessment of moderate sensitivity for prehistoric archaeological sites in stream valley bottoms aforementioned alignment segments remains unchanged. Most remaining bottom settings and upland areas overlooking Hominy Creek and Roaring Creek either encompass steep slopes or have been severely disturbed by activities mentioned above.

Based on this review, URS recommends that a subsurface archaeological survey (Phase I) be conducted in areas where project impact zones for transmission alignment intersect settings of moderate potential. These include the following seven areas (PR 1-2, PR 12-13, PR 83-84, PR 92-95, PR 98-99, PR 112-114, and PR132-134).

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3.1 ECOLOGICAL INVESTIGATIONS

URS conducted an ecological evaluation of the proposed Alternate Route in Greenbrier and Nicholas Counties (Figure 1). This evaluation included (1) identification of potential types and locations of wetlands, (2) number and type of riparian stream crossings and (3) suitability of habitat for threatened and endangered species. The field survey was conducted between August 1 and 11, 2005.

3.2 THREATENED AND ENDANGERED SPECIES

As identified, there has been previous studies and documentation prepared in support of development of the EIS for this project. As part of the previous studies a request was made to the United States Fish and Wildlife Services (USFWS) for information concerning any potential impacts within a 30-mile radius of the power plant site. This radius would include the area impacted by the proposed Alternate Route. Appendix A contains the July 8, 2004 response from the USFWS identifying three mammals (2 bats and 1 squirrel), two plants and three mussels that maybe be present in this 30-mile radius. On July 26, 2005, URS contacted Monte Mathews of the Elkins, West Virginia USFWS office and provided him with a map of the Alternate Route and requested an update concerning any species of concern specific to this location. Mr. Mathews identified that there were no additional species of concern outside those listed in their July 8, 2004 letter. Mathews said that although the letter lists species that may occur within the general area, there was no confirmed documentation of any of the species along the Alternate Route. He also indicated that there are no know hibernaculum caves along the corridor. The species of concern would be the Indiana bat since it may be in the general area and its habitat (hollow trees or loose bark) is pervasive in any forested area.

Also in support of the EIS, the project requested the same information from the West Virginia Division of Natural Resources (WVDNR). An additional letter was received from the WVDNR on May 25, 2004. The letter is also included in Appendix A, and lists all of the same federal species as does the USFWS, in addition to the Shale barren rockcress (*Arabis serotina*).

3.2.1 Regional Species Occurrence

Based on consultation with the USFWS and the 2004 letter from the WVDNR the following are species that could occur within the project study area.

Indiana bat - *Myotis sodalis*
The Indiana myotis is a rather nondescript small brown bat with a wingspan of approximately 9.5-10.5 inches. This bat is very similar in appearance to the common little brown myotis (a bat often found in houses), but can be distinguished by the duller luster of its fur and toe hairs that do not extend beyond the tips of the claws. The Indiana myotis also has a more pinkish colored nose. The calcar (the cartilage which extends from the ankle to support the tail membrane) of the Indiana myotis usually has a keel, but this is often difficult to see. During hibernation Indiana myotis congregate in more densely packed clusters than other bats in its range.
Habitat: The Indiana bat is a "tree bat" in summer and a "cave bat" in winter. There are four ecologically distinct components of the annual life cycle: winter hibernation, spring staging and autumn swarming, spring and autumn migration, and the summer season of reproduction. Caves are important for the Indiana myotis. During the winter, large numbers of Indiana myotis gather in a few caves that provide suitable conditions for hibernation. During the summer, females form small colonies under the loose bark of trees. Here they raise their young. Males also appear to form small colonies in trees, either in hollow trees or under loose bark. Feeding areas for the Indiana myotis consist of wooded habitats. Early studies indicated that wooded areas along rivers were the preferred feeding areas, but more recent studies suggest that upland forests are also used.
Range: The Federally-endangered Indiana bat is known from the region that includes central West Virginia and western Virginia, and has been reported in Greenbrier County. Winter hibernacula occur along the eastern and southern border of Virginia, including Greenbrier, Hardy, Mercer, Monroe, Pendleton, Pocahontas, Preston, Randolph, and Tucker counties. In western Virginia, winter hibernacula have been reported from Bath, Bland, Craig, Giles, Dickenson, Highland, Lee, Montgomery, Tazewell, and Wise counties. Summer records for the area consist primarily of adult males, with sites in Clay and Nicholas counties, West Virginia. The U.S. Fish and Wildlife Service Recovery Plan (1999) provides a description of the life history.

Virginia Big-eared Bat - *Corynorhinus townsendii virginianus*
Description: The Virginia big-eared bat is a medium-sized bat, about 3.5 - 4 inches long. Characteristic features are the large ears (more than one inch long) and the presence of two large lumps (glands) on the muzzle. Virginia big-eared bats can be distinguished from Rafinesque's big-eared bats, by fur color and toe hairs. Virginia big-eared bats are pale to dark brown on the back and light brown underneath.
Habitat: Virginia big-eared bats prefer caves in karst regions (areas underlain with limestone bedrock and many caves and sinkholes) dominated by oak-hickory or beech-maple-hemlock forest. These bats usually hibernate in tight clusters near entrances of caves that are well-ventilated and where temperatures range from 32 to 54 degrees F. In summer, maternity colonies are found in the relatively warm parts of caves.

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Range: The Federally-endangered Virginia big-eared bat is the subspecies of Townsend's big-eared bat that occurs in Kentucky, North Carolina, Virginia, and West Virginia. Caves used by the species are concentrated in the northeastern portion of the state: Grant, Tucker, Pendleton, Hardy, Preston, and Randolph counties. The largest single colony is approximately 90 miles to the northeast in Pendleton County. In Virginia, two active Virginia big-eared bat maternity colonies are currently known; both are over 60 miles away from the project area in Tazewell County.

Virginia Northern Flying Squirrel – *Glaucomys sabrinus fuscus*
Description: This species is a small nocturnal mammal, with a browner dorsal pelage, distinguished by the belly hairs being slate-colored at the bases, the coat is dense, soft and the sides grayish-brown, sometimes washed with cinnamon. The tail is broad, horizontally flattened, and there are membranes (patagia) between the fore and hind legs. The eyes are prominent, large and blackish. The total length is 11-12 in. (290 mm), and weight 4-6.5 ounces. This species usually lives in small family groups in nests in tree holes, and old bird nests. They are nocturnal, usually active even in the severest winter weather. The voice is high-pitched insect-like chirps.
Habitat: This subspecies is typically found in conifer-hardwood ecotones or mosaics consisting of mature beech, yellow birch, sugar maple, hemlock, and black cherry associated with red spruce and balsam or Fraser fir. This species often lives near streams and rivers.
Range: The Federally-endangered Virginia northern flying squirrel (*G. s. fuscus*) is known only from the Appalachian Mountains in West Virginia and Virginia. In West Virginia, it has been captured in Greenbrier, Pendleton, Pocahontas, Randolph, Tucker, and Webster counties (USFWS 1990). The closest known population is in Cranberry Wildlife Management Area on Monongahela National Forest, about 15 miles northwest of the project areas. This species is closely associated with higher elevations (>3,280 ft) and coniferous forests of spruce and fir (USFWS 1990).

Virginia Spiraea - *Spiraea virginiana*
Description: Virginia Spiraea bears cream-colored flowers on branched and flat-topped axes. This shrubby plant grows from 2 to 10 feet (0.6 to 3 meters) tall and has arching, upright stems. Its alternate leaves are of different sizes and shapes extremely variable; the usual length is 2-4 inches and elliptic in outline. The flowers, found in June and July, are white and occur in groups at the end of leafy branches. Spiraea spreads clonally and forms dense clumps that spread in rock crevices and around boulders.
Habitat: Virginia Spiraea is unique because it occurs along rocky, flood-scoured riverbanks in gorges or canyons. Although it is an unusual requirement, flood scouring is essential to this plant's survival because it eliminates taller woody competitors and creates riverwash deposits and early sucessional habitats. These conditions are apparently essential for this plant's colonization of new sites (Rawinski 1988). Spiraea is found in thickets. Common woody vine associates include fox grape; summer grape; riverbank grape; winter grape; graybark or pigeon grape; possum grape; sand grape; and muscadine, scuppernong. Other plant associates include royal fern, yellow ironweed or wing-stem; ninebark; smooth alder or brookside alder; silky cornel or kinnikinnik; and shrubby yellowroot (Parkin, U.S. Fish and Wildlife, Personal Communication, 1990). The bedrock surrounding Spiraea habitat is primarily sandstone and soils are acidic and moist. Spiraea grows best in full sun, but it can tolerate some shade (Technical Bulletin 1990). One population in West Virginia inhabits a disturbed wetland habitat near a road (Rawinski 1988).
Range: West Virginia has the largest population with 5,700 plants (Rawinski 1988). West Virginia's populations are found on the Bluestone River in Mercer County; the Buchannon River

in Upshur County; in a shrub-dominated, wet meadow in Raleigh County; and along the Gauley and Meadow Rivers in Nicholas and Fayette Counties.

Running buffalo clover - *Trifolium stoloniferum*
Description: Running buffalo clover is a glabrous perennial that forms long basal runners that root at the nodes. The plant's erect, flowering stems, typically 3 to 6 inches tall, with two leaves near the summit, their stipules with ovate-oblong blades, their obovate leaflets 2.5-4.5cm long; leaves of the runners with lancolate stipules and mostly smaller leaflets; peduncles short, from the upper axils; heads subglobose, 2.5-3.5 cm in diameter; calyx teeth twice as long as the glabrous tube; corolla white, tinged with purple, exceeding calyx. Flowering occurs from mid-April to June.
Habitat: In West Virginia, running buffalo clover is present on jeep trails, old logging roads, skid rows, and wooded thickets. The plant has been identified at approximately 35 sites in West Virginia in Barbour, Brooke, Fayette, Pendleton, Pocahontas, Randolph and Tucker Counties.

Small-whorled pogonia - *Isotria medeoloides*
Description: Small-whorled pogonia is a perennial herb with pubescent roots that grows up to 9.5 to 25 centimeters in height (USFWS 1996). A whorl of 5 or 6 leaves light green (USFWS 1996) to grayish-green are produced near the top of the stem and are usually 4 to 8 cm in length. The presence of the leaves beneath the flower(s) gives the plant its common name. The greenish-yellow flowers are solitary (or occasionally paired) and arise from the center of the leaf whorl. Flowering occurs from about mid-May to mid-June, with the flowers apparently lasting only a few days to a week or so and the species doesn't necessarily flower annually (USFWS 1996).
Habitat: Small-whorled pogonia generally inhabits open, dry, deciduous woods with acid soil. It occurs in habitat where there is relatively high shrub coverage or high sapling density (USFWS, 1996).
Range: Small-whorled pogonia is a widespread, but very local species in northeastern North America from southern Maine and Michigan, south to central and western West Virginia, western North Carolina, eastern Tennessee, and into northern Georgia. In West Virginia it has only been identified at two sites with one to two plants at each site.

Shale Barren Rockcress *Arabis serotina*
Description: A biennial plant, in that after a seed sprouts, leaves grow in a small circular cluster next to the ground during the first year. This group of leaves is called a rosette, and they remain alive through their first winter and into the second year when the plant may produce flowers near the end of summer. To produce flowers, a stem grows upward from the rosette to a height of about 2 feet and may have many branches. Small flowers and a few small leaves grow from these branches. New rosettes usually sprout from seeds although they may occasionally sprout from other rosettes.
Habitat/Range: The shale barrens, where this rockcress grows, have soil which contains many hard, small shale fragments. The hillsides typically face the south or the east, so they get very hot during summer days. Shale barrens occur on Devonian-aged shale exclusively in the Valley and Ridge Geographic Province of the Allegheny Mountains. Only a few types of plants can survive on shale barrens. These plants include pines, oaks, and junipers along with a sparsity of non-woody plant species. It has been found in only Greenbrier, Pendleton, and Hardy Counties, West Virginia.

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Fanshell - *Cyprogenia stegaria*
Description: Shell rounded, solid, and moderately inflated. Anterior margin rounded, posterior margin bluntly rounded or truncated. Ventral margin broadly rounded. Umbos not elevated above the hinge line. Beak sculpture, if visible, of a few weak ridges. Growth lines appear as distinct elevated ridges. Numerous pustules usually concentrated in the center but occasionally covering the entire surface of the shell. Periostracum usually greenish yellow, with a pattern of dark green rays made up of numerous smaller broken lines or dots. Length to 3 inches (7.6 cm). Pseudocardinal teeth relatively large and serrated; two in the left valve, one in the right. Lateral teeth roughened, straight to slightly curved, heavy and very short. Interdentum wide. Beak cavity shallow to moderately deep. Nacre white, iridescent posteriorly.
Habitat/Range: Ohio River basin from Illinois across to Alabama, Virginia, West Virginia and Pennsylvania in medium to large rivers in gravel riffles.In West Virginia it has been identified in the Kanawha River in Fayette and Kanawha Counties.

Northern Riffleshell - *Epioblasma torulosa rangiana*
Description: This subspecies is a small to medium-sized, sexually dimorphic freshwater mussel. Shell lengths of adults range from 4.5 - 7.6 cm. The shell is brownish yellow to yellowish green with diffuse, fine green rays. The very broadly rounded expansion of the shell of adult females enables one to differentiate between the sexes.
Habitat/Range: The mussel lives mainly in highly oxygenated riffle areas of rivers or streams of various sizes. Preferred substrates range from rocky, sandy bottoms, to firmly packed sand and fine to coarse gravel. Only two specimens have been reported in West Virginia in the Elk River in Kanawha County.

Pink Mucket - *Lampsilis abrupta*
Description: Shell round to elliptical, solid, and inflated. Anterior end rounded, posterior end bluntly pointed in males, truncated in females. Dorsal margin straight, ventral margin straight to slightly curved. Umbos turned forward and elevated above the hinge line. Beak sculpture, if visible, of three or four double-looped ridges. Shell smooth, yellow or yellowish green and rayless or with faint green rays. Length to 4 inches. Pseudocardinal teeth triangular, thick, divergent; two in the left valve, one in the right, occasionally with a smaller tubercular tooth in front. Lateral teeth short, heavy, and relatively thick. Beak cavity deep. Nacre pink or white, iridescent posteriorly.
Habitat/Range: The lower Mississippi and Ohio rivers and their larger tributaries in gravel or sand. In West Virginia it has been identified in the Ohio River in Cabell, Mason and Wood counties, Kanawha River in Fayette County and Elk River in Kanawha County.

3.2.2 Results of Field Reconnaissance

As a result of the fieldwork activities no threatened or endangered mammal species were identified. Based on a review of the aerial maps and field reconnaissance, it is estimated that approximately 50 % of the corridor is forested land. Therefore, due to the habitat present and range for the Indiana Bat (*Myotis sodalis*), it is not impossible for the Indiana Bat to be present at various locations along the proposed route.

Habitat for the Virginia Big-eared Bat (*Corynorhinus townsendii virginianus*) and the Virginia Northern Flying Squirrel (*Glaucomys sabrinus fuscus)* appeared to be limited as a result of the fieldwork activities. The Virginia Big-eared Bat prefers caves in the karst regions while the Virginia Northern Flying Squirrel prefers spruce and fir forests. Neither of these habitat types was encountered during fieldwork activities.

No threatened or endangered plant species were encountered as a result of fieldwork activities. Virginia Spirea (*Spirea virginiana*) habitat includes rivers and gorges. There are no large riverine systems within the project area, therefore the possibility of encountering this species is unlikely. Shale barren rockcress habitat is limited to shale barrens. There were no shale barrens encountered during fieldwork activities, therefore the possibilities of the presence of this species is also unlikely.

Habitat for the Running Buffalo Clover (*Trifolium stoloniferum*) and the Small Whirled Pagonia (*Isotria medeoloides*) prefer open woodlands. Due to historical coal mining and logging operations throughout various portion of the proposed corridor, suitable habitat was considered limited and no species were noted.

Habitat for the Northern Riffle Shell (*Epioblasma torulosa rangiana*), Fanshell (*Cyprogenia stegaria*), and the Pink Mucket (*Lampsilis abrupta*) is not present within the proposed corridor. These mussel species prefer medium to large rivers with gravel and sand and have been identified in the Kanawha River in Fayette County and the Elk River in Kanawha County.

3.3 WETLAND AND STREAM EVALUATIONS

On August 1 through August 11, 2005 an evaluation was conducted to estimate the potential wetlands and streams that occur within the proposed electric transmission corridor for the WGC project.

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Wetlands were delineated using the Modified Routine On-site Determination Method, as described in the *1987 Corps of Engineers Wetlands Delineation Manual* (Technical Report Y-87-1). All wetlands within the study corridor were classified according to the U.S. Fish and Wildlife Service's (USFWS) *Classification of Wetlands and Deepwater Habitats for the United States* (Cowardin et. al., 1979). Wetland classification found in the project corridor included: palustrine emergent (PEM), palustrine scrub/shrub (PSS), palustrine open water (POW), palustrine forested (PFO) and a combination of above.

The study area soils were examined with a drain spade shovel. Soils were classified according to the criteria outlined in the 1987 Federal Manual through the use of a *Munsell Soil Color Chart* (Kollmorgen, 1975). In addition to the direct observation of soil saturation and inundation, hydrologic indicators such as buttressed root systems, wetland drainage patterns, leaf litter staining, etc. were also used to determine the presence of wetland hydrology within the study area.

National Wetland Inventory (NWI) Mapping (1996) for the study area was reviewed to identify potential wetlands prior to entering the field. Once field activities commenced, any NWI wetlands identified located within the study corridor were thoroughly investigated in the field to determine if these areas were regulated wetlands. Additional wetlands not shown on the NWI map were identified based on observations made during the field investigation.

Once the field team determined that a potential system was a wetland, the wetland was identified and flagged using survey flagging. GPS equipment was then used to locate the wetland boundaries if possible. Color photos were taken at each wetland.

Information collected during the field investigation included dominant vegetation, soil characteristics, hydrology source and any other pertinent notes regarding the wetland.

Coal mining and timbering operations were the most significant type of disturbance within the project study corridor. Other disturbances noted during the field investigations

included mowing and electrical line right-of-ways. Wetlands were considered to exist in a disturbed condition if one or more of the three wetland criteria (hydrophytic vegetation, hydric soils and hydrology) exhibited strong unnatural characteristics.

Figures 17 through 34 identify the location of the streams and potential wetland areas.

3.3.1 Wetlands – Results

The NWI mapping identified two wetland systems within the project study corridor. One wetland was identified as a palustrine, unconsolidated bottom, permanently flooded, diked/impounded wetland (PUBHh) located near PR 40. The other NWI wetland, located near PR 97, was designated as palustrine, unconsolidated bottom, permanently flooded, artificial substrate, excavated wetland (PUBHrx).

Soil colors, vegetation and hydrologic indicators indicate that wetlands are present within the study corridor. During the field investigation, a total of 14 palustrine wetland systems were identified and delineated. A listing of wetland classifications, location and sizes is presented in Table 3-1.

Table 3-1. Wetland Summary Table

Wetland Name	Location	Classification	Size (acres)	Size (hectares)
W-01	PR14	PEM	0.01	0.01
W-02	PR26	PEM	0.09	0.04
W-03	PR28/PR29	PEM	0.01	>0.01
W-04	PR38	POW	0.12	0.05
W-05	PR38/PR39	POW/PEM	0.33	0.13
W-06	PR40	POW	0.23	0.09
W-07	PR47/PR48	PEM	0.09	0.04
W-08	PR97	POW/PEM	0.50	0.20
W-09	PR98/PR99	PEM/PSS	0.08	0.03
W-10	PR100	PEM	0.02	0.01
W-11	PR101	PEM/PFO	0.68	0.27
W-12	PR102	PEM	0.31	0.13
W-13	PR116/PR117	POW	0.27	0.11
W-14	PR151	PEM	0.05	0.02
Total Wetland Sizes			**2.79**	**1.13**

PEM – Palustrine Emergent
POW – Palustrine Open Water
PSS – Palustrine Scrub Shrub
PFO – Palustrine Forested

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Wetlands – Descriptions

The hydrology of the wetlands is driven by several different sources. Groundwater, usually in combination with overland flow, is the primary source of hydrology for a majority of the wetlands. Most of the wetlands also exhibit drainage patterns, soil saturation and standing water.

The majority of the soils taken within the wetlands are silt loam or clay loam in texture. Rock fragments were present throughout many of the wetland soils that were identified and delineated. Typical wetland soils for this project have a hue of 10 YR, value of 3 and 6 and a chroma of 1 or 2 (*Munsell Soil Color Chart*). Activities such as coal mining and various timbering operations have influenced the soils in a number of areas within the project study corridor.

Several species of plants appear within each vegetative class. Typical PEM wetlands within the project corridor contain Sensitive Fern (*Onoclea sensibilis*), Soft Rush (*Juncus effuses*), Spotted Jewelweed (*Impatiens capensis*) and Grass sp. (*Graminaceae sp.*). Typical PSS vegetation contains Black Willow (*Salix nigra*) and saplings (less than 3 in. diameter at breast height [dbh]) of Slippery Elm (*Ulmus rubra*) and Silver Maple (*Acer saccharinum*). Typical components of PFO contain trees (< 3 in. dbh) of the aforementioned species. Wetlands having more than one vegetative class are generally composed of a combination of the above species. No threatened or endangered plant species were identified at the time of the field investigations.

Wetlands – Summary

A total of 14 wetlands were identified and delineated within the project study area corridor. These wetlands comprise 2.79 acres (1.13 ha) of wetland habitat. The classification of the majority of the wetlands identified was PEM. There were seven PEM wetlands comprised a total of 0.58 acres (0.24 ha). Three wetlands determined to be POW wetlands totaled 0.62 acres (0.25 ha). Two POW/PEM wetlands were identified totaling 0.82 acres (0.33 ha). One PEM/PSS wetland was identified totaling 0.08 ac (0.03 ha) and one PEM/PFO wetland measured 0.68 acres (0.27 ha).

3.3.2 Streams – Results

Aquatic biota sampling was undertaken in perennial and intermittent streams in order to document macroinvertebrate occurrence. Qualitative macroinvertebrate samplng was conducted during fieldwork activities by overturning the rock substrate at several locations within the study corridor. Macroinvertebrates were then identified in the field. Generally, mayflies (*Ephemeroptera*), stoneflies (*Plecoptera*) and caddisflies (*Trichoptera*), are generally considered pollution sensitive taxa, and therefore are abundant in streams with good water quality.

A total of 32 streams (perennial and intermittent) were identified in the project study corridor. Sample points for each stream were established at the crossing within the corridor. The stream was then surveyed for the width of the study corridor. Table 3-2 provides results from the field investigations.

There were 24 perennial streams identified within the project study corridor. Meadow Creek, Burdette Creek, Hominy Creek and its unnamed tributary were identified as a result of the fieldwork activities. These four streams were the largest of the streams encountered, with average widths of 20 to 30 ft and depths of an average of 3 ft. Substrate present within all of the perennial streams include bedrock, boulders, rubble, cobble. Macroinvertebrates that were evident in most of the perennial streams include *Trichoptera*, and *Plecoptera*, which are all indicators of good water quality. *Chrironomidae*, was also noted, however this species is not indicative of water quality since it is tolerant of many pollution sources. Numerous species of fish were also located in several of the larger streams.

Seven of the streams identified were considered intermittent. These streams were of this classification because of the substrate present with an established bed and bank but no flowing water.

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One of the streams, S-17 showed characteristics of both perennial and intermittent streams within the project study corridor.

The majority of the streams had stable, vegetated banks. Typical vegetation on the streambanks include Rhododendron (*Rhododendron sp.*), Mountain Laurel (*Kalmia latifolia*), birch (*Betula sp.*) and maple (*Acer sp.*) species.

Factors that may impact the streams within the study corridor include mining activities and timbering practices that are currently being conducted. Without the proper best management practices, the streams can be impacted from siltation entering the stream and lack of cover to cool the streams and provide food for macroinvertebrates.

Table 3-2. Stream Summary Table

Stream ID	Location	Type	Estimated Width	Estimated Depth	Notes
S-01	PR8/ PR9	Perennial	2 ft	6 in	Established bed and bank with flowing water; macroinvertebrates identified (*Trichoptera, Chironomidae*)
S-02	PR13/ PR14	Perennial	16 in	6 in	Established bed and bank with flowing water; macroinvertebrates identified (*Chironomidae*)
S-03	PR19/ PR20	Perennial	12 ft	12 in	Meadow Creek; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*); stream listed on the WVDNR for stocking
S-04	PR22	Intermittent	NA	NA	Pockets of water noted with no macroinvertebrates noted
S-05	PR26	Perennial	12 ft	6-10 in	Established bed and bank with flowing water; macroinvertebrates identified (*Trichoptera, Chironomidae*); Blacknose Dace (*Rhinichthys atratulus*) also noted
S-06	PR28/ PR29	Intermittent	10 in	2 in	Channel contains substrate but no water. Stream flows into W-03
S-07	PR38	Intermittent	1 ft	3 in	Channel contains substrate but no water. Flows into W-05
S-08	PR38	Perennial	1 ft	3 in	Water flows into W-05, but no macroinvertebrates identified
S-09	PR42	Perennial	6 ft	6-8 in	Established bed and bank with flowing water; macroinvertebrates identified (*Trichoptera, Chironomidae*)
S-10	PR47	Perennial	8 ft	8 in	Burdette Creek; Water cloudy due to recent rains; established bed and bank (approximately 8ft wide)
S-11	PR51	Perennial	3 ft	2 in	Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*)
S-12	PR51/ PR52	Intermittent	2 ft	NA	Established bed and bank with no flowing water
S-13	PR57	Perennial	3 ft	8 in	Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*)
S-14	PR67	Perennial	20 ft	6-10 in	Anglines Creek; Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*)
S-15	PR75	Intermittent	3 ft	NA	Established bed and bank but no flowing water; 2 AMD seeps flow into stream
S-16	PR76	Perennial	8 ft	18 in	Kern Branch; Heavy siltation present within stream bottom; Blacknose Dace (*Rhinichthys atratulus*) also noted
S-17	PR85/ PR86	Intermittent/ Perennial	10 in	1 in	Stream originated from drainage/seep; no macroinvertebrates noted
S-18	PR87/ PR88	Perennial	3 ft	6 in	Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*); stream splits in corridor then reconverges outside of the project corridor

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Stream ID	Location	Type	Estimated Width	Estimated Depth	Notes
S-19	PR94	Perennial	20 ft	2 ft	Hominy Creek; bank erosion noted in areas as well as fish (not identified)
S-20	PR97	Perennial	3 ft	4 in	Outflow of W-07; high gradient stream with established bed and bank
S-21	PR98/ PR99	Perennial	3 ft	3 in	Slight erosion on stream banks noted
S-22	PR102	Perennial	2 ft	6 in	Stream flows through W-11; macroinvertebrates sampled include *Trichoptera* and *Chironomidae*
S-23	PR103	Perennial	1 ft	6 in	Established banks with *Chironomidae* noted
S-24	PR106/ PR107	Perennial	2 ft	8 in	Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Diptera* and *Chironomidae*);
S-25	PR116	Perennial	10 ft	12 in	Roaring Creek; Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*);
S-26	PR118	Perennial	10 ft	10 in	Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*);
S-27	PR122	Perennial	10 ft	8 in	Established bed and bank, good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Diptera* and *Chironomidae*);
S-28	PR134	Perennial	20 ft	1 ft +	Unnamed tributary to Hominy Creek; good substrate with flowing water; macroinvertebrates identified (*Plecoptera, Trichoptera, Chironomidae*);
S-29	PR138	Intermittent	1 ft	1 in	Originated from groundwater seeps outside of the study corridor
S-30	PR143	Perennial	1.5 ft	4 in	Originates in a recently timbered area; good substrate with flowing water; macroinvertebrates identified (*Trichoptera* and *Chironomidae*)
S-31	PR151	Perennial	1 ft	2 in	Banks degraded; forms around groundwater seep; macroinvertebrates identified (*Trichoptera* and *Chironomidae*)
S-32	PR153	Intermittent	2 ft	2 in	Stream flows subsurface for portions of the stream channel

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Appendix L

Appendix A

July 8, 2004 Letter from US Fish and Wildlife

May 25, 2004 Letter from West Virginia Department of Natural Resources

United States Department of the Interior

FISH AND WILDLIFE SERVICE

West Virginia Field Office
694 Beverley Pike
Elkins, West Virginia 26241

July 8, 2004

Mr. Fred Carey. P.E.
Project Manager
Potomac-Hudson Engineering, Inc.
4833 Rugby Avenue, Suite 100
Bethesda, Maryland 20814

Re: Environmental Impact Statement, Western Greenbrier Co-Gen, LLC, Co-Production Facility, Greenbrier County, West Virginia

Dear Mr. Carey:

This responds to your information request of 27 April 2004 regarding the potential impacts of a proposed project on federally listed endangered and threatened species and species of concern. Western Greenbrier Co-Gen, LLC, proposes to design, construct and operate an 85 MW ACFB power plant, which will burn 1,800 tons per day of waste coal for the generation of electricity and steam. The selected area is a 26-acre site near the town of Rainelle, in Greenbrier County, West Virginia. The initial site for acquiring waste coal is near Anjean, West Virginia.

Potomac-Hudson Engineering has requested impacts from this project on any endangered or threatened species within a 30-mile radius from the site for the preparation of an Environmental Impact Statement (EIS). This distance is requested due to the possible changes in atmospheric conditions that may occur from this power plant. These comments are provided pursuant to the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e).

Fish and Wildlife Surveys and Investigations

For the purposes of this report, impacts to federally listed endangered and threatened species have been separated into two different categories: *(1) Site Specific Impacts*, and *(2) 30-Mile Radius Impacts*. In addition, other impacts to fish and wildlife have been provided and are listed under the category: *(3) Other Impacts*.

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(1) Site Specific Impacts:
Certain impacts can be attributed to the actual construction of the power plant and the associated features (rail-way, transmission lines, etc.). A check of our records indicate that only one federally listed species could occur in the project area, the endangered Indiana bat, Myotis sodalis.

The federally listed endangered Indiana bat may occur in the project area and could conceivably be adversely affected by the project proposal. The Indiana bat may use the project area for foraging and roosting between April 1 and November 15. Indiana bat summer foraging habitats are generally defined as riparian, bottomland, or upland forest, and old fields or pastures with scattered trees. Roosting/maternity habitat consists primarily of live or dead hardwood tree species, which have exfoliating bark that provides space for bats to roost between the bark and the bole of the tree. Tree cavities, crevices, splits, or hollow portions of tree boles and limbs also provide roost sites.

The U.S. Fish and Wildlife Service (Service) has determined the number of acres of suitable foraging and roosting habitat on the West Virginia landscape available to each Indiana bat, versus the total acreage of forest. On that basis, we have determined that small projects, outside of a five-mile radius of a hibernaculum and a two-mile radius of a capture site, affecting 17 acres or less of suitable forested habitat, will have a very small chance of resulting in direct or indirect take of the species, and therefore these effects are considered discountable.

If less than 17 acres of potential habitat for that species will be impacted, then no further consultation under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) is required regarding the Indiana bat on a site-specific impact. Should project plans change, or if additional information on the Indiana bat becomes available, this determination may be reconsidered. If more than 17 acres of forested habitat will be impacted, further coordination with this office will be required for this site-specific concern.

(2) 30-mile radius impacts:
Several endangered and threatened species occur within the 30-mile radius from the proposed project site. They include the Indiana bat (Myotis sodalis), the Virginia big-eared bat (Corynorhinus townsendii virginianus), Virginia spiraea (Spiraea virginiana), the West Virginia Northern flying squirrel (Glaucomys sabrinus fuscus), small whorled pogonia (Isotria medeoloides), running buffalo clover (Trifolium stoloniferum), the northern riffleshell mussel (Epioblasma torulosa rangiana), the pink mucket pearly mussel (Lampsilis abrupta), and the fanshell mussel (Cyprogenia stegaria).

While the Service commends the energy community for providing lower emission power plants, federally protected species (as listed above) could be sensitive to even slight changes in atmospheric conditions. For example, the endangered West Virginia Northern flying squirrel is dependant upon a specific habitat type. Potential habitat for the West Virginia northern flying squirrel is defined as high elevation northern hardwood forest with a conifer component, usually of red spruce or hemlock. Other parameters indicative of potential habitat include abundant

large woody debris on the forest floor, cooler temperatures and higher humidity that promotes lichen growth and presence of moss, fern, liverwort or clubmoss groundcover. The cumulative effects from acid deposition may have a detrimental impact upon this type of habitat (especially those found in higher elevations and colder temperature regimes).

In addition, the three protected mussels species found within the 30-mile radius may show detrimental effects to changes in stream water pH and metal accumulation (aluminum, mercury, etc.) through contaminated rain and snowfall. Federally listed plants could also become indirectly impacted through acid deposition on soils, which may change the nutrient composition of the soils (calcium depletion, increasing sulfur and nitrogen, etc.).

Projected emissions were not included within your letter. Accurate emission figures, coupled with anticipated deposition rates, historical wind currents and rainfall amounts are necessary to determine environmental (and species specific) changes through atmospheric deposition (via modeling). Until this is complete, we cannot determine the long-range impact to listed species.

(3) *Other Impacts:*
Of particular concern are impacts to other fish and wildlife resources that stem from the storage and disposal of waste materials generated at coal burning plants. This waste material is generally composed of noncombustible materials (minerals) and can be either collected within the flue stacks (fly ash) or as heavier bottom ash. Your letter states that the Woodbrik manufacturing plant will use a portion of this ash (along with other materials) in the construction of bricks. Your letter goes on to state that excess ash will also be used to remediate acid mine drainage (AMD) from the source waste coal piles. The Service not only recognizes the problems in water quality associated with AMD, but also the potential for ash to release high levels toxic metals within the stream environment. The Service cannot recommend trading one environmental problem for another, potentially more serious one. Therefore the Service recommends a proper study of the composition of the ash to be used, as well as the expected dissolution of toxic metals within the downstream environment and all associated cumulative health risks to fish and wildlife. Alternate disposal areas should also be considered in order to minimize any potential risks to water quality.

Typically, power plants discharge water at permitted sites covered under the National Pollutant Discharge Elimination System (NPDES) permitting procedures. While your letter states that the power plant will provide hot water and steam for nearby businesses, it is not clear if all waste water will be processed in this manner or if some portion will be discharged into the environment. Discharged water may contain biocides and other additives used to control algae and bacteria within the power plant lines. This, as well as the extreme temperatures may be harmful to surface and groundwater quality. Possible discharge sites should be explored in order to provide for the least damaging alternative.

Conclusion

Overall, the purpose of this project remains unclear. There was no indication within your letter that the construction of this power plant would alleviate a power deficiency within West

Appendix L

Virginia. In fact, your letter does not mention any type of alternatives that have been considered prior to the preparation of an EIS or the implementation of the National Environmental Policy Act (NEPA) process. The NEPA process should assist with the procedures of choosing the appropriate alternative, instead of supporting the choice made prior to the NEPA implementation. With this in mind, alternate locations should be considered so that those who benefit from the electricity generated from this plant would also be responsible for the proper disposal and control of the inherent pollution.

If you have any questions regarding this letter, please contact Mr. Monte Matthews of my staff at (304) 636-6586, or at the letterhead address.

Sincerely,

Thomas R. Chapman
Field Supervisor

DIVISION OF NATURAL RESOURCES
Wildlife Resources Section
Operations Center
P.O. Box 67
Elkins, West Virginia 26241-3235
Telephone (304) 637-0245
Fax (304) 637-0250

Bob Wise
Governor

Ed Hamrick
Director

May 25, 2004

Mr. Fred Carey
Potomac-Hudson Engineering, Inc.
4833 Rugby Avenue, Suite 100
Bethesda, MD 20814

Dear Mr. Carey:

We have reviewed our files for information on rare, threatened, and endangered (RTE) species in the area the proposed Western Greenbrier Co-Gen, LLC Co-Production Facility in Rainelle, Greenbrier County, West Virginia. There are no known occurrences of RTE species at the Rainelle site, nor do we have any known occurrences at the Anjean waste coal piles.

Enclosed is a compact disc containing a list of RTE species currently known from Greenbrier County (GreenbrierCounty.doc), RTE species within a 30-mile radius of Rainelle (RainelleData.xls), and an explanation of our ranking system denoting species rarity (Rankexpl.doc). The table below lists federally protected species within the boundaries of your project description:

Name	Status*	Comments
Greenbrier County		
Shale barren rockcress (*Arabis serotina*)	LE	Restricted to shale barrens of Greenbrier, Hardy, and Pendleton counties.
Northern flying squirrel (*Glaucomys sabrinus fuscus*)	LE	Restricted to the higher elevations of the mountain counties (Greenbrier, Pendleton, Pocahontas, Randolph, Tucker, Webster); in areas with red spruce or a conifer component.
Small-whorled pogonia (*Pogonia medeoloides*)	LT	Currently known from only Greenbrier County; does not appear restricted to a specific habitat.

Appendix L

Indiana bat (*Myotis sodalis*)	LE	Hibernates in caves in Greenbrier, Hardy, Mercer, Monroe, Pendleton, Pocahontas, Preston, Randolph, and Tucker counties; documented as utilizing mine portals in Fayette and Raleigh counties as summer roosts; also utilizes trees as roosts; suspected maternity site in Boone County in 2003.
Virginia spiraea (*Spiraea virginiana*)	LT	A riparian shrub known to occur along the Bluestone, Greenbrier, Gauley, and Meadow rivers; additional non-riparian sites in Raleigh County.
30-MILE RADIUS OF RAINELLE		
Shale barren rockcress (*Arabis serotina*)	LE	See comments above.
Virginia big-eared bat (*Corynorhinus townsendii virginianus*)	LE	Utilizes caves as hibernacula and maternity colonies in Grant, Hardy, Pendleton, Preston, Randolph, and Tucker counties; utilizes mine portals as summer and fall roosts
Fanshell mussel (*Cyprogenia stegaria*)	LE	Known from the Kanawha River in Fayette County and the Ohio River in Wood and Jackson counties.
Northern riffleshell (*Epioblasma torulosa rangiana*)	LE	Known from the only the Kanawha River in Fayette and Kanawha counties.
Northern flying squirrel (*Glaucomys sabrinus fuscus*)	LE	See comments above.
Small-whorled pogonia (*Pogonia medeoloides*)	LT	See comments above.
Pink mucket pearly mussel	LE	Known from the Kanawha River in Fayette and Kanawha counties, and the Ohio River in Cabell, Mason, and Wood counties.
Indiana bat (*Myotis sodalis*)	LE	See comments above.
Virginia spiraea (*Spiraea virginiana*)	LE	See comments above.
Running buffalo clover (*Trifolium stoloniferum*)	LE	Found in disturbed areas in old jeep trails, logging roads, skid rows, etc. in Barbour, Brooke, Fayette, Pendleton, Pocahontas, and Randolph counties; historically known from Preston and Webster counties.

*LE = endangered; LT = threatened

This response is based on information currently available and should not be considered a comprehensive survey of the areas under review. We hope you find this information helpful in your planning process.

Enclosed please find an invoice.

Thank you for contacting us and please call if you should have any questions.

Sincerely,

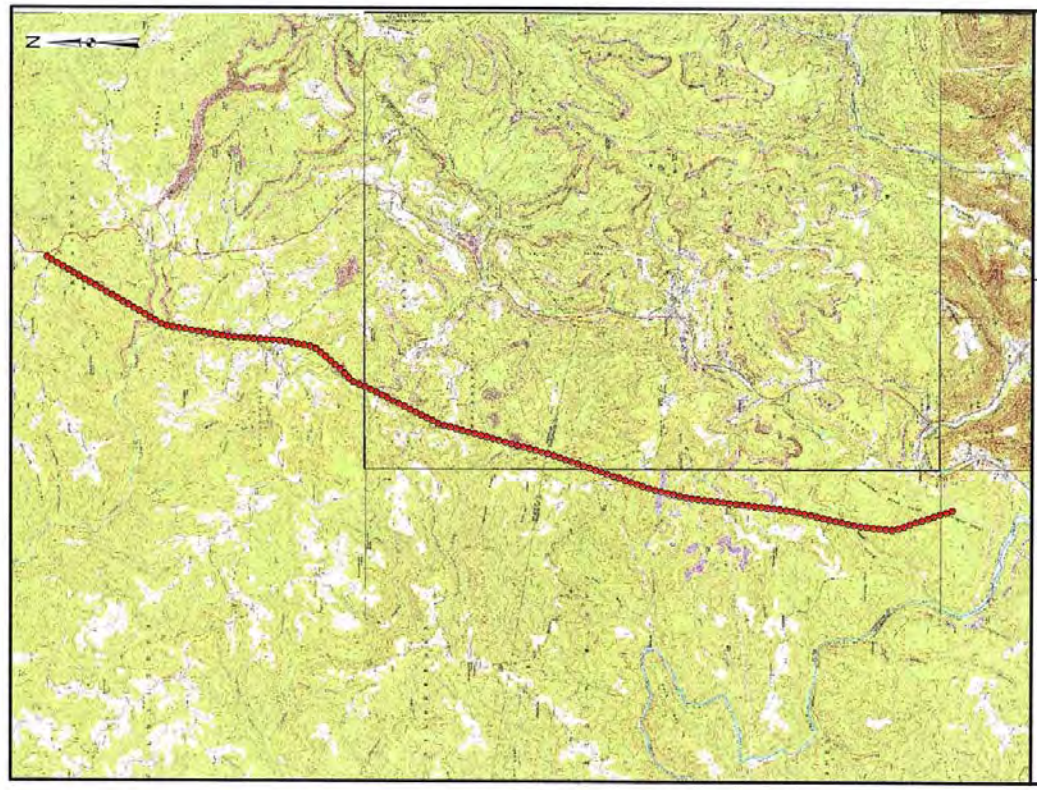
Barbara Sargent
Environmental Resources Specialist
Wildlife Diversity Program

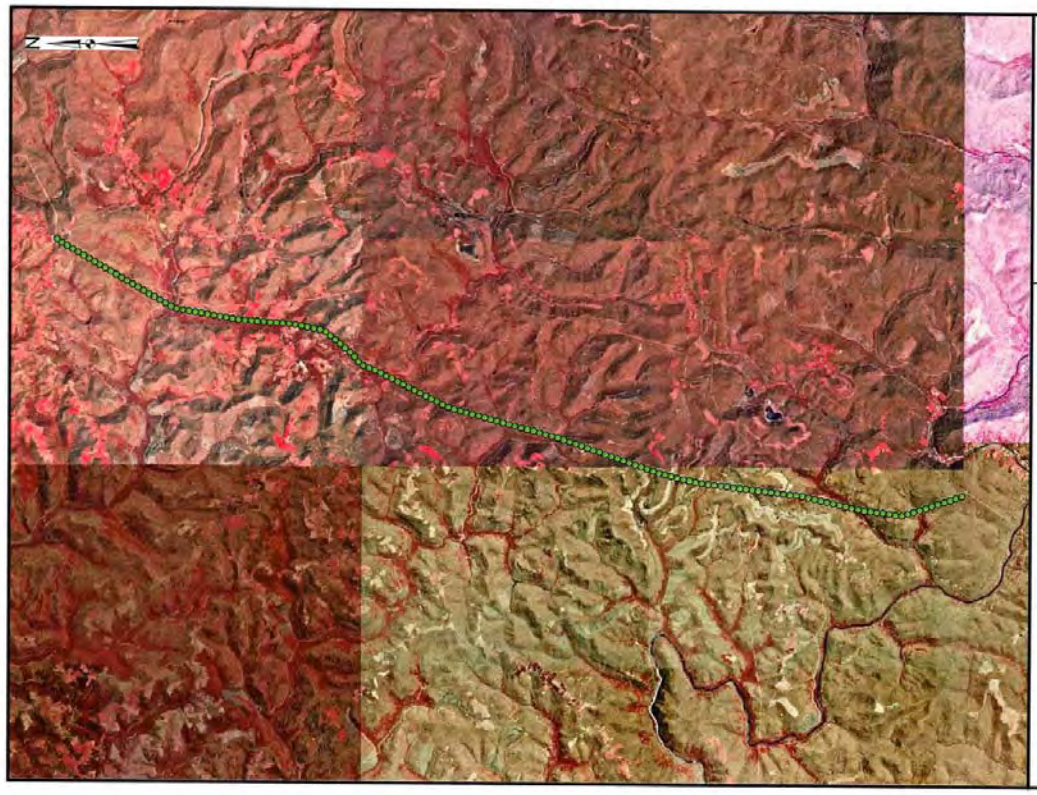
enclosures

Appendix L

FIGURES

Appendix L


N
FIGURE 2
PROPOSED ELECTRIC TRANSMISSION ROW
Western Greenbrier Co-Generation LLC
URS
0 5,000 10,000 20,000 30,000 Feet
1:70,000


N
FIGURE 1
PROPOSED ELECTRIC TRANSMISSION ROW
Western Greenbrier Co-Generation LLC
URS
0 5,000 10,000 20,000 30,000 Feet
1:70,000

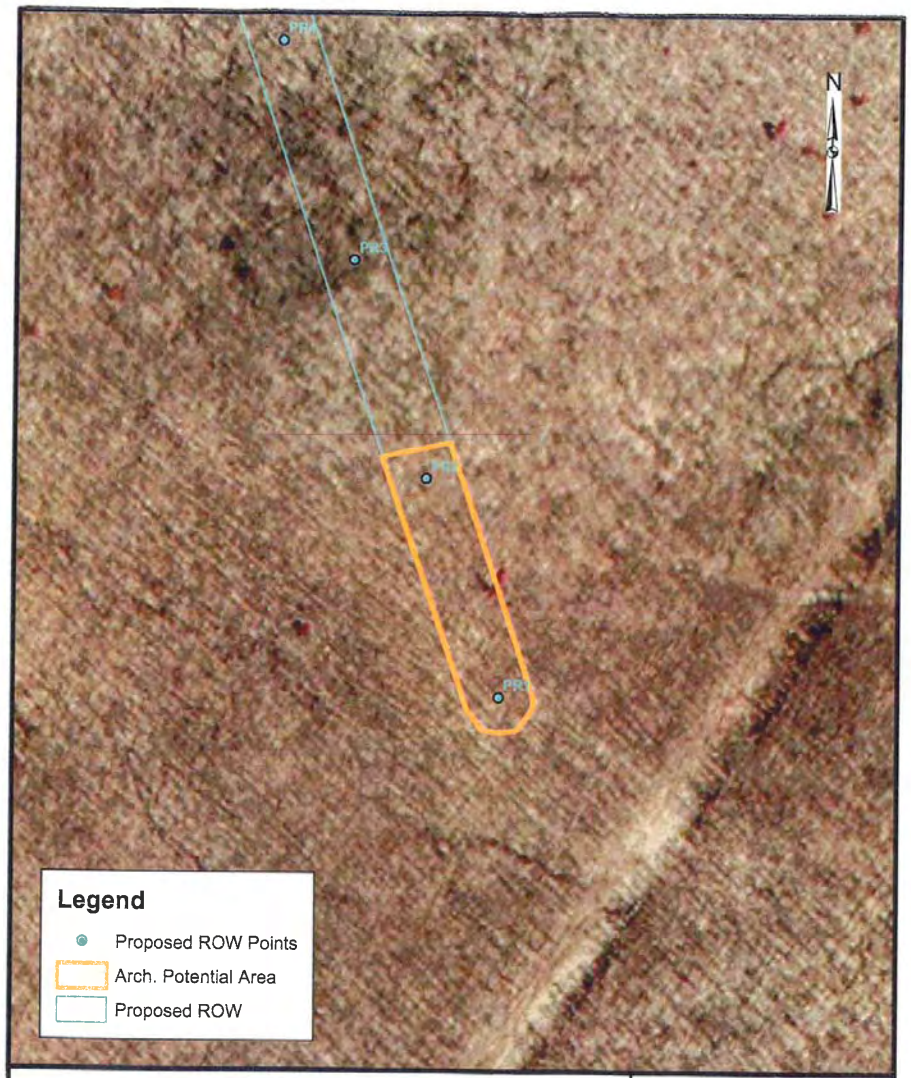


FIGURE 3
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

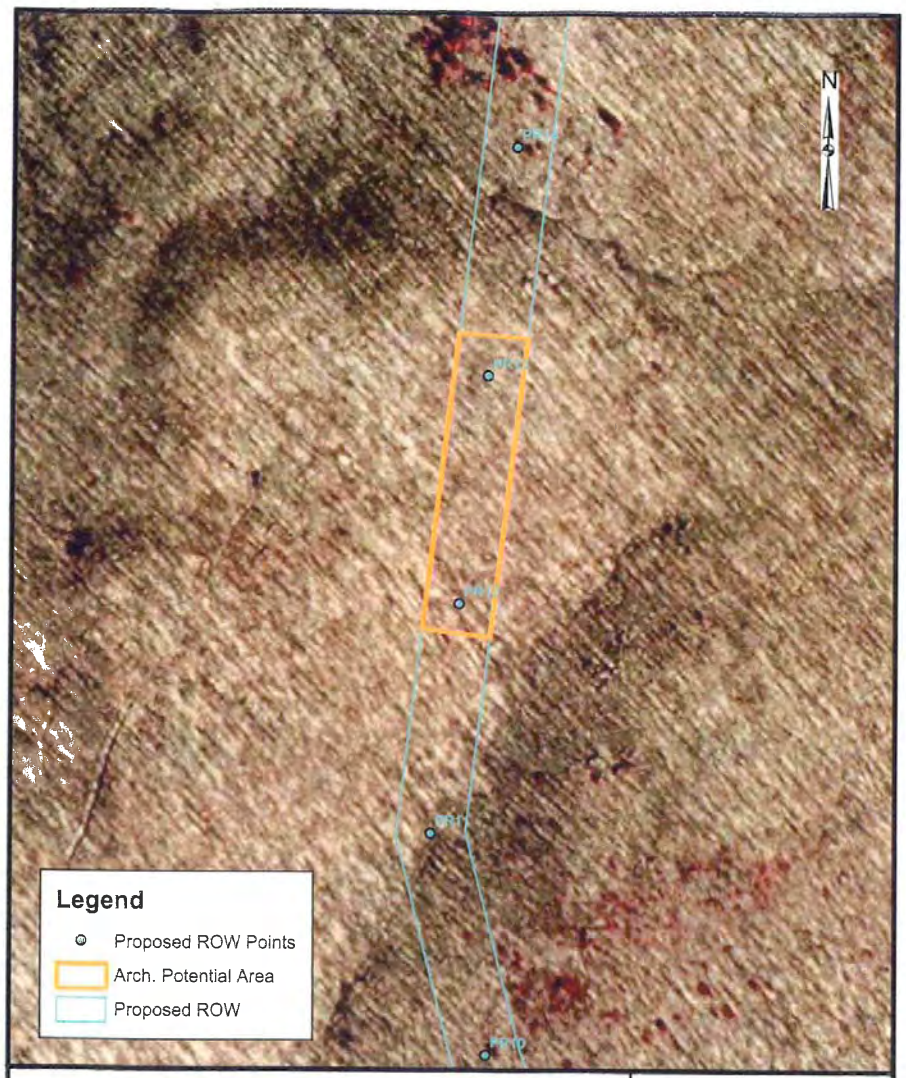


FIGURE 4
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

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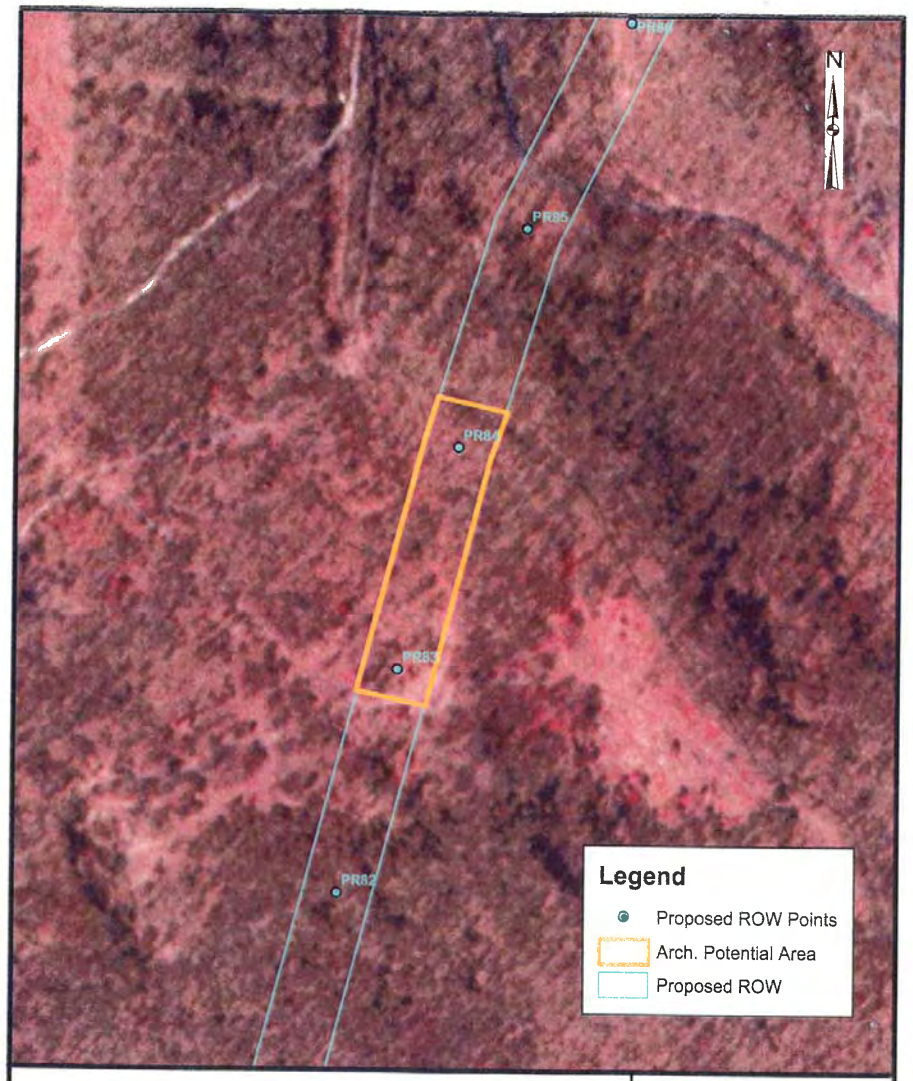


FIGURE 5
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

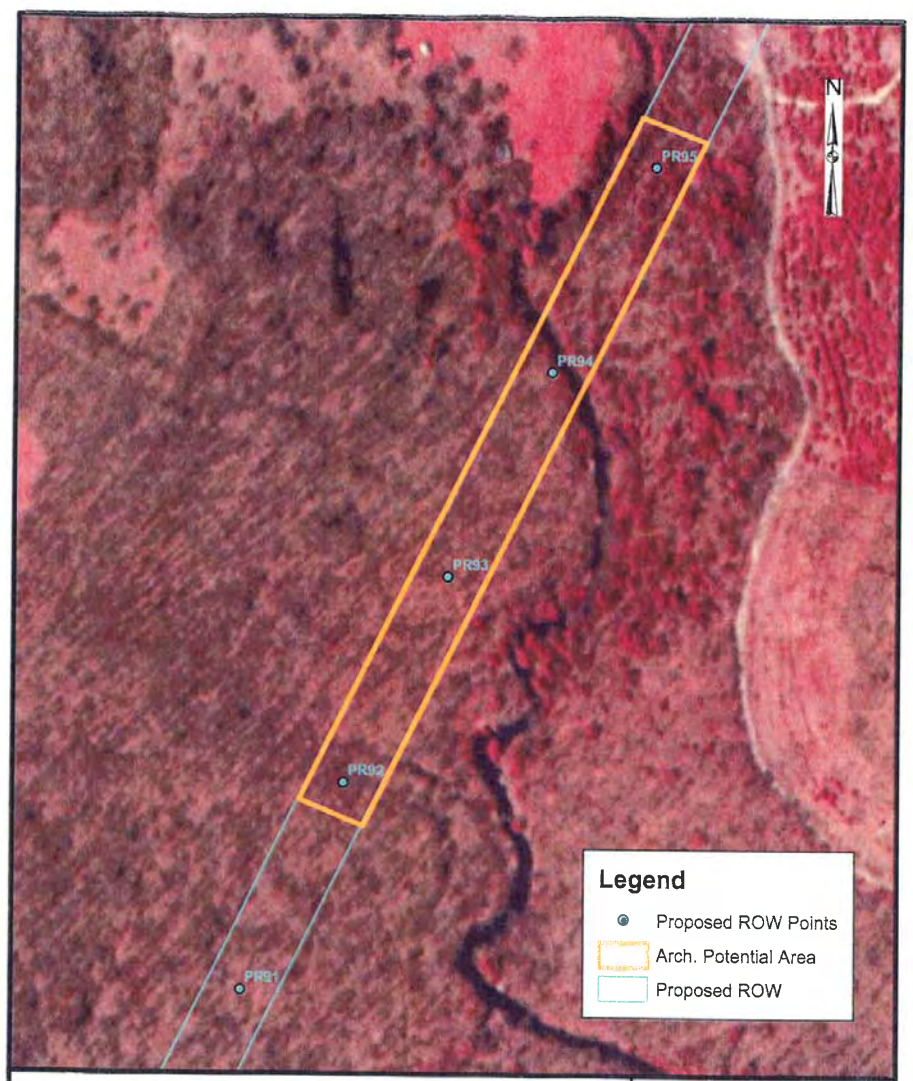


FIGURE 6
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

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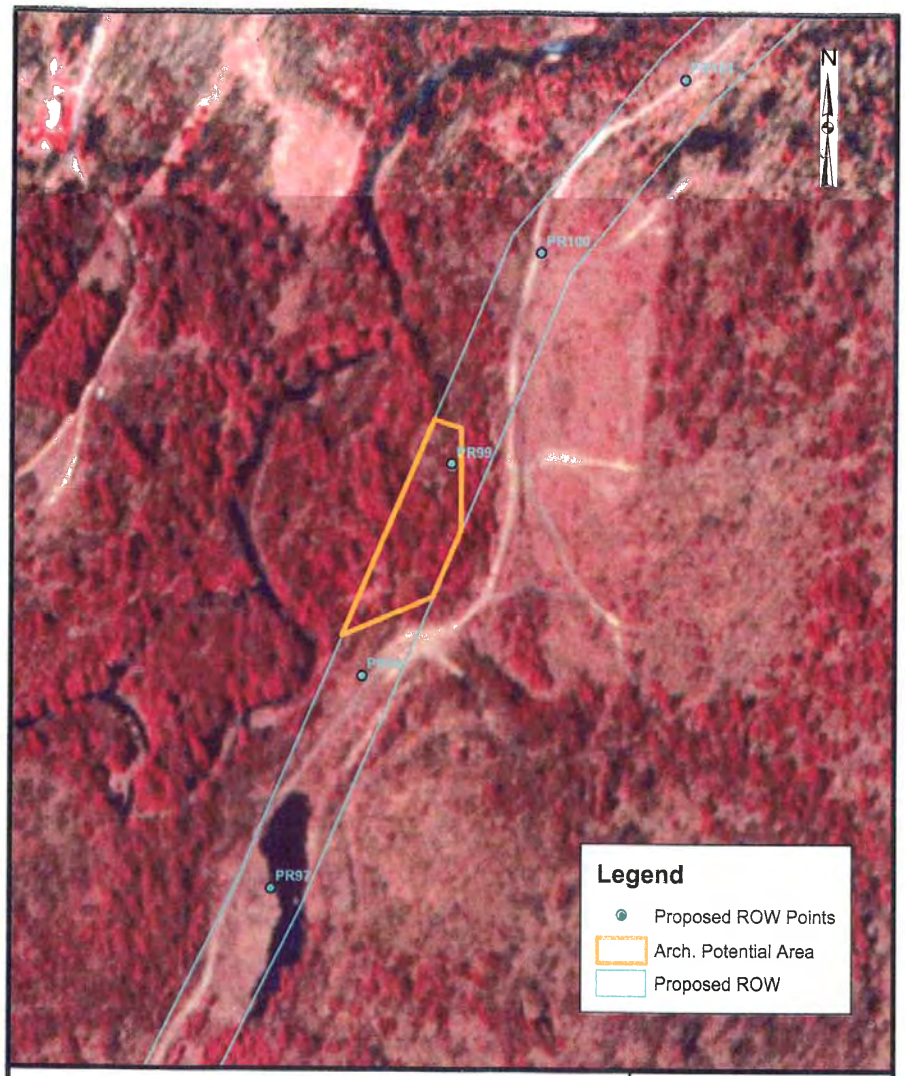


FIGURE 7
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

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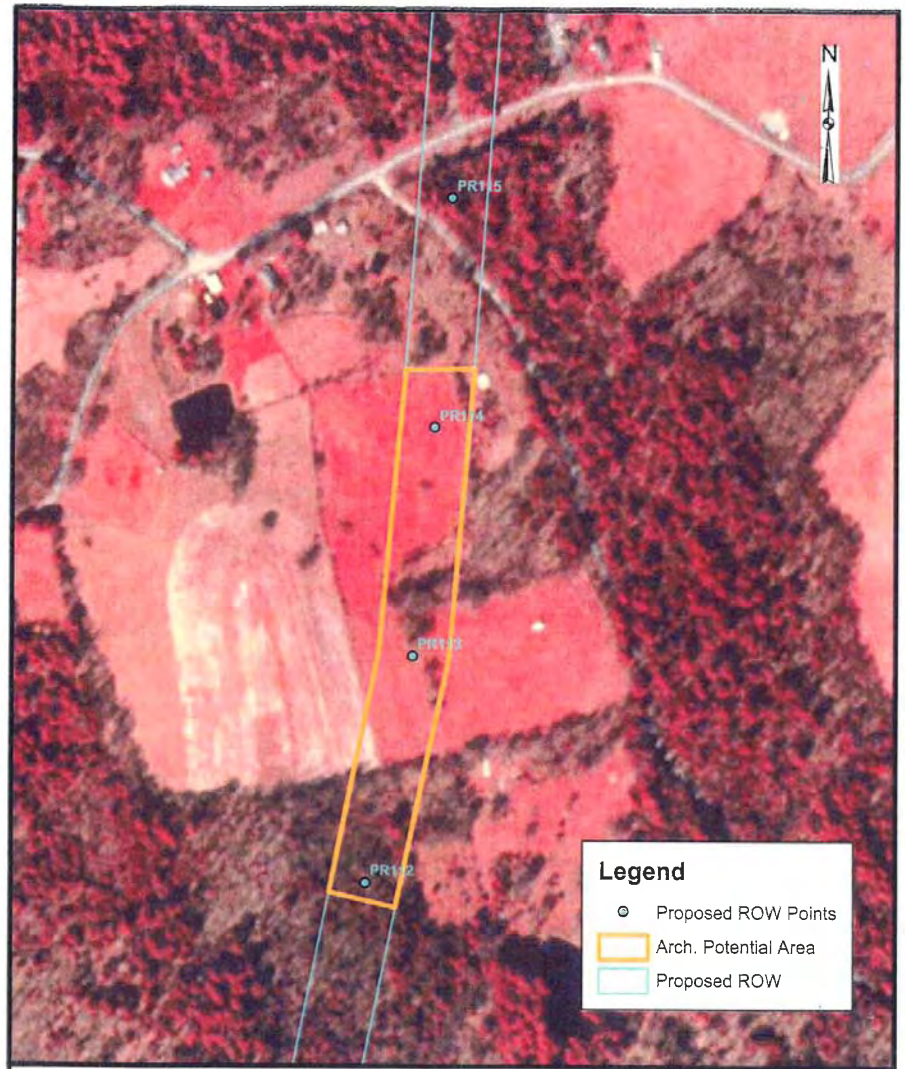


FIGURE 8
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

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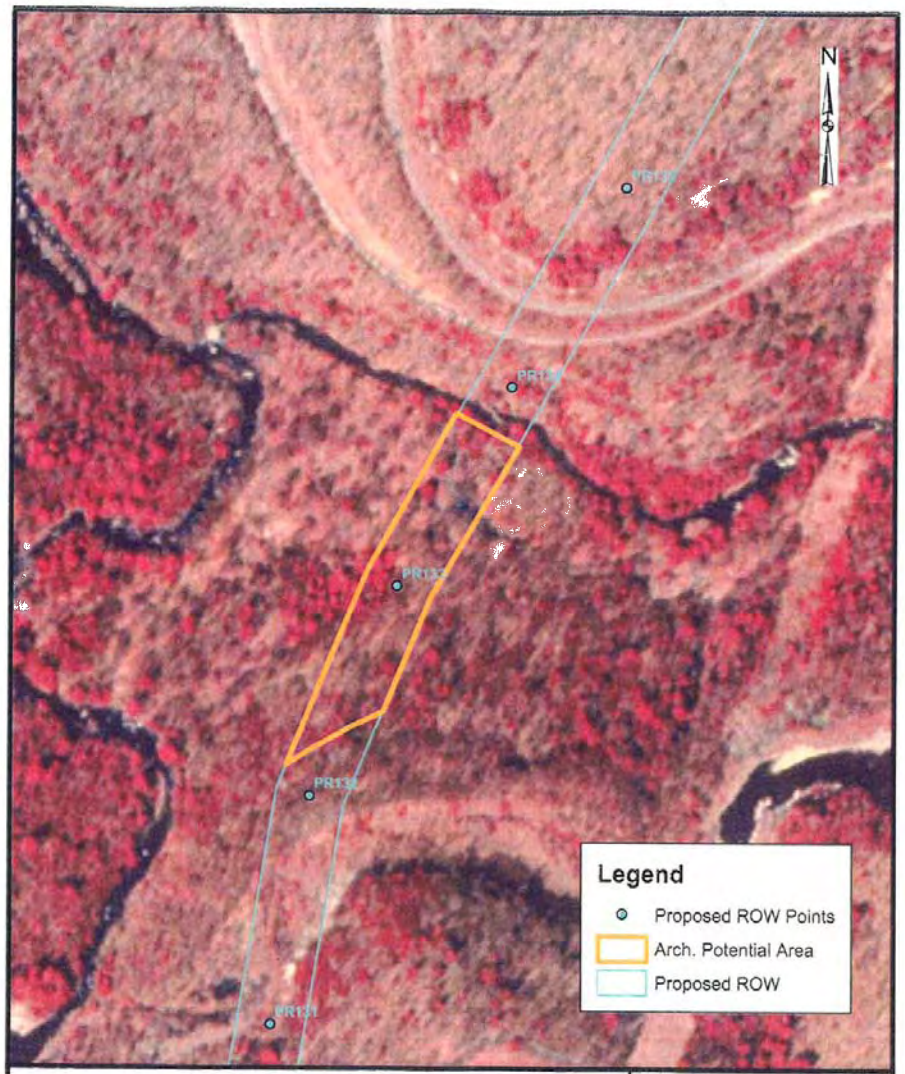


FIGURE 9
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

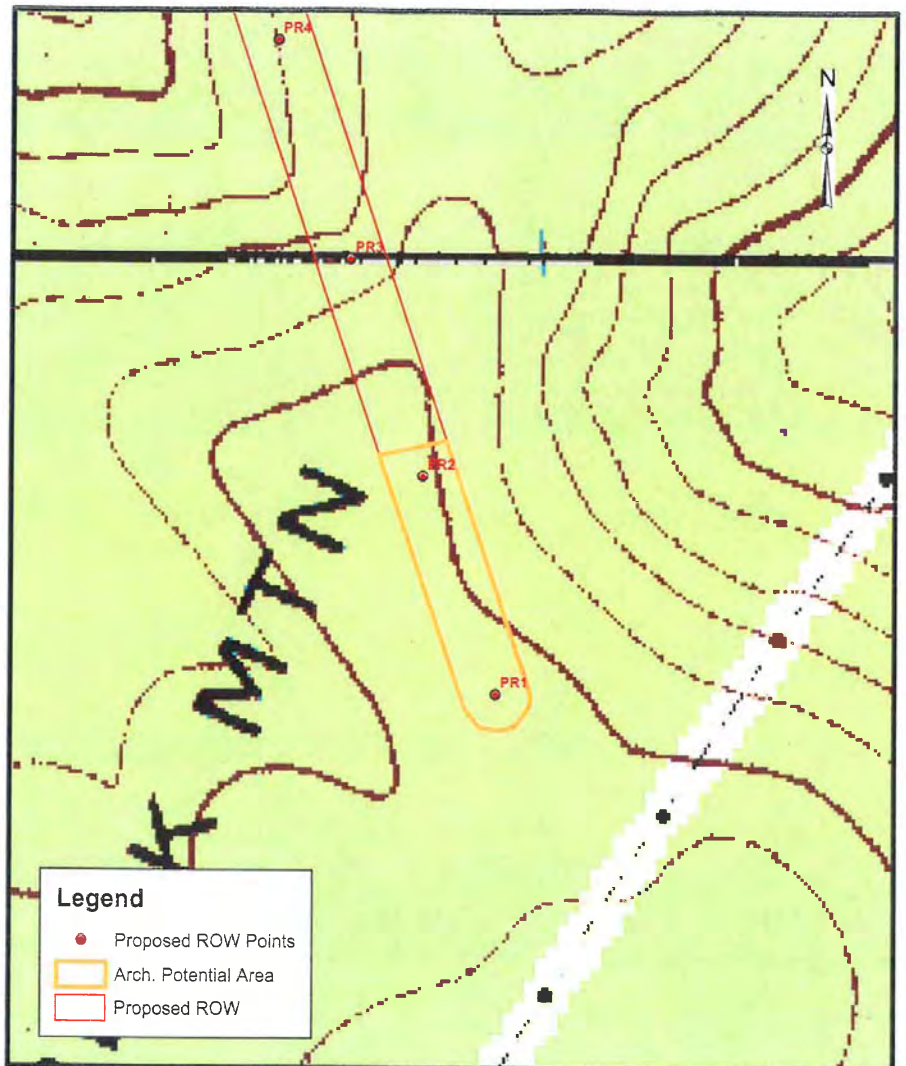


FIGURE 10
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

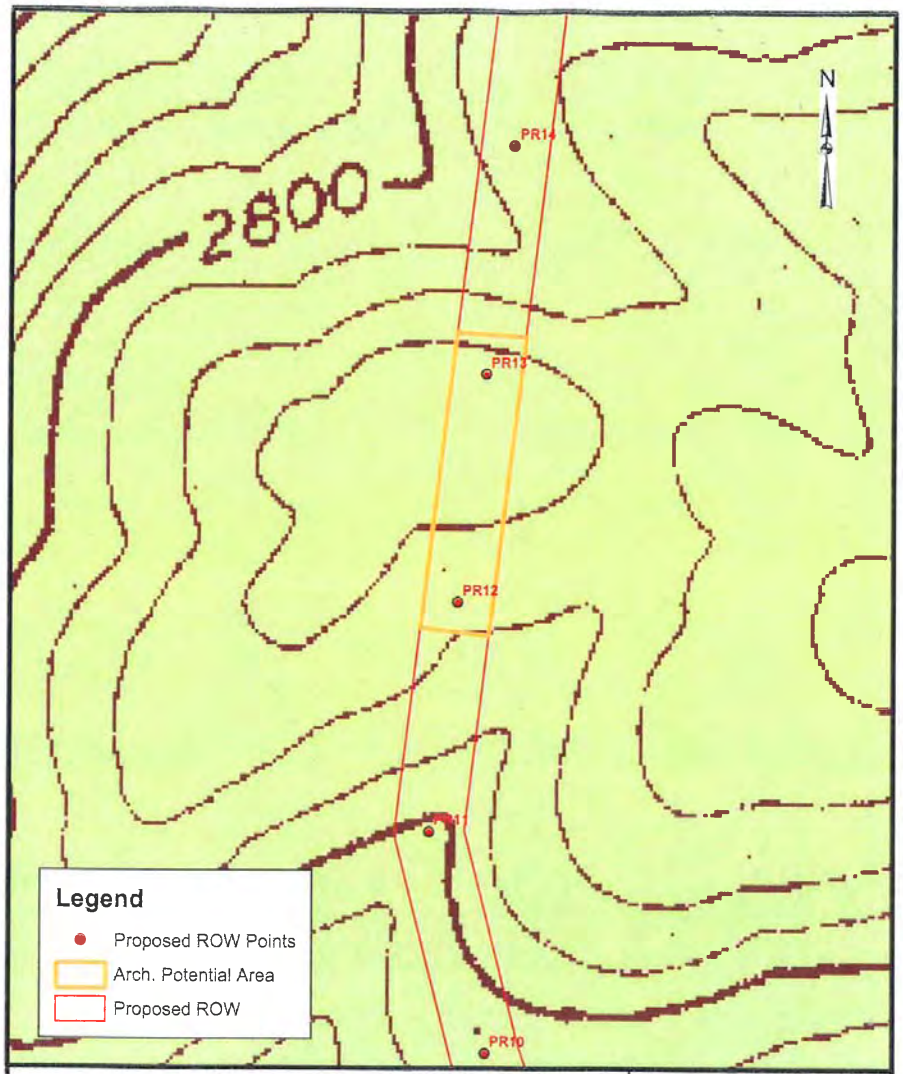


FIGURE 11
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

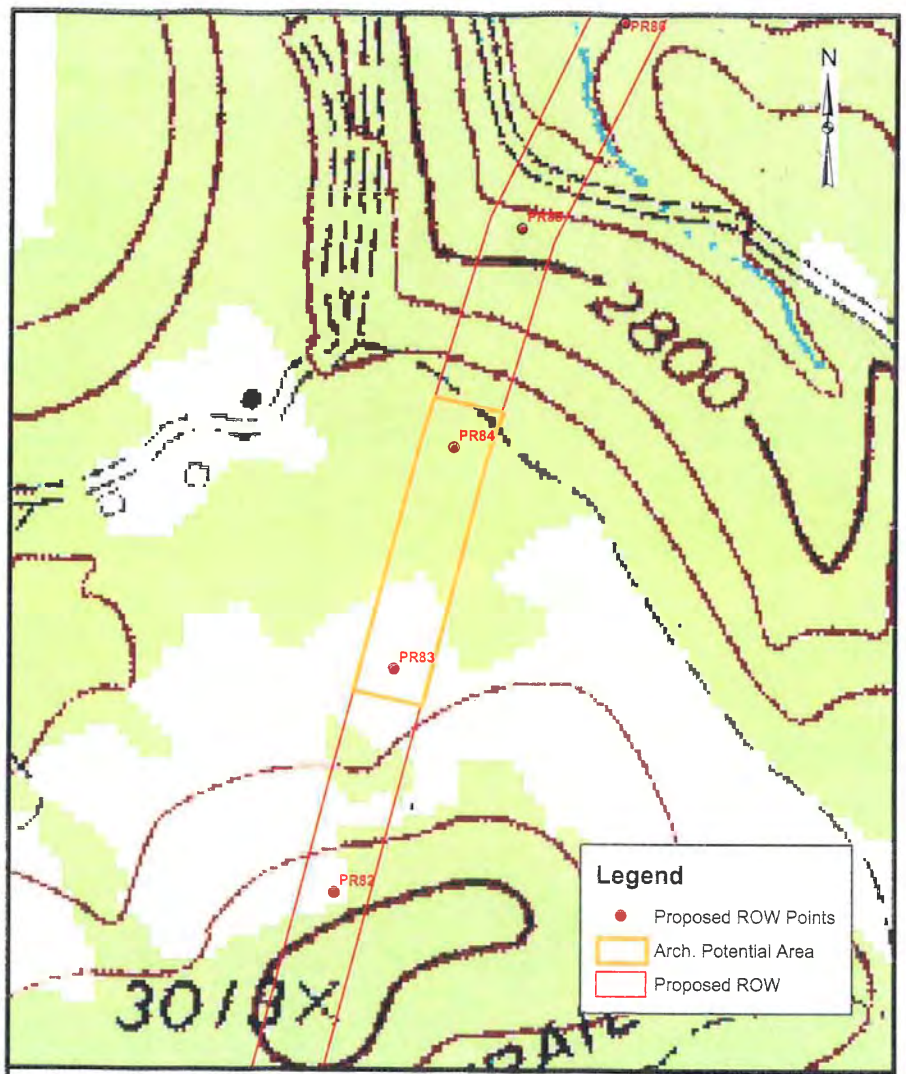


FIGURE 12
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

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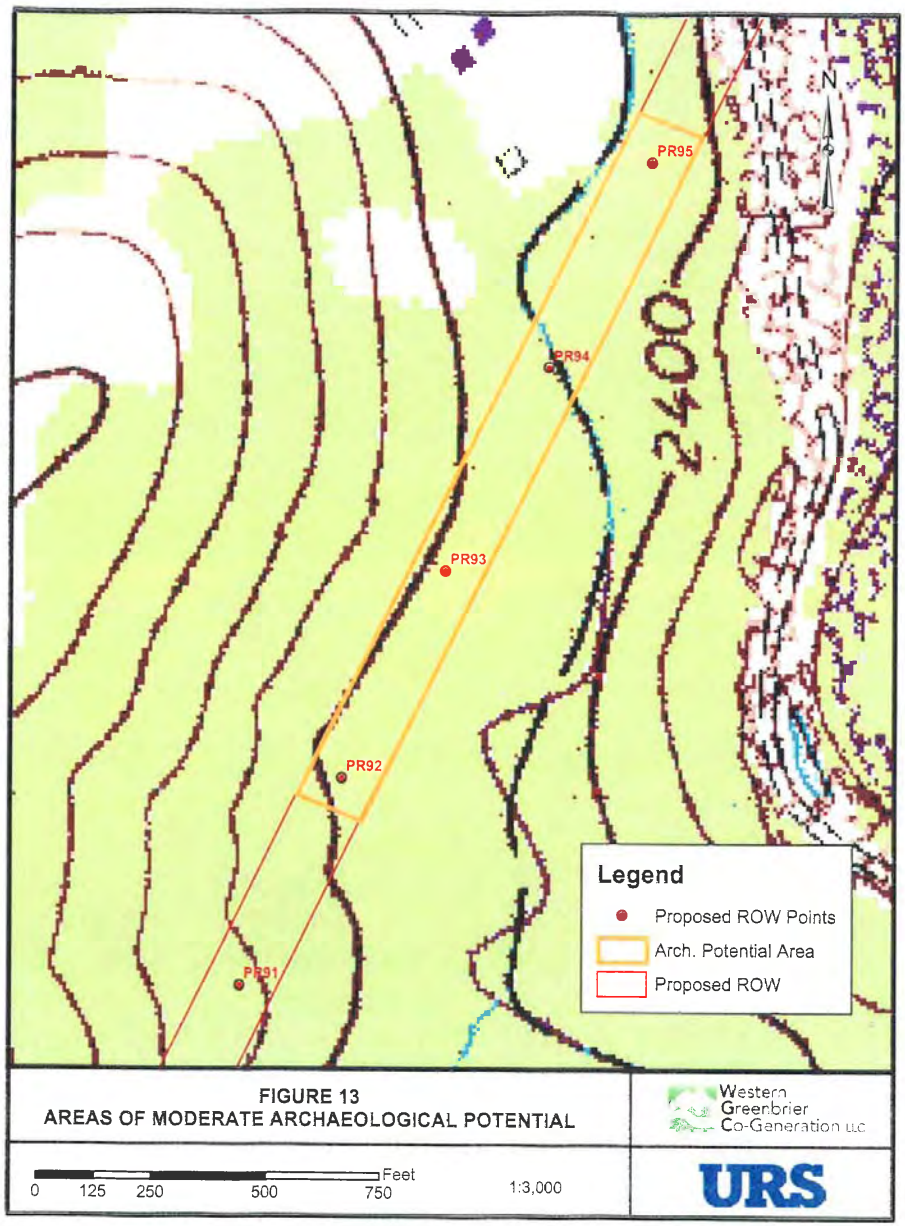


FIGURE 13
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

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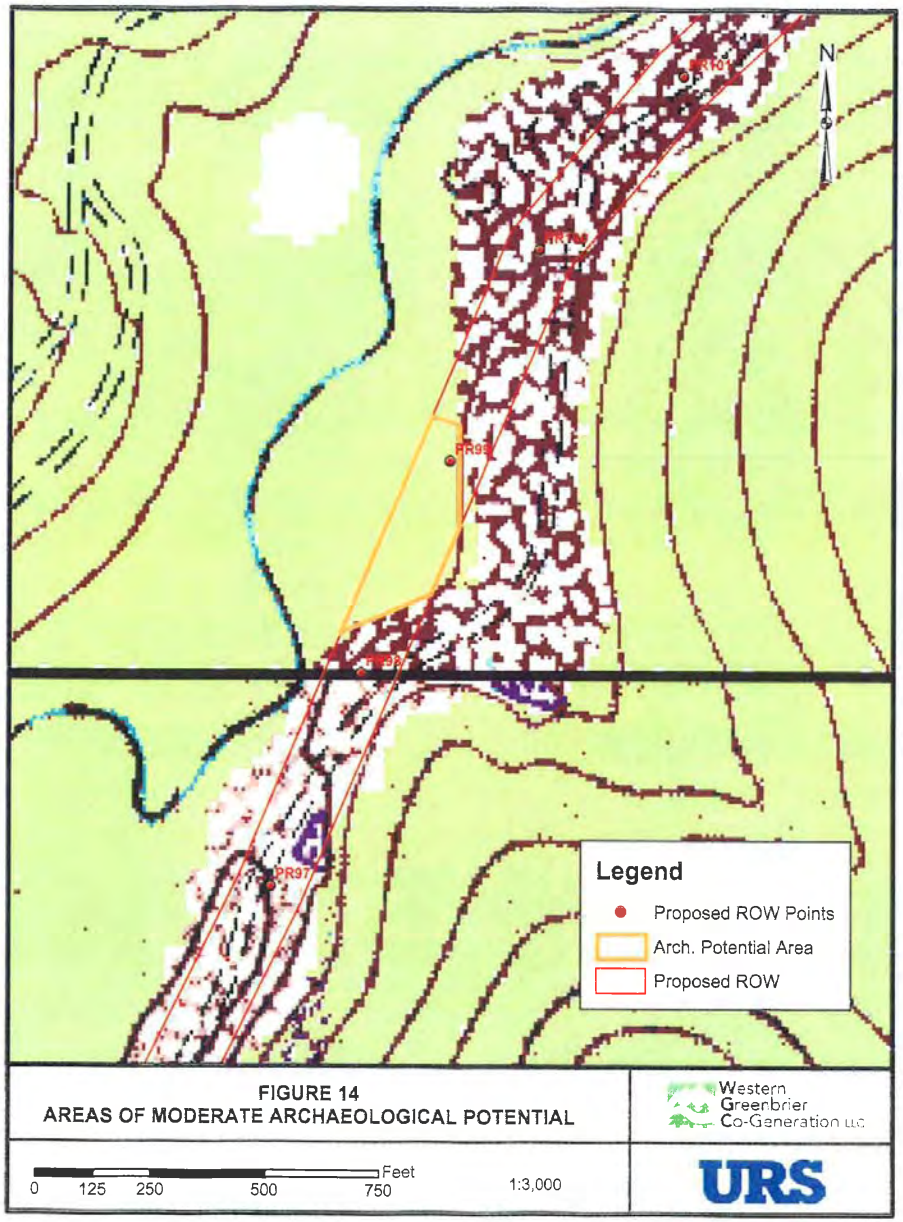


FIGURE 14
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

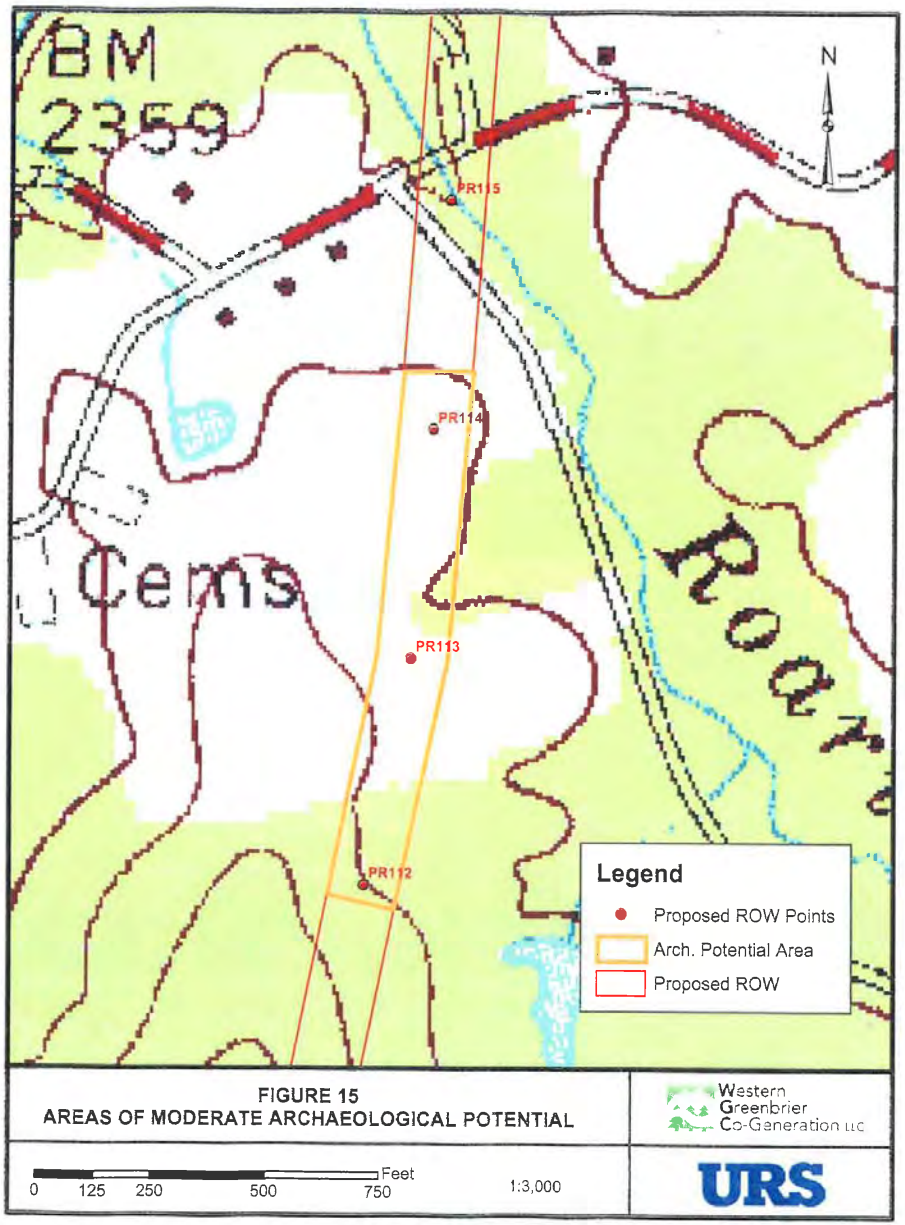


FIGURE 15
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

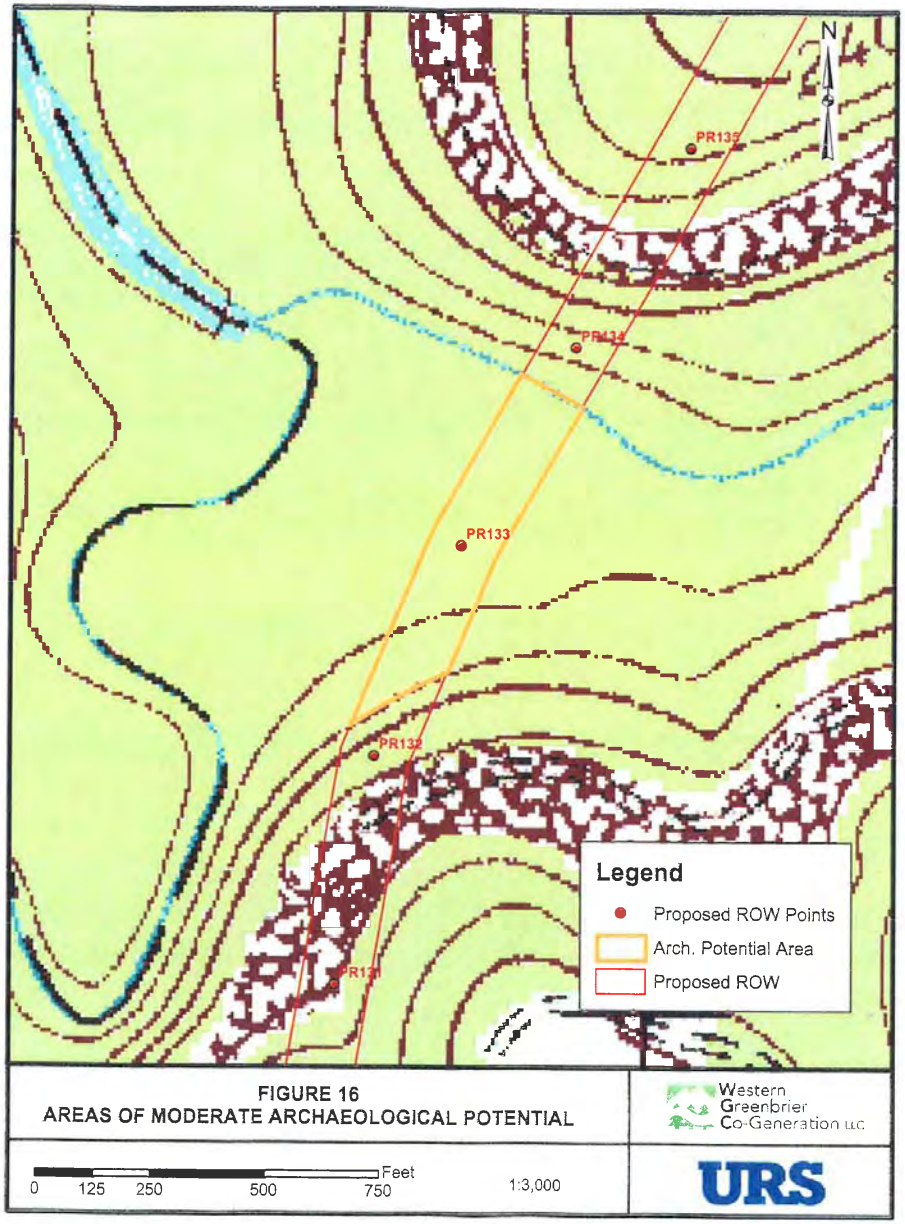


FIGURE 16
AREAS OF MODERATE ARCHAEOLOGICAL POTENTIAL

Western Greenbrier Co-Generation LLC

URS

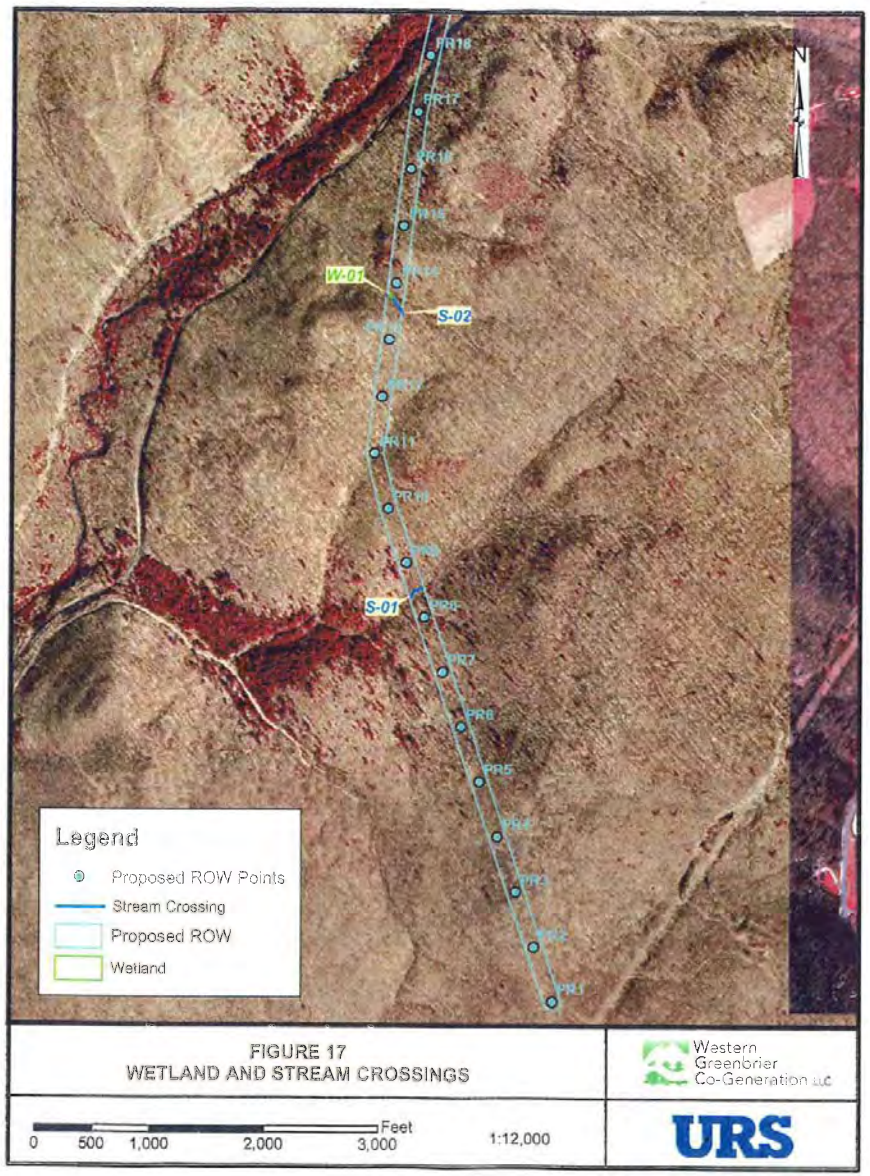


FIGURE 17
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS

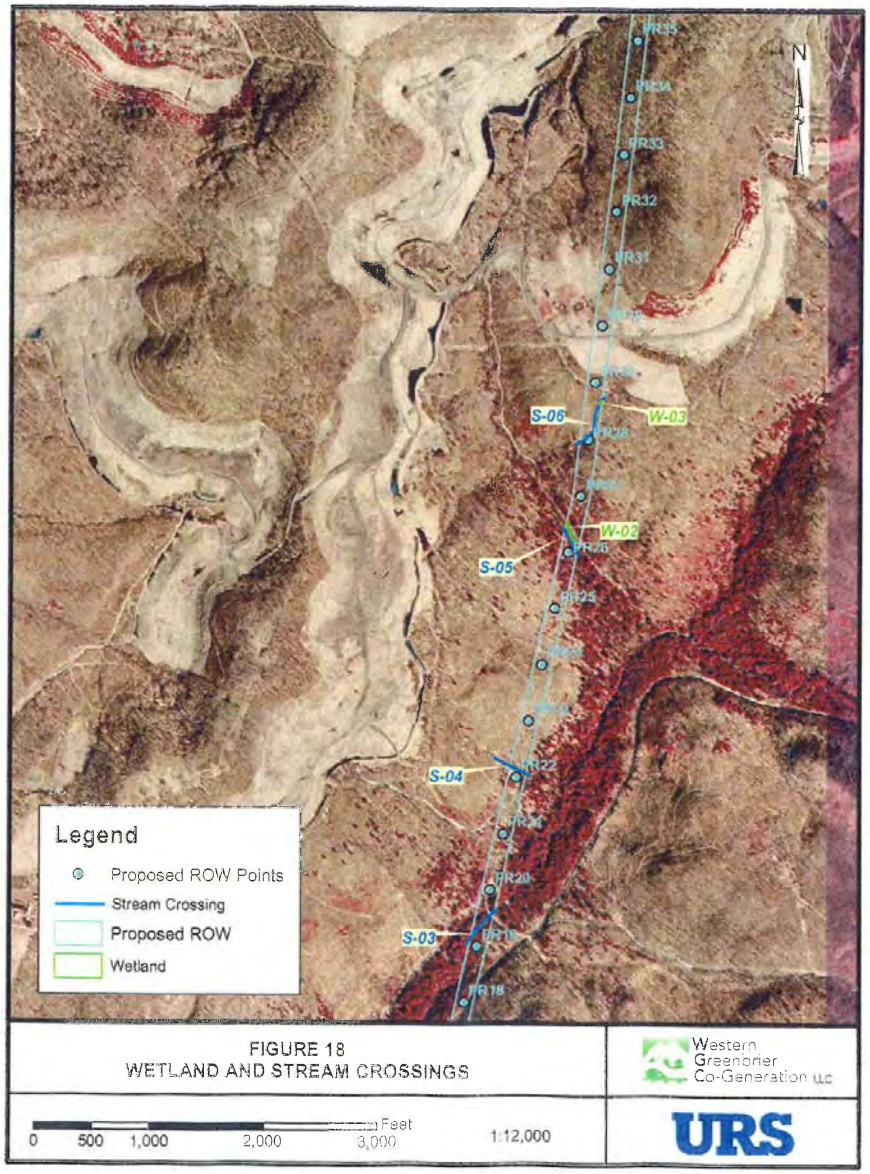
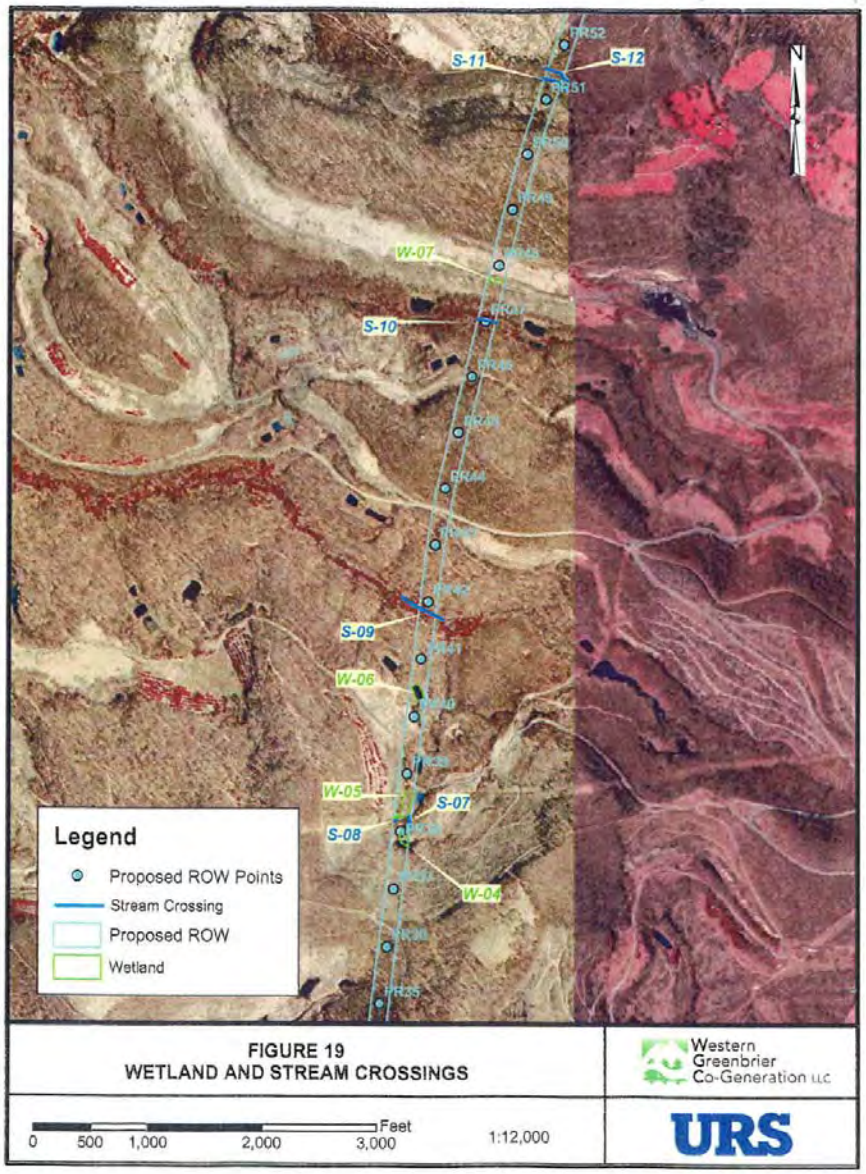
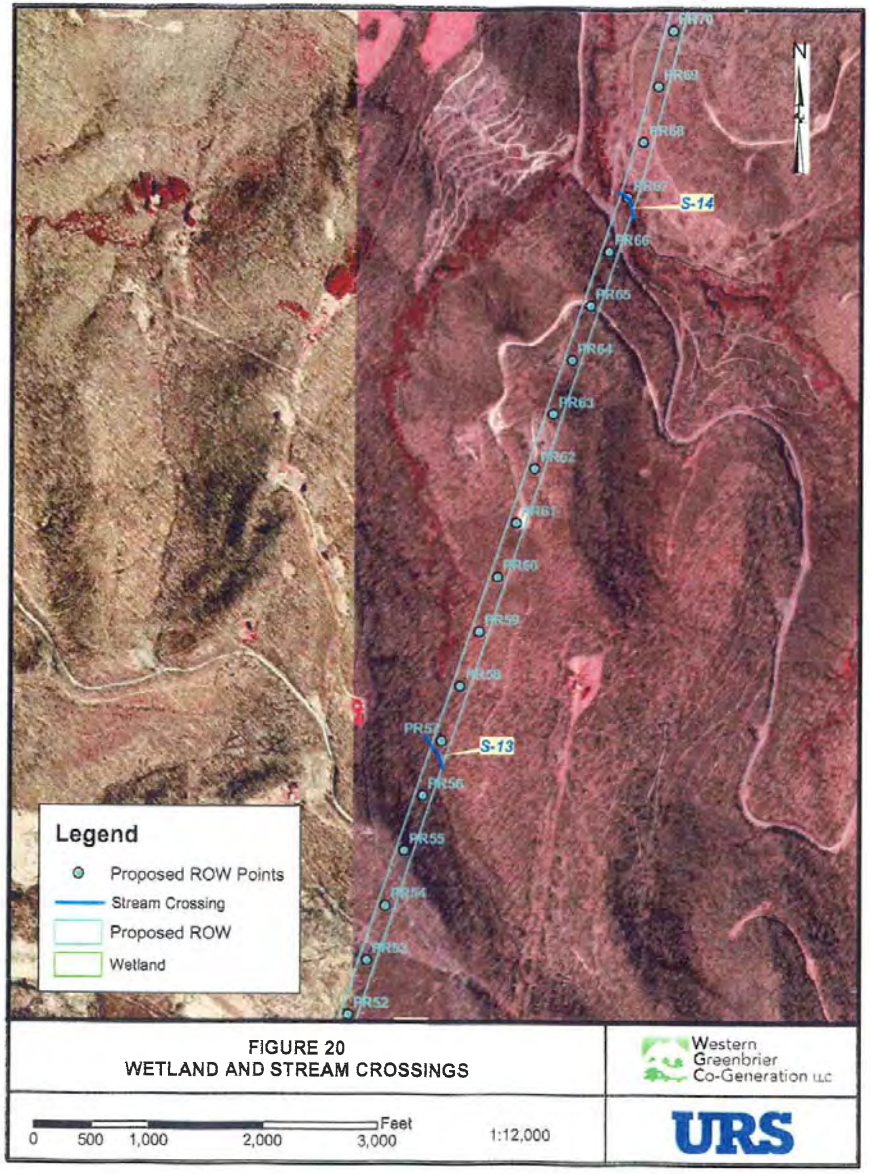


FIGURE 18
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS


PR52
S-11
S-12
PR51
PR50
PR49
W-07
PR48
PR47
S-10
PR46
PR45
PR44
PR43
PR42
S-09
PR41
W-06
PR40
PR39
W-05
S-07
S-08
PR38
PR37
W-04
PR36
PR35
N
Legend
Proposed ROW Points
Stream Crossing
Proposed ROW
Wetland
FIGURE 19
WETLAND AND STREAM CROSSINGS
Western Greenbrier Co-Generation LLC
0 500 1,000 2,000 3,000 Feet
1:12,000
URS


PR70
PR69
PR68
PR67
S-14
PR66
PR65
PR64
PR63
PR62
PR61
PR60
PR59
PR58
PR57
S-13
PR56
PR55
PR54
PR53
PR52
N
Legend
Proposed ROW Points
Stream Crossing
Proposed ROW
Wetland
FIGURE 20
WETLAND AND STREAM CROSSINGS
Western Greenbrier Co-Generation LLC
0 500 1,000 2,000 3,000 Feet
1:12,000
URS

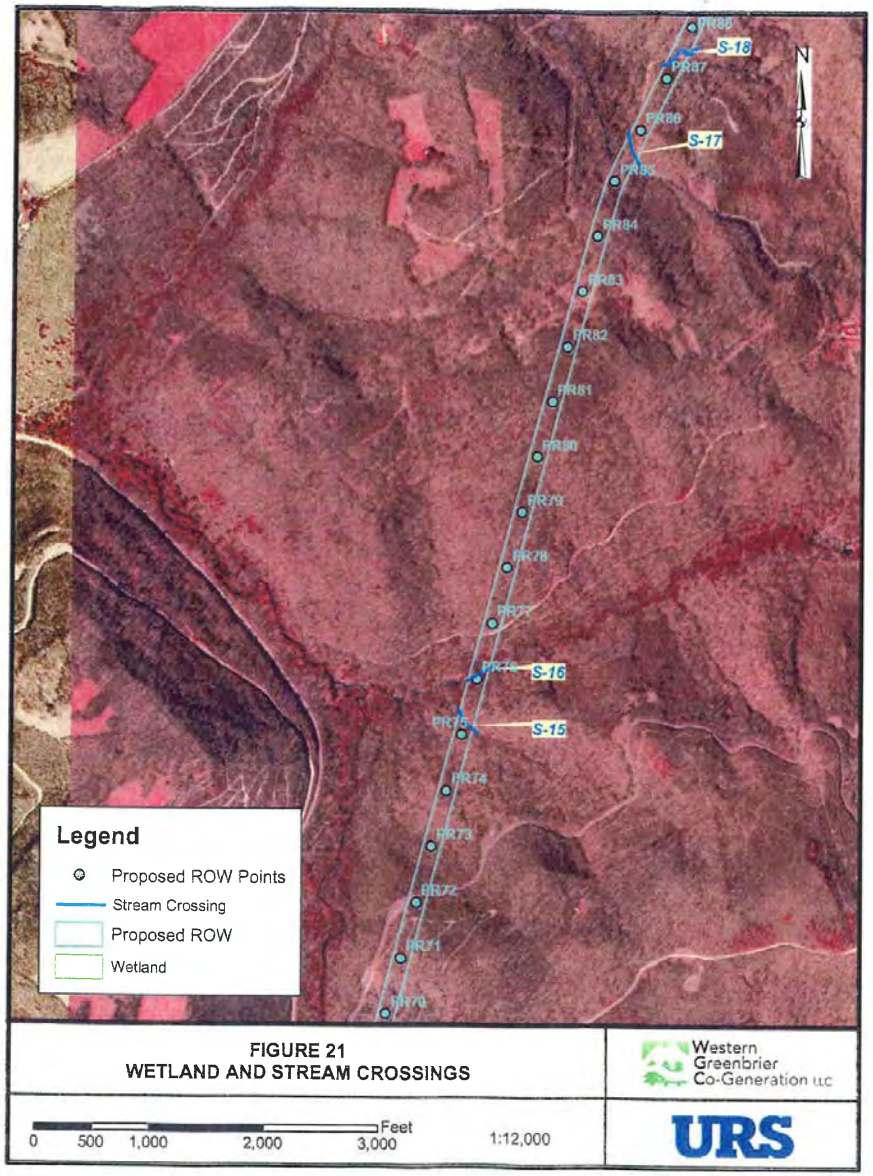


FIGURE 21
WETLAND AND STREAM CROSSINGS

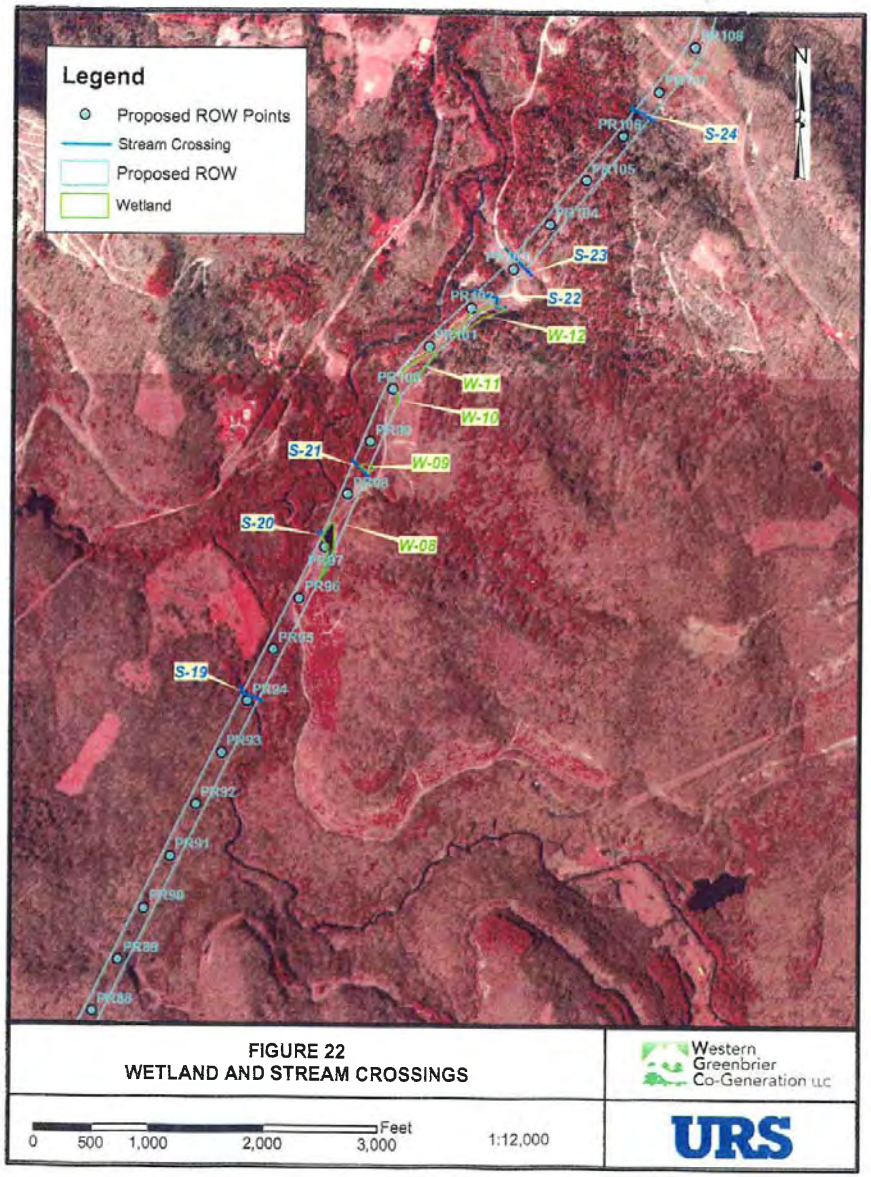


FIGURE 22
WETLAND AND STREAM CROSSINGS

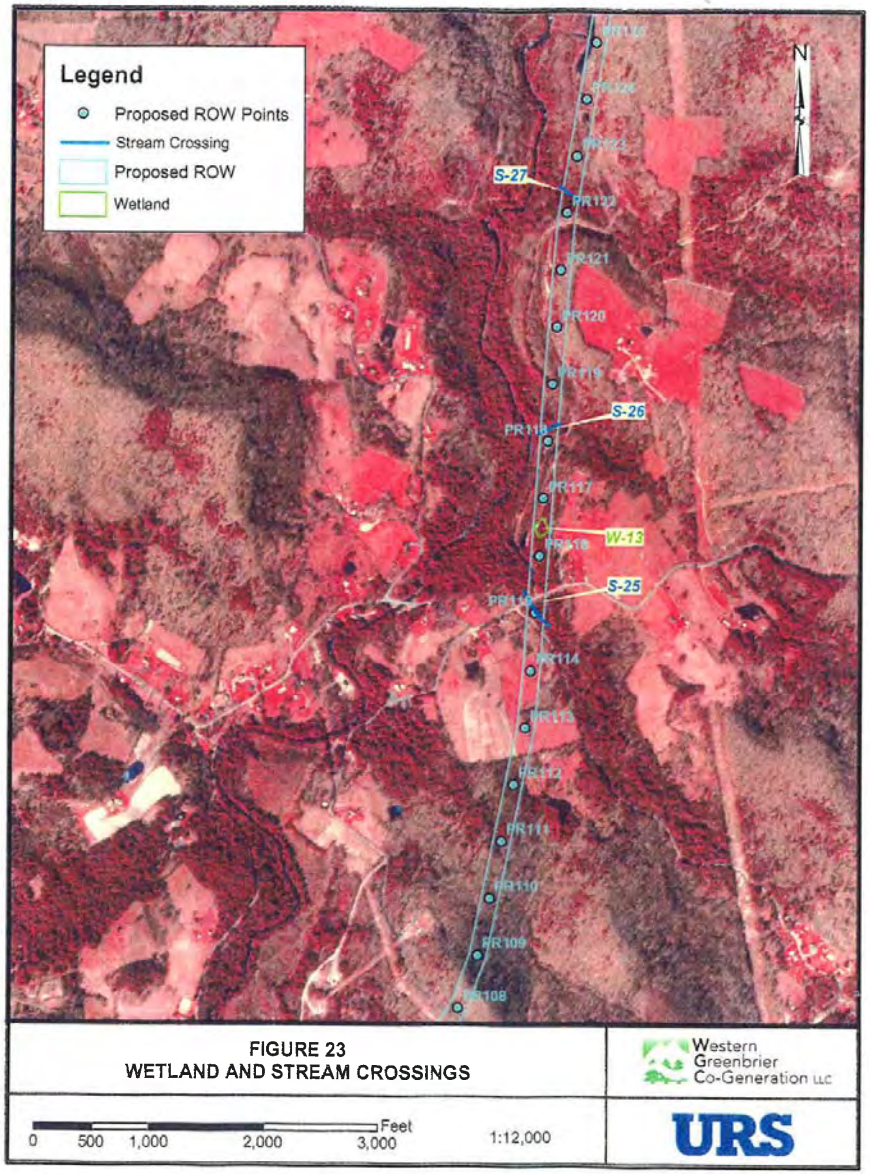


FIGURE 23
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS

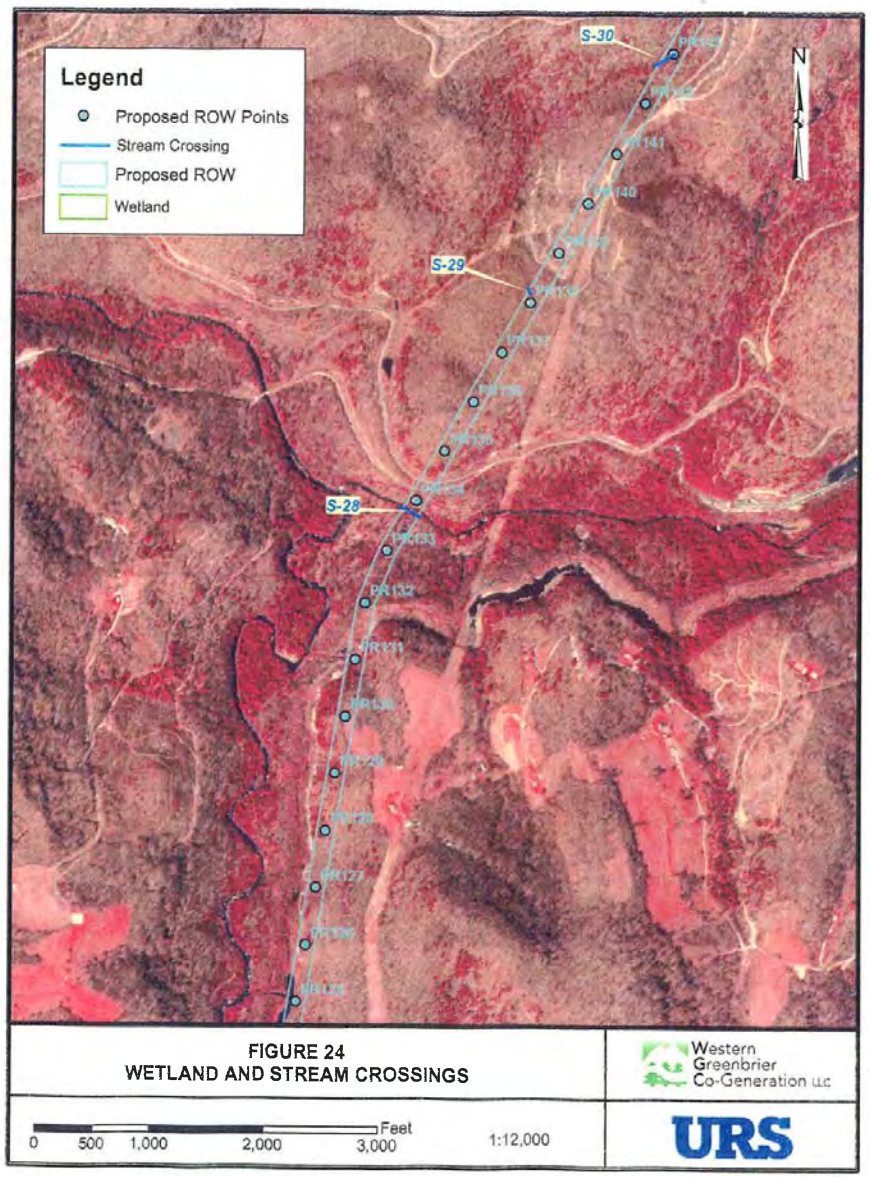
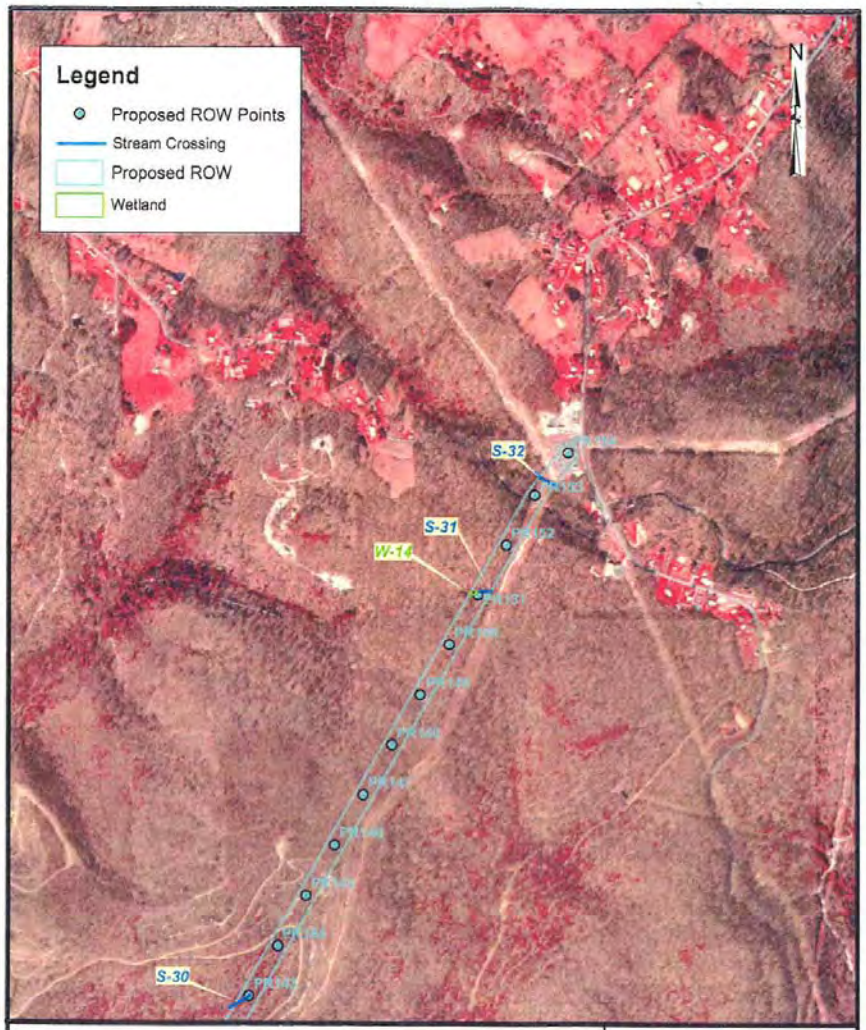
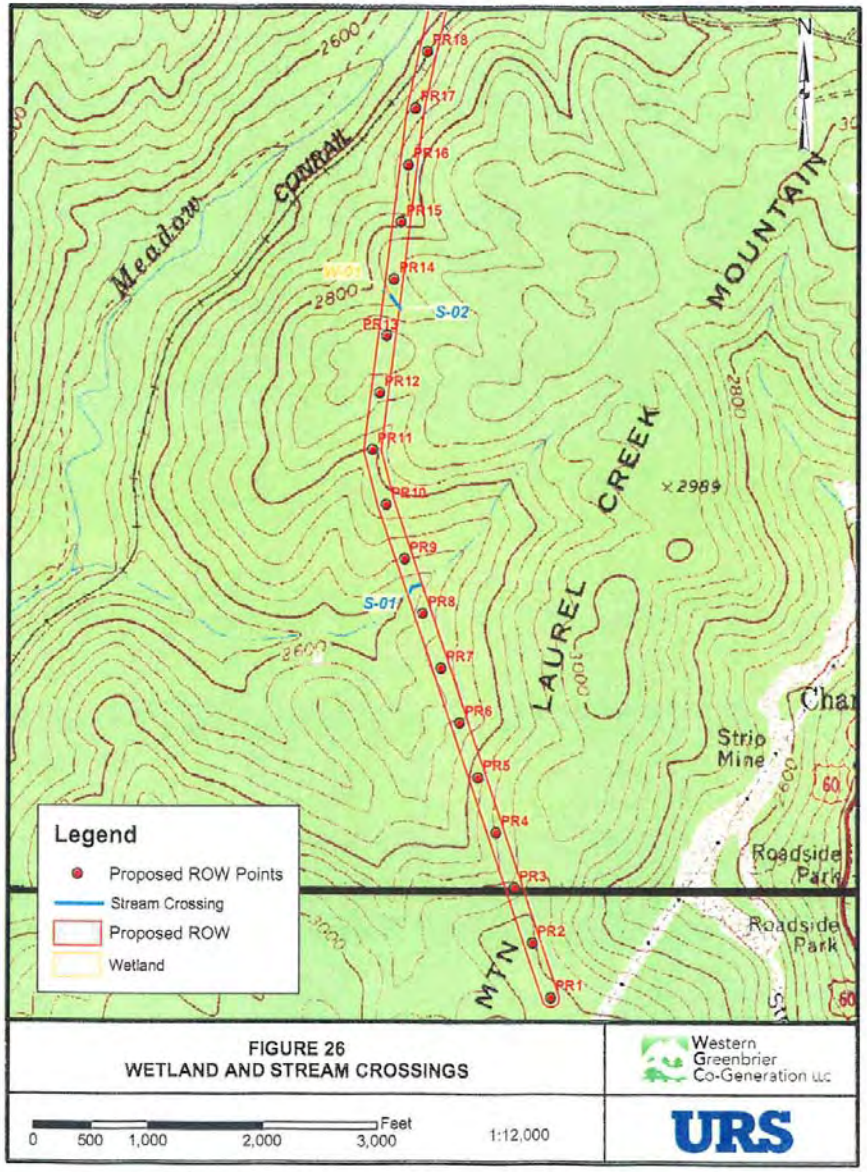


FIGURE 24
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS


Legend
Proposed ROW Points
Stream Crossing
Proposed ROW
Wetland
N
S-32
S-31
W-14
S-30
FIGURE 25
WETLAND AND STREAM CROSSINGS
Western Greenbrier Co-Generation LLC
0 500 1,000 2,000 3,000 Feet
1:12,000
URS


N
PR18
PR17
PR16
PR15
PR14
PR13
PR12
PR11
PR10
PR9
PR8
PR7
PR6
PR5
PR4
PR3
PR2
PR1
W-01
S-02
S-01
2600
2800
Meadow
Conrail
MOUNTAIN
LAUREL
CREEK
Strip
Mine
Roadside
Park
MTN
Legend
Proposed ROW Points
Stream Crossing
Proposed ROW
Wetland
FIGURE 26
WETLAND AND STREAM CROSSINGS
Western Greenbrier Co-Generation LLC
0 500 1,000 2,000 3,000 Feet
1:12,000
URS

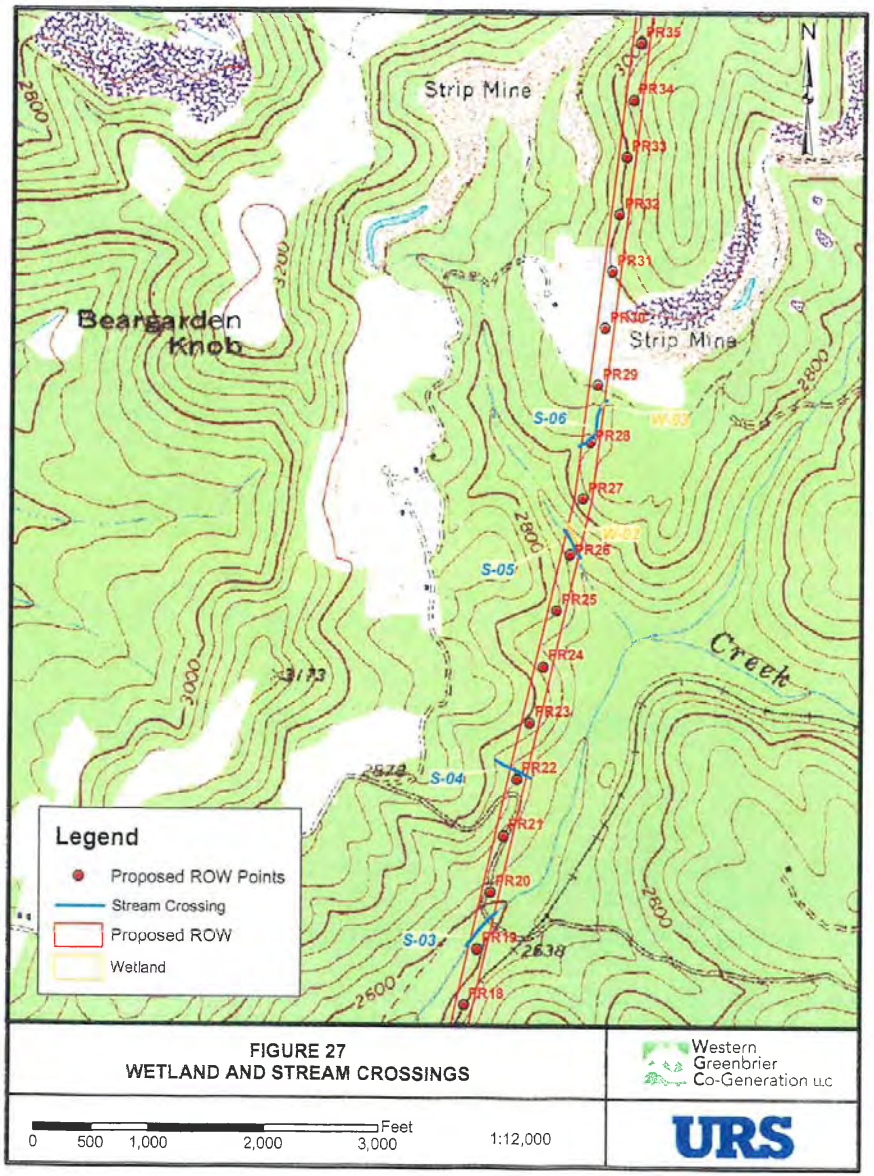


FIGURE 27
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS

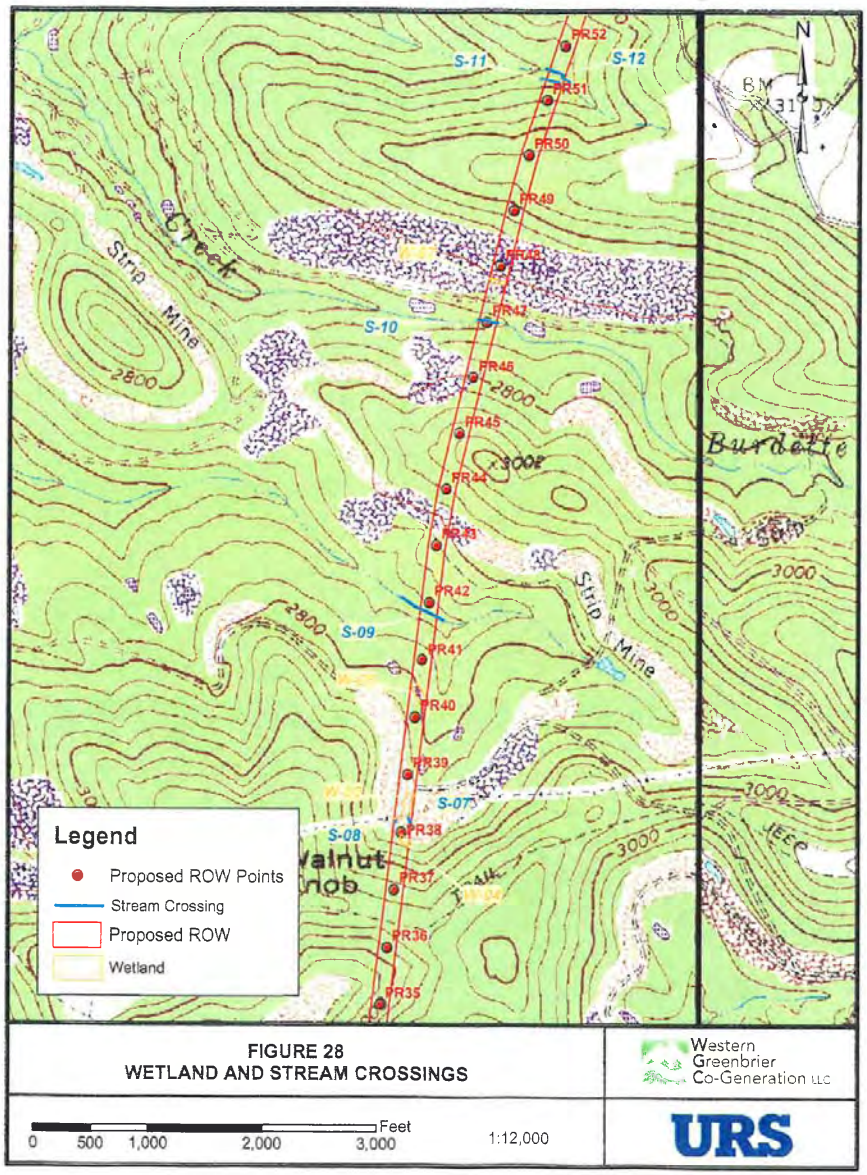


FIGURE 28
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS

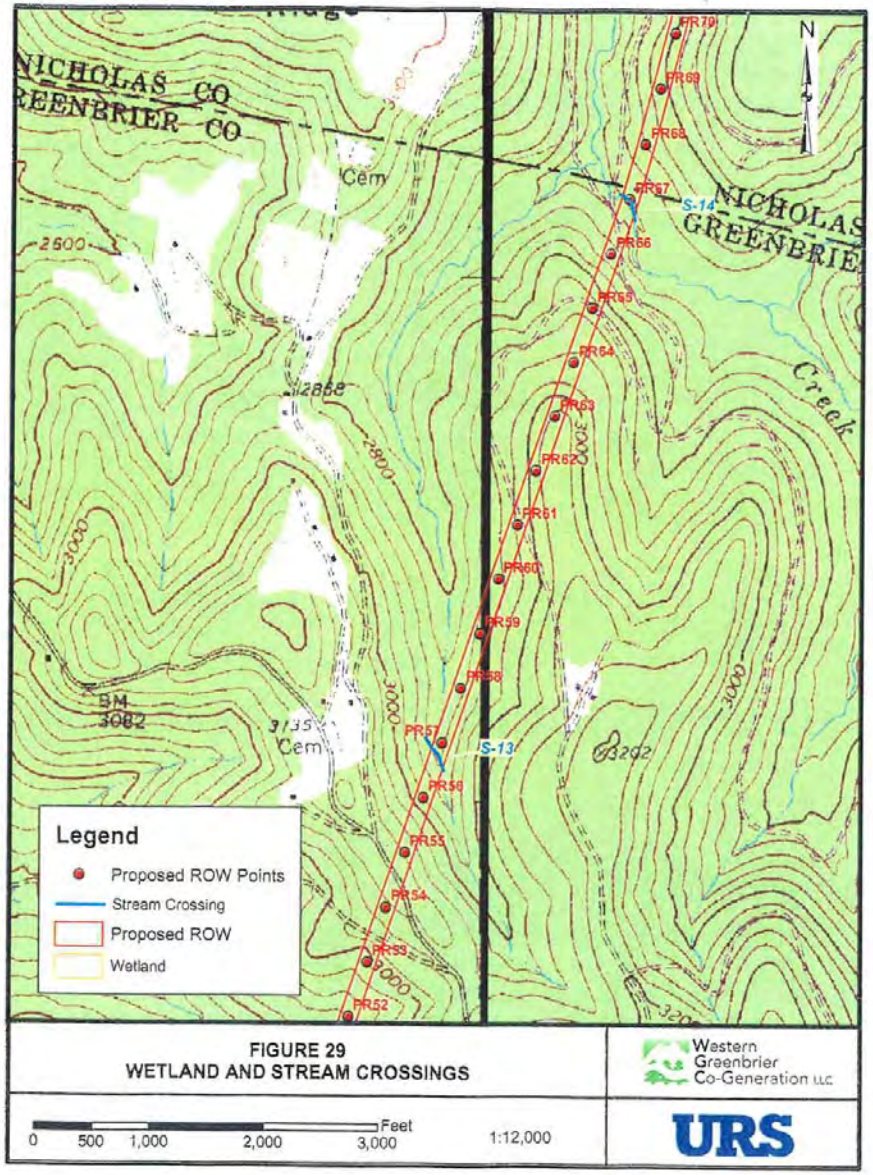


FIGURE 29
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS

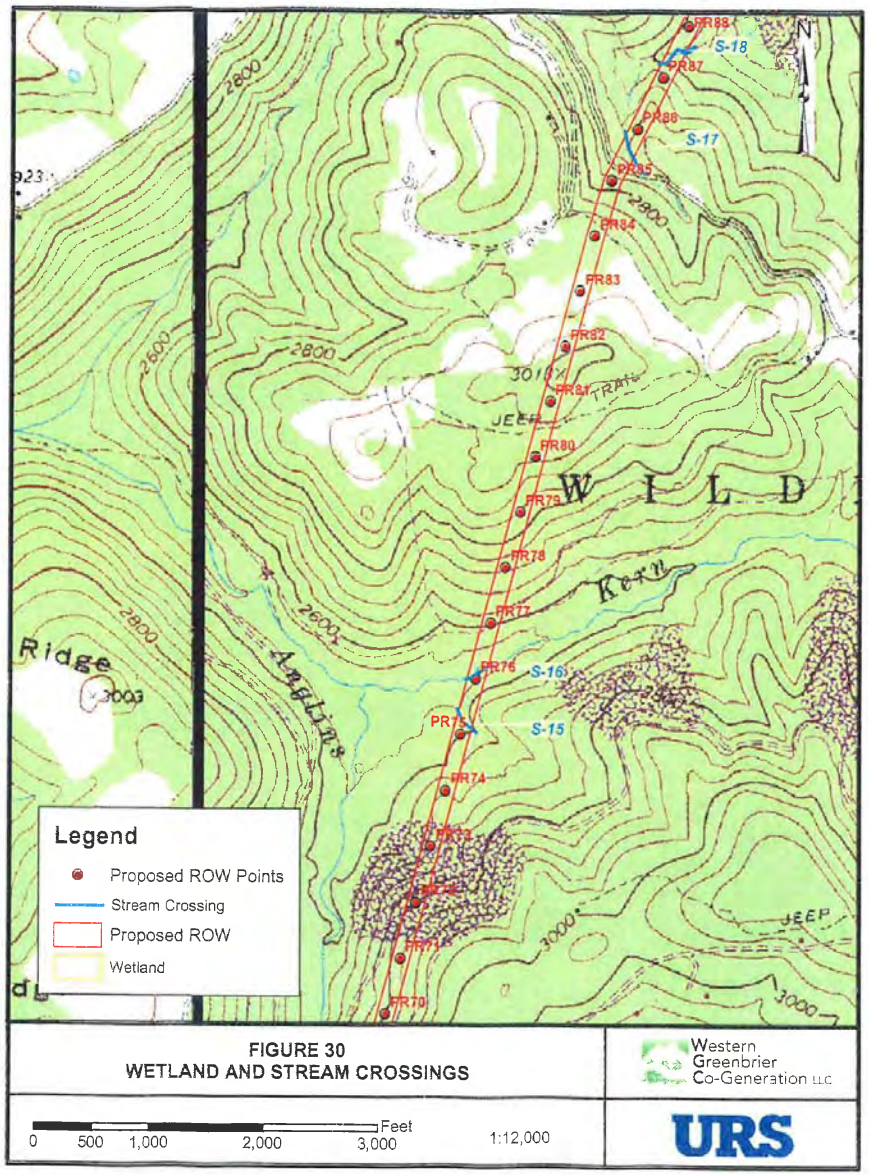


FIGURE 30
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

URS

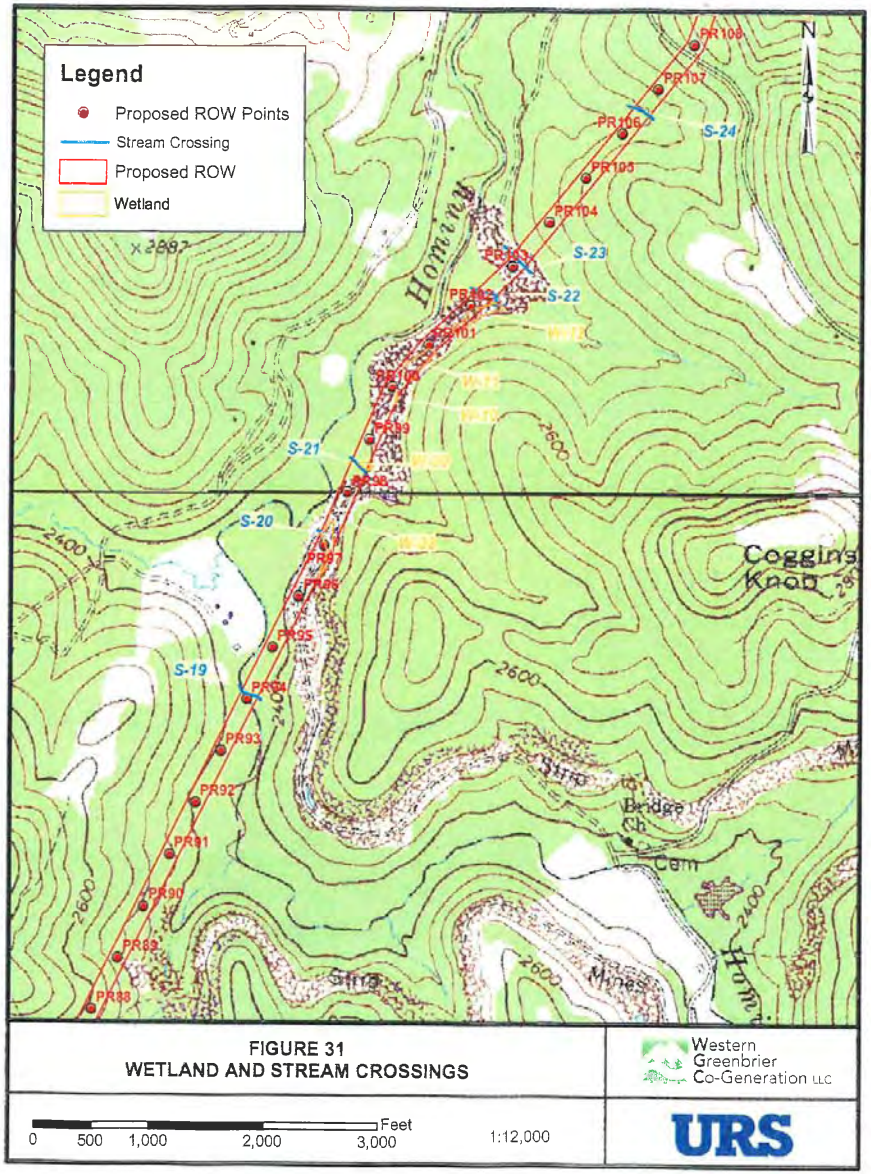


FIGURE 31
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

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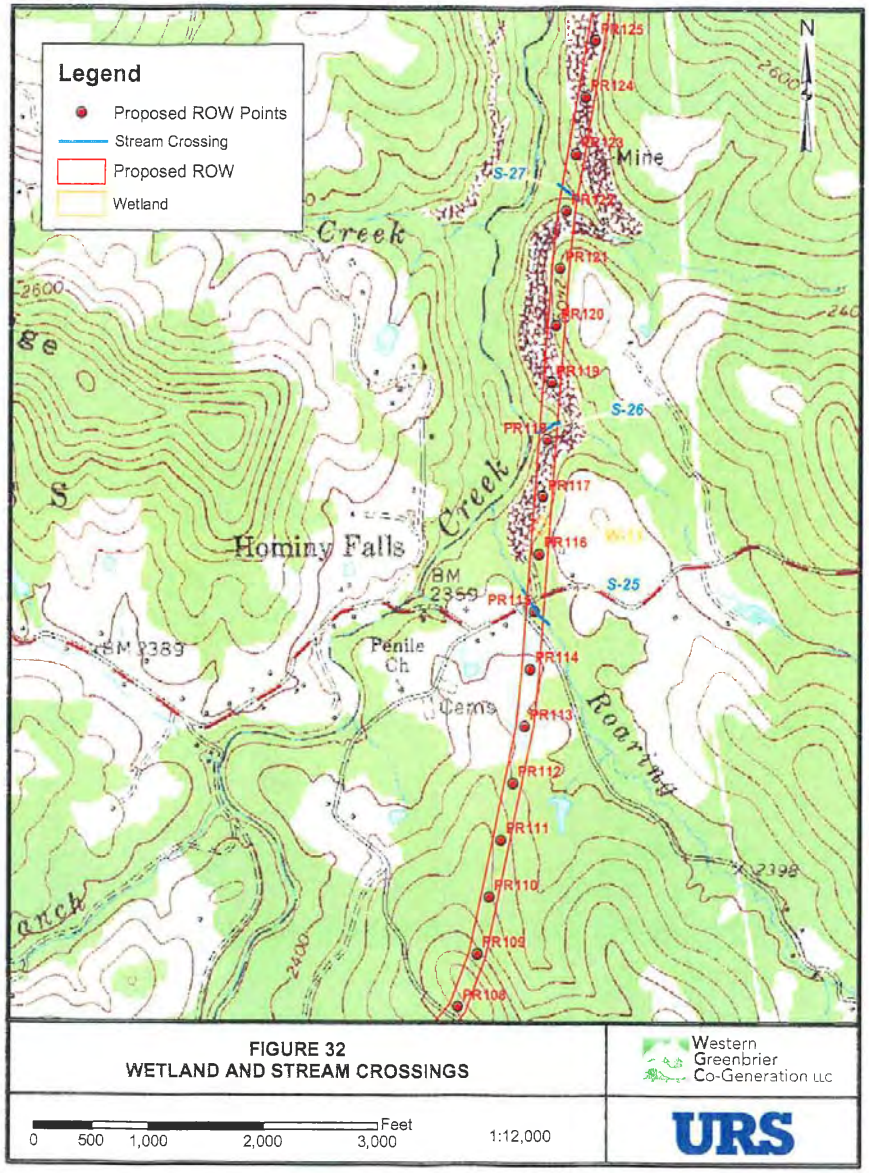


FIGURE 32
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

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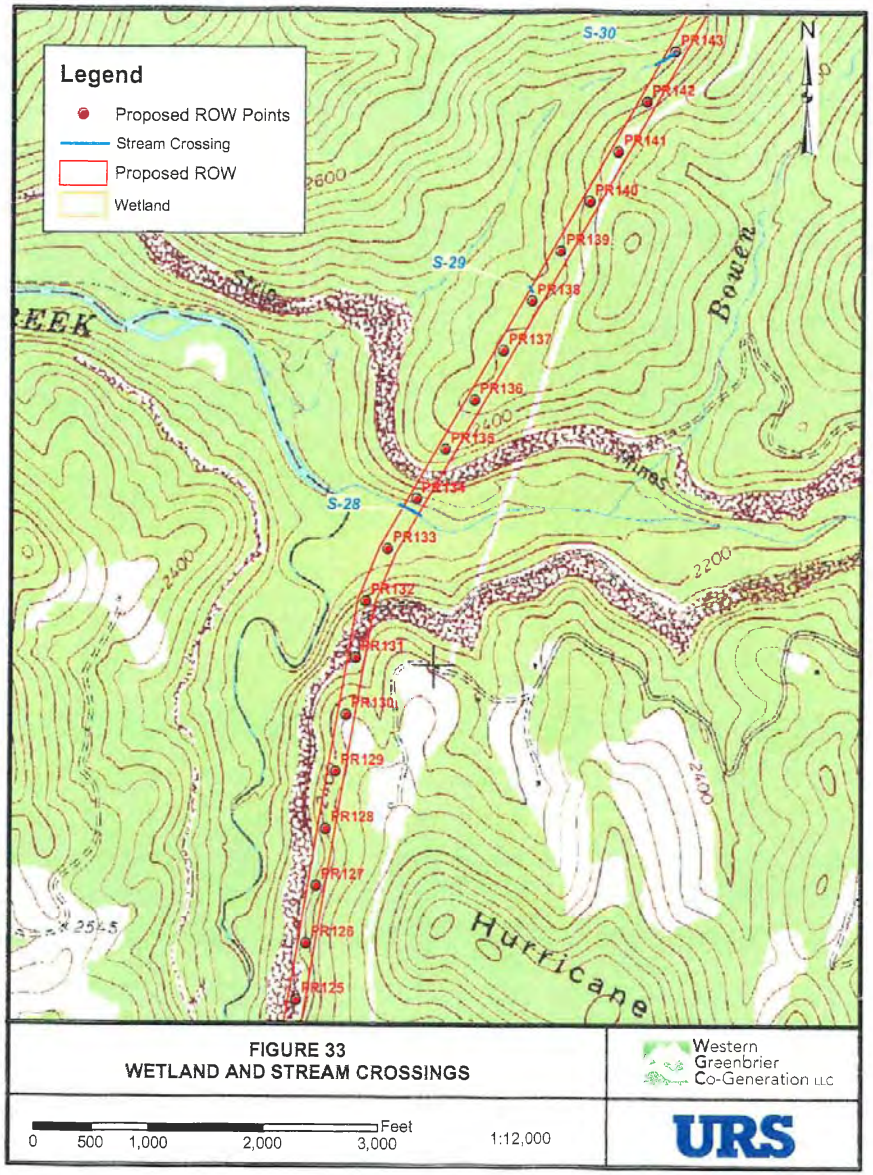


FIGURE 33
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

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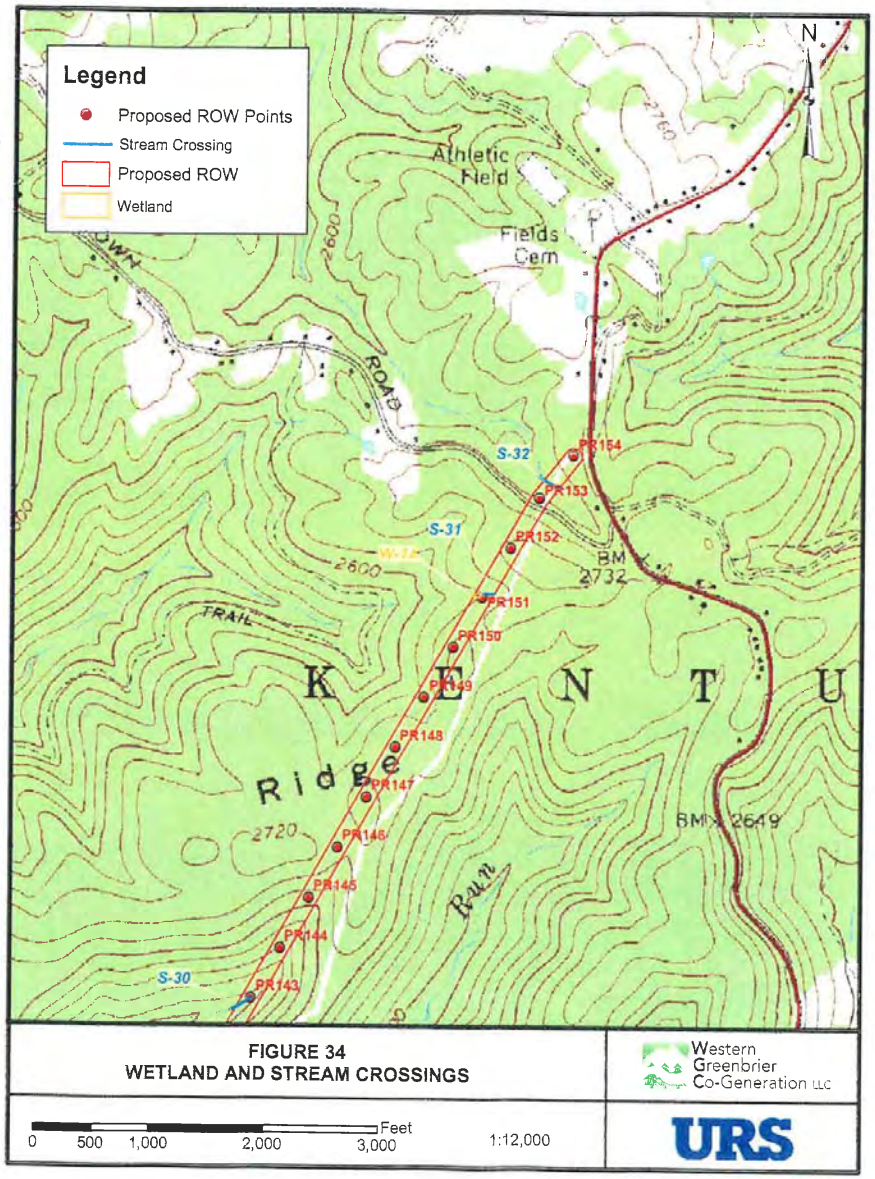


FIGURE 34
WETLAND AND STREAM CROSSINGS

Western Greenbrier Co-Generation LLC

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Appendix M
Floodplain and Wetland Assessment*

To date (July 2007),WGC has submitted a revised permit application to the WVDEP and the USACE. Initially, WGC had submitted wetland encroachment permit applications for commercial and institutional development (Nationwide General Permit 39) and a utilities line (Nationwide General Permit 12) permit for the project. However, the cumulative wetland impact exceeded 0.5 acres, which necessitated WGC's submission of an Individual Permit (IP) application. Both the state (401) and federal (404) wetland permit applications discuss temporary and permanent wetland impacts, BMPs and include a compensatory conceptual wetland mitigation plan for impacted wetlands. The conceptual wetland replacement design would be finalized once WVDEP approves the plan.

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1. INTRODUCTION

Pursuant to Executive Order 11988, Floodplain Management, each federal agency is required, when conducting activities in a floodplain, to take actions to reduce the risk of flood damage; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains. Pursuant to Executive Order 11990, Protection of Wetlands, each federal agency is to avoid, to the extent practicable, the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists. The U.S. Department of Energy (DOE) issued regulations that implement these Executive Orders (10 CFR Part 1022, Compliance with Floodplain/Wetlands Environmental Review Requirements). In accordance with the terms of this regulation, specifically 10 CFR Part 1022.11(d), DOE must prepare a floodplain assessment for proposed actions that would take place in floodplains and a wetland assessment for any proposed actions that would take place in wetlands.

This appendix is intended to comply with 10 CFR Part 1022 and is both the floodplain assessment and the wetlands assessment. A floodplain and wetlands assessment consists of a description of the Proposed Action, a discussion of its effects on floodplains and wetlands, and a discussion of the proposed alternatives. The discussion of the Proposed Action also describes the functions and values of floodplains/wetlands and steps taken to minimize impacts on these sensitive natural resources.

Because project development activities tend to be an ongoing process and often involve the reconfiguration of proposed project components, changes to original wetland impact estimates are common. To date, the final location for the water intake structure and an associated road has not been finalized, although, final location decisions would be based on minimum disturbance to wetlands. Likewise, refinement of the transmission corridor (Segment C) is currently ongoing and final alignment decision criteria include minimum impacts to wetlands. Consequently, Western Greenbrier Co-Generation, LLC (WGC) is in the process of consulting with the U.S. Army Corps of Engineers (USACE) for the wetland permitting process to identify wetland impacts and methods for avoiding and minimizing impacts and developing suitable forms of wetland mitigation. See Section 4.3 of this assessment for an updated discussion on the current status of the permit applications and wetlands mitigation plans for the project.

1.1 Project Description

Under the Proposed Action, DOE is considering providing federal financial assistance for the construction and demonstration of a 98 megawatt (MWe) power plant and cement-making facility (hereafter referred to as "Co-Production Facility"). Under the proposed federal action, DOE has entered into a 5-year cooperative agreement with Western Greenbrier Co-Gen LLC (WGC) to provide financial assistance through the Clean Coal Power Initiative (CCPI) Program for the development of a Co-Production Facility to be located at Rainelle, Greenbrier County, West Virginia (Figure 1.1).

The DOE goal for this project is to demonstrate a commercially innovative design for an atmospheric pressure, circulating fluidized bed (ACFB) power plant that would generate electricity and steam using coal refuse as fuel and manufacturing a cement product utilizing the resulting ash. A coal-fired rotary kiln coupled with the power plant would combine coal ash, limestone, and other waste materials into a cement material for use in manufacturing structural building products. The ash byproducts would be manufactured at or adjacent to the site of the power plant.

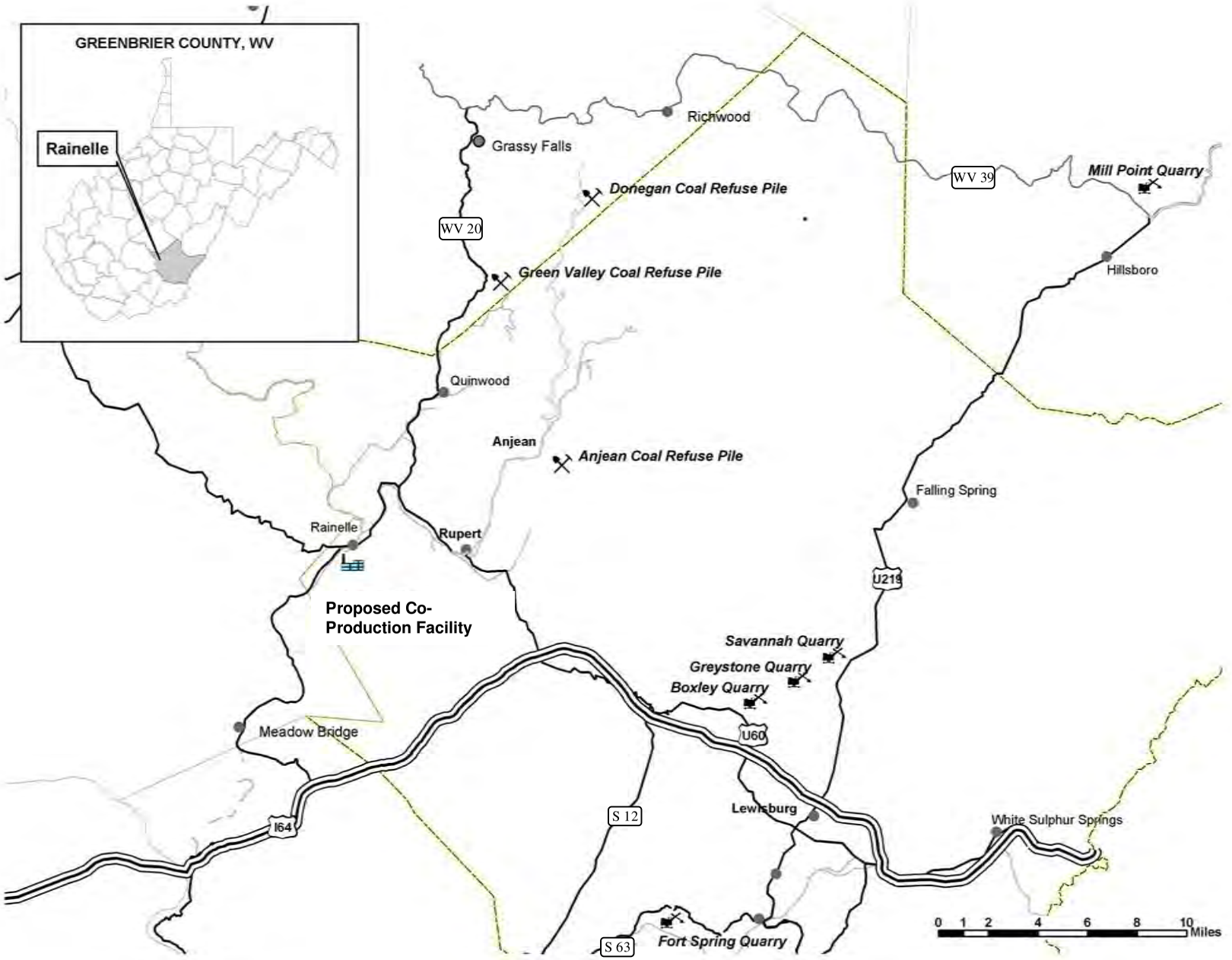


Figure 1.1
General Location

Floodplain and Wetland Assessment

Western Greenbrier Co-Production Demonstration Project

The proposed project includes an environmentally balanced industrial park (EcoPark) situated on and adjacent to the site of the former MRL property on the southern outskirts of the town's city limits. This ''EcoPark'' would use hot water produced from the plant's turbine exhaust to provide heat for buildings. Steam would also be used for various heating and industrial processes, which could include hardwood drying. A 4-million ton coal refuse site in Anjean, WV, and other coal refuse sites in the vicinity of Rainelle, would supply coal refuse fuel for the plant.

Rainelle is a small rural community consisting of residential, commercial, and industrial land and situated along US 60 in western Greenbrier County, West Virginia. The county is rural in character with farms and forest comprising up to 95% of the county's 1,026 square miles (EK, 2003a). Historically, Rainelle supported an active lumber industry that was centered on the Meadow River Lumber Company (MRL) (JMA, 2005). Since the closure of the MRL and the opening of Interstate 64, the town has experienced an economic downturn.

Because the project area is situated adjacent to Sewell Creek, wetlands, floodplains, and surface waters could potentially be affected by the Proposed Action. The severity of potential impacts to wetlands and floodplains would be dependant on the degree and magnitude of the varying design alternatives and associated infrastructures presented by proposed actions. The land is generally flat in the Sewell Creek floodplain from the proposed location of the Co-Production Facility site, northeast to Rainelle's downtown, and north and northwest toward the Rainelle City Hall, Rainelle Medical Center, Rainelle School, and golf course.

Additional information about the Proposed Action can be found in the body of the Environmental Impact Statement (EIS) – Volume 1, which has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) and as amended (42 USC 4321 *et seq.*). Chapter 2 of the EIS contains a detailed description of the Proposed Action. Sections 3.5 and 3.7 provide detailed information on the flooplains and wetlands in the area of the Proposed Action. Section 4.5 and 4.7 provide the DOE analysis of potential impacts to floodplains and wetlands that could result from the construction and operation of the proposed power plant.

1.2 Regulatory Requirements

For actions that would be located in a floodplain, DOE is required to describe the nature and extent of the flood hazard. Using the most authoritative information available about site conditions, DOE must determine if a proposed action would be located within either a base action floodplain or a critical action floodplain. The base floodplain is, at a minimum, the area inundated by a flood having a 1.0 percent chance of occurring in any given year (referred to as the 100-year floodplain). The critical-action floodplain is the area inundated by a flood having a 0.2-percent chance of occurring in any given year (referred to as the 500-year floodplain).

Critical action is defined as any activity for which even a slight chance of flooding would be too great. Such actions could include the storage of highly volatile, toxic, or water-reactive materials. DOE does not consider the activities associated with the construction and operation of the proposed power plant as critical actions; therefore, only the 100-year floodplain will be evaluated in this assessment.

Title 10 CFR Part 1022.11 lists four sources of information that must be reviewed to determine whether a proposed action would be located within a floodplain. These sources include the following:

- Flood Insurance Rate Maps (FIRM) or Flood Hazard Boundary Maps prepared by the Federal Emergency Management Agency (FEMA)
- Information from a land-administering agency or from other government agencies with floodplain determination expertise

- Information in safety basis documents as defined in 10 CFR Part 830 (*Nuclear Safety Management*)
- DOE environmental documents.

Title 10 CFR Part 1022.11 requires DOE to examine the following information to determine whether a proposed action would be located in a wetland, consistent with the most authoritative information available about site conditions:

- U.S. Army Corps of Engineers (USACE), *Wetlands Delineation Manual*
- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI)
- U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Local Identification Maps
- U.S. Geological Survey (USGS) Topographic Maps
- DOE environmental documents

2. FLOODPLAIN AND WETLAND DESCRIPTIONS

2.1 Floodplains

A floodplain is an area next to a river, stream, or creek that may be covered with water following heavy rainstorms. The floodplain can retain excess water, allowing it to be slowly released into the river system and seep into groundwater aquifers. Vegetation and woody debris in floodplains disrupts surface flow and causes sediment to settle out of floodwaters, thereby keeping it out of water bodies. Floodplains often support important wildlife habitat and are frequently used by humans as recreation areas.

FEMA completed a Flood Insurance Study for Rainelle in 1987. The Flood Insurance Study covered a detailed study of Sewell Creek from the confluence of the Meadow River to the confluence with Little Sewell Creek. A detailed study determines the water-surface elevations on streams and Base Flood Elevations (BFEs) for 10-year, 50-year, 100-year and 500-year flood events. The remaining portion of Sewell Creek and Wolfpen Creek were studied by approximate methods (FEMA, 1987). The approximate method study did not establish BFEs and did not designate floodways.

Floodplains were delineated for Sewell Creek and Little Sewell Creek within the corporate limits of the city of Rainelle as part of the Flood Insurance Study. Topography for the Sewell Creek floodplain is mostly flat north and south of the watercourse. Some variations in topographic elevations occur immediately south of Sewell Creek and the majority of the proposed power plant site facility (E&R site) lies outside the 100-year floodplain. The FIRM of Rainelle shows that only a small portion of the project area (approximately 3 acres [1.2 hectares]), is within the 100-year floodplain. This area is shown as Zone A (Figure 2.1).

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplain that is determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses were not performed for such areas, no BFEs or depths are shown around the proposed power plant site. Thus, for this area no floodway has been designated. Generally for projects located in the 100-year floodplain, the local community will require that project owners submit engineering analyses before permits are approved for development in the floodplain. The 100-year flood elevation from the FIRM was overlaid on a 1-foot contour topographic map that was developed as part of project efforts to estimate the elevation of the floodplain around the project area. Based on the overlay, the FEMA 100-year flood elevation is approximately 2,398 feet (731meters) at the proposed project site and covers approximately 300 feet (91 meters) above mean sea level (amsl) on either side of Sewell Creek. However, because this estimate only

approximates the extent of the 100-year flood elevation, modeling was employed to estimate flood risk at the project site.

Detailed hydraulic modeling of the proposed project site was conducted as part of baseline characterization to determine floodplain boundaries. Stream segments studied include the section of Sewell Creek from the confluence of Wolfpen Creek to US Route 60, Wolfpen Creek from the US Route WV 20 (South Street) bridge to the confluence with Sewell Creek, and an unnamed tributary approximately 2,300 feet (7,010 meters) downstream on Sewell Creek from the confluence with Wolfpen Creek.

Expected flood flows for 100-year, 100-year + 1 Standard Error Estimate (SEE), and 100-year + 2 SEE storm events were calculated based on techniques presented in USGS Open-File report 80-1218, "Runoff Study on Small Drainage Areas in West Virginia." This technique provides a method of estimating the magnitude of peak discharges of 100-year, 100-year + 1SE, 100 year +2SE frequency for unregulated, virtually natural streams in West Virginia. Hydraulic modeling was accomplished using HEC-RAS to estimate base flood elevations for the calculated discharge rates. The 100-year flood elevation was determined to be at an elevation of approximately 2,400 feet and covered a small portion of the Sewell Creek floodplain (Figure 2.2).

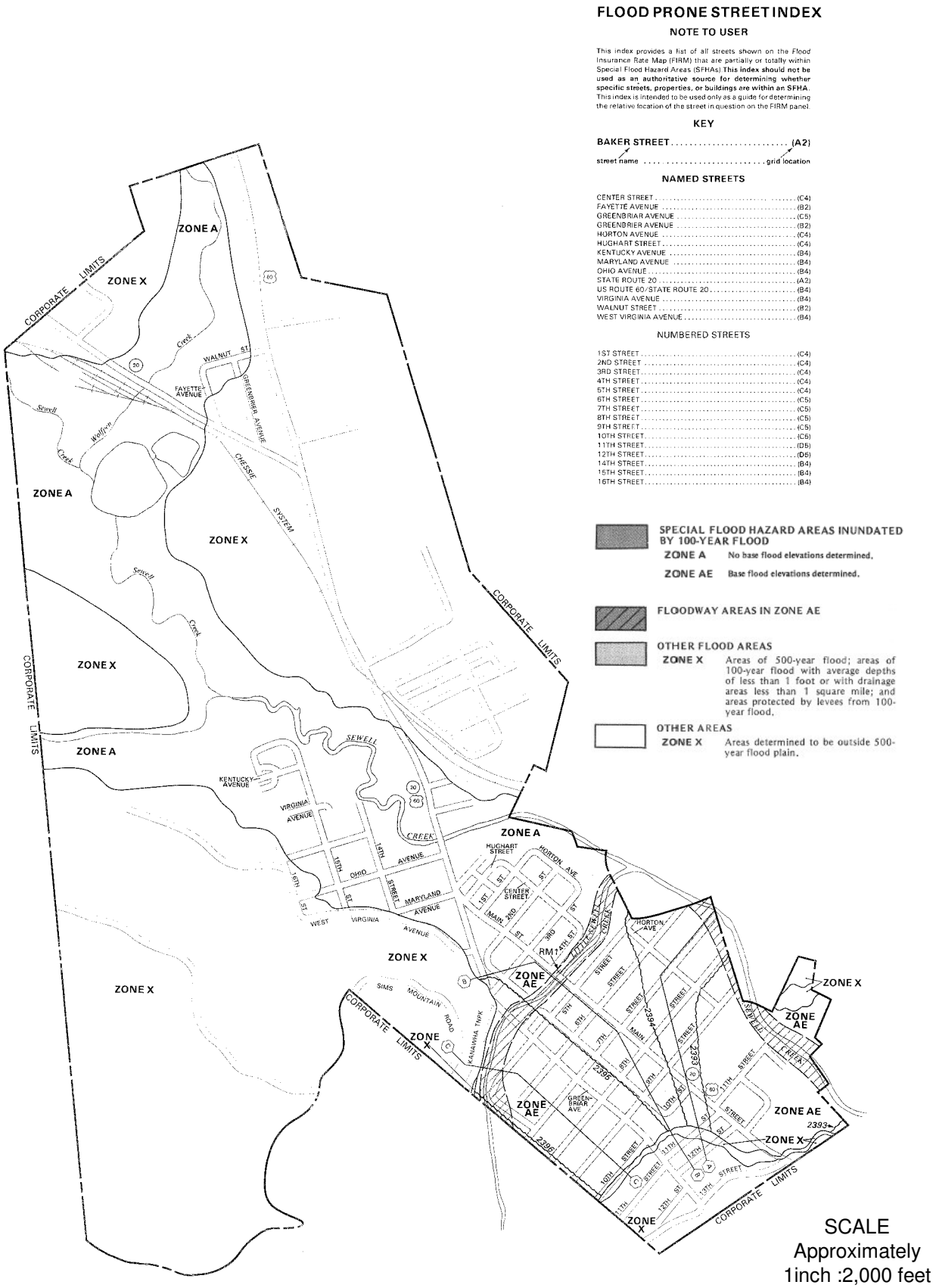


Figure 2.1
Flood Insurance Rate Map (FIRM) of Rainelle

Sources:Federal Emergency Management Agency Community Panel Number 540228 0001 A Effective Date: 19 Nov 1987

Floodplain and Wetland Assessment

Western Greenbrier Co-Production Demonstration Project

2.2 Wetlands

The USACE defines wetlands as "those areas that are inundated or saturated with ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas," as defined in 33 CFR Part 328. Wetlands are important natural resource systems because of the diverse biologic and hydrologic functions they perform. Wetlands provide wildlife habitat, store and release surface waters, and thereby reduce flood damage, retain and bind sediments, and provide ground water discharge or recharge functions. Wetland functions also include water quality improvement, pollution abatement, and nutrient cycling.

Wetlands are protected as a subset of the "waters of the United States" under Section 404 of the Clean Water Act (CWA). The term "waters of the United States" has a broad meaning and incorporates deepwater aquatic habitats and special aquatic habitats, including wetlands. Jurisdictional "waters" of the United States are areas regulated under the CWA and include coastal and inland waters, lakes, rivers, ponds, streams, intermittent streams, and "other" waters that, if degraded or destroyed, could affect interstate commerce.

Wetlands were delineated using the routine methodology outlined in the 1987 USACE Wetlands Delineation Manual. Wetlands typically exhibit three characteristics, which include wetland hydrology, hydrophytic (wetland) vegetation and hydric (wetland) soils. There generally must be a positive indicator of each of these characteristics for a site to be classified as a wetland. Determination of the wetland criteria mentioned above consisted of performing a plant community inventory in which greater than 50 percent of the cumulative cover types (trees, shrubs, vines and herbs) were facultative or wetter, determining the presence of hydric soils, and evaluating the site for evidence of wetland hydrology.

The USFWS Cowardin wetland classification characterizes water resources based upon their position within the landscape. Wetlands satisfying the Cowardin classification are identified as Palustrine and Riverine systems.

The majority of water resources wetlands in EcoPark (north of Sewell Creek) and in the Power plant site facility (E&R site) are characterized as palustrine emergent, scrub-shrub and forested wetlands. Wetlands at the EcoPark are vegetated by persistent and nonpersistent herbaceous plants and woody shrubs. Typical members of the aquatic plant community generally consist of:

- cattail (*Typha latifolia*),
- willow (*Salix* sp.),
- swamp dogwood (*Cornus amomum*),
- sedge (*Carex* sp) and
- sensitive fern (*Onoclea sensibilis*).

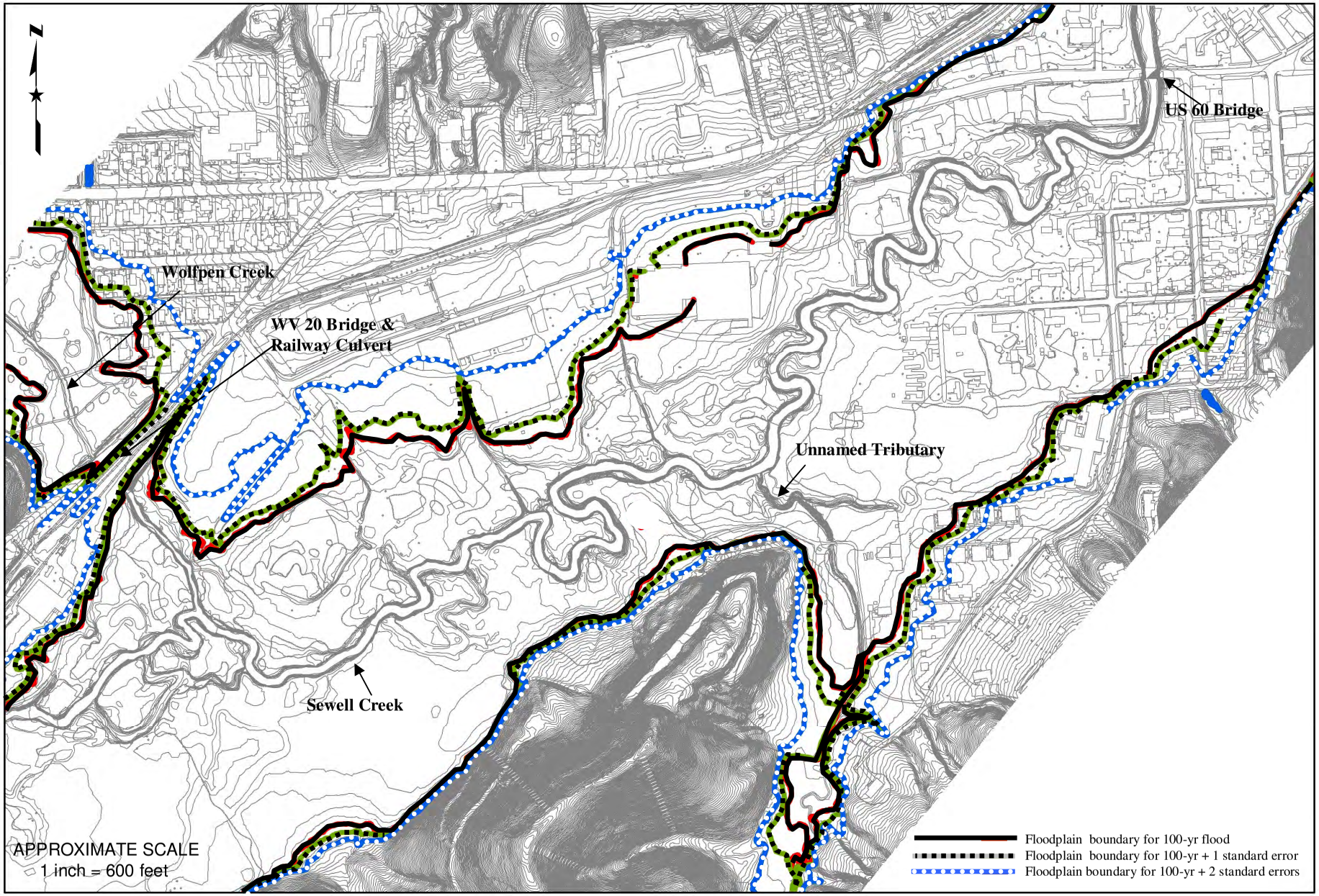


Figure 2.2
Floodplain boundaries for 100-yr, 100-yr + 1SE, and 100-yr + 2SE

Map Source: Potesta, 2004

Floodplain and Wetland Assessment

Western Greenbrier Co-Production Demonstration Project

Wetlands in the western half of the power plant site are emergent and forested. Wetland hydrology in the forested wetlands was characterized by braided drainage channels. The dominant species observed in the wooded wetland are:

- red maple (*Acer rubrum*),
- pin oak (*Quercus palustris*),
- spicebush (*Lindera benzoin*),
- swamp dogwood (*Cornus amomum*),
- cinnamon fern (*Osmunda cinnamomea*),
- jewelweed (*Impatien*s sp.),
- sensitive fern, and
- skunk cabbage (*Symplocarpus foetidus*).

The wooded upland areas are dominated by:

- red maple,
- American beech (*Fagus grandifolia*),
- red oak (*Quercus rubra*),
- hawthorne (*Cretagus* sp.),
- ironwood (*Carpinus caroliniana*),
- Christmas fern (*Polystichum acrostichoides*),
- witch hazel (*Hamamelis virginiana*) and
- Virginia creeper (*Parthenocissus quinquefolia*).

The riverine system includes water resources within a stream channel that is characterized as “an open conduit either naturally or artificially created which periodically or continuously conveys water, or which forms a connecting link between two bodies of standing water" (Cowardin et al. 1979). Upland islands or palustrine wetlands may occur in the channel. Based upon the result of the field investigations, Sewell Creek, Wolfpen and intermittent tributaries meet the definitions of Riverine Systems. Figure 2.3 shows the extent of wetlands in the project area.

3. FLOODPLAIN AND WETLAND IMPACTS

In accordance with 10 CFR Part 1022.12(a)(2), a floodplain and wetland assessment must discuss the positive and negative; direct and indirect; long- and short-term effects of the proposed action on the floodplain and/or wetlands. In addition, the effects on lives and property, and on natural and beneficial values of floodplains, must be evaluated. For actions taken in wetlands, the assessment should evaluate the effects of the proposed action on the survival, quality, and natural and beneficial values of the wetlands. If DOE could find no practicable alternative to constructing in floodplains or wetlands, DOE would design or modify its actions to minimize potential harm to floodplains and wetlands. This section provides a discussion of the potential impacts of the proposed action and alternatives, including impacts that would be associated with each alternative.



Figure 2.3
Jurisdictional Wetlands Boundaries

Source: Potomac-Hudson Engineering

Floodplain and Wetland Assessment

Western Greenbrier Co-Production Demonstration Project

In accordance with 10 CFR Part 1022.13(a)(3), DOE must also consider alternatives to the proposed action that would avoid adverse impacts and incompatible development in the floodplain or wetland, including alternative sites, alternative actions, and no action. Further, DOE must evaluate measures that mitigate the adverse impacts of actions in a floodplain or wetland including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas. Alternative are discussed in this section along with impacts associated with each alternative.

Portions of the proposed site for the Co-Production Facility fall within the 100-year floodplain (Zone A). Flood hazard boundaries have been mapped, but FEMA has not defined floodway boundaries for the project area. Part 65 of the National Flood Insurance Program (NFIP) (44 CFR Part 65, Identification and Mapping of Special Flood Hazard Areas) requires that until a floodway is developed for a mapped stream, substantial development or new construction is not allowed in the floodplain unless it is demonstrated that the cumulative effect of the development will not result in increases in the water surface elevation above the designated height along any segment of the water course. Local communities generally require that project owners submit engineering analyses before permits are approved for development in the floodplain.

Since each of the proposed alternatives includes development within floodplains and wetlands, they would be subject to the NFIP requirements. Both the power island and the ash byproduct facility would be graded so that the base elevations of these sites are above the 100-year floodplain elevation. Therefore, permanent losses of floodplain areas would occur as a result of the Proposed Action and would include a potential loss of flood storage volume. The amount of floodplain lost in terms of square feet is listed in the sections below.

3.1 3.1 No Action Alternative

Under the No Action alternative, DOE would not provide financial assistance for the Co-Production facility. Although WGC could proceed to implement the proposed project in spite of the lack of funding, it is unlikely that this project would be completed successfully without DOE funding support. As a result, no development would occur in floodplains or wetlands and there would be no impact or change in baseline conditions relating to the potential for future flooding.

3.2 Facility Footprint - Alternative A

The Co-Production facility property on the south side of Sewell Creek was selected by the project developer as the preferred alternative, based upon a number of considerations, including the availability of adequate site acreage; limited disturbance of wetlands and floodplains; and concerns about economic, community, and surrounding land uses. Alternative A (see Figure 3.1) would disturb an estimated 16 acres (6.5 hectares) of floodplains. Vegetated water resources (wetlands) potentially disturbed by the Proposed Action total ***0.258*** acres (***1,044*** square meters).

Emergent wetlands, *other waters of the U.S.* (Sewell Creek and an unnamed tributary), forested wetlands and a vegetated ditch would be impacted by the proposed development activities. Cumulatively, the water resources provide sediment stabilization and water quality functions. However, when viewed from a watershed context, the wetlands to be impacted provide relatively low magnitude functions when compared to undisturbed wetlands occurring within the watershed because they have been altered by past human activities. These activities consist of ground disturbance, and stream channel realignments, and therefore possess a lower functional capacity. Potential impacts to wetlands and other waters related to Option A are listed below and summarized by Co-Production Facility component in Table 1.

Leveling of the previously cleared northeastern end of the ridge connected with Sims Mountain could accommodate the facility. The site grade would be raised from the existing base elevation

of approximately 2,400 feet to approximately 2,420 feet above mean sea level, and thereby provide buildable land without extensive encroachment into the 100-year floodplain (Figure 3.1).

To date, WGC has prepared and submitted state and federal wetland encroachment permit applications (401 and 404) associated with unavoidable wetland impacts. The permit applications contain more refined site-specific information related to the proposed facility and transmission corridor, and hence, there are slight acreage differences between what was stated in the Draft EIS and the permit applications. The updated acreages of wetland impacts at the power plant site that are listed in the applications are presented in Table 1 below.

Table 1: Wetland Areas/Waters of the U.S. Affected by Facility Footprint - Option A

Facility Component or Feature	Approximate Area in Acres	Approximate Area in Hectares
Ditch crossing	***0.028***	0.01
Power Plant	***0.13***	***0.05***
Stream Crossing	0.03	0.01
West of permanent bridge	0.01	0.004
Tributary Impact	0.02	0.01
Temporary Road	0.01	0.004
Water Supply Line	0.03	0.01
Total Area	***0.258***	***0.10***

Generally, to comply with NFIP requirements, communities prohibit development in the floodway, which is defined by FEMA as "*…the channel of a river or other water course and the adjacent areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation by more than the designated height*." The designated height set by FEMA is a surcharge value of 1.0 foot (0.30 meters) for the 1 percent annual chance flood (i.e., the 100-year recurrence interval flood). In areas where floodway boundaries have not been established by FEMA, it is incumbent upon the community to ensure that development within the floodplain complies with the NFIP requirements. Although a minimal amount of floodplain area would be affected by the proposed project, none of the siting options identified would result in changes in surface water elevations that would exceed the FEMA designated height of one foot for the 100-year flood event. Wetlands not disturbed by the activities would continue to perform water quality functions such as sediment retention and stabilization, nutrient transformation, and flood flow attenuation. An unnamed intermittent stream is located east and north of the proposed power plant site. A portion of this intermittent stream would be affected by construction of an emergency access road entering the site facility in the southeast quadrant of the project area. Consequently, approximately 100 linear feet of the intermittent stream would be affected by the proposed placement of a culvert. It is expected that the culvert design would allow sufficient water to pass though the culvert without creating significant back water flooding or other adverse environmental impacts.



Figure 3.1 Site Layout – Alternative A

The land bordering the intermittent stream is currently characterized as a mowed grassy upland field. Therefore, the area affected by the Proposed Action provides low magnitude wildlife habitat, flood attenuation and water quality functions. Disturbed areas would be restored to their original grade, where feasible, and planted with native vegetation. Areas not altered by the construction of the access road would continue to serve wildlife habitat and sediment stabilization functions. Best management practices would be implemented to minimize adverse environmental impacts during construction of the road crossing. The intermittent stream (Wolfpen Creek) situated upstream from the power plant would not be affected by the Proposed Action.

Out of a total of 0.258 acres of wetlands, 0.068 acres would be temporary emergent wetland impacts, which would be restored to its pre-disturbance condition once land disturbing activities cease. Two areas mentioned in Table 1 (perennial and intermittent streams) encroach on other "waters of the U.S." One stream impact would span Sewell Creek (perennial), and the second stream impact crosses an un-named tributary (intermittent) to Sewell Creek. The length of streams affected by the project total 40 and 100 linear feet for the perennial and intermittent streams, respectively. The wetlands impacts associated with the proposed water intake structure and transmission corridor (Segment C) are discussed in Sections 3.6 and 3.7 of this assessment, respectively.

3.3 Facility Footprint - Alternative B

This alternative would potentially encroach into significant wetland and floodplain areas. In addition, Alternative B would also involve the encroachment and fill of a meander bend of Sewell Creek (Figure 3.2). In addition to encroachment into waters of the US, a small portion of Sewell Creek would be straightened, which would affect the physical characteristics of Sewell Creek downstream from the project area, and may result in increased stream velocities locally. The project would result in the loss of riparian wetlands and their ability to filter sediments, resulting in a decrease in water quality and wildlife habitat. An estimated 20 acres of floodplains would be affected under this alternative. Alternative B also includes the relocation of the unnamed tributary, which would result in a more substantial change in local hydrology.

The relocation of the intermittent stream east of the power plant site would result in minor temporary impacts to water quality during construction. Small amounts of sediment could be discharged and transported down stream into Sewell Creek, resulting in a short-term increase in turbidity. The riparian zone of the intermittent stream would temporary loose its ability to retain and stabilize sediments, and its ability to export detritus would be temporarily compromised. Impacts to the intermittent stream and Sewell Creek could be further minimized by constructing the stream realignment during the dry season. Best management practices would be implemented during the construction, and the disturbed areas would be restored to its original grade, were feasible, and planted with native vegetation common to the region of influence. Wolfpen Creek would not be adversely affected by the Proposed Action.

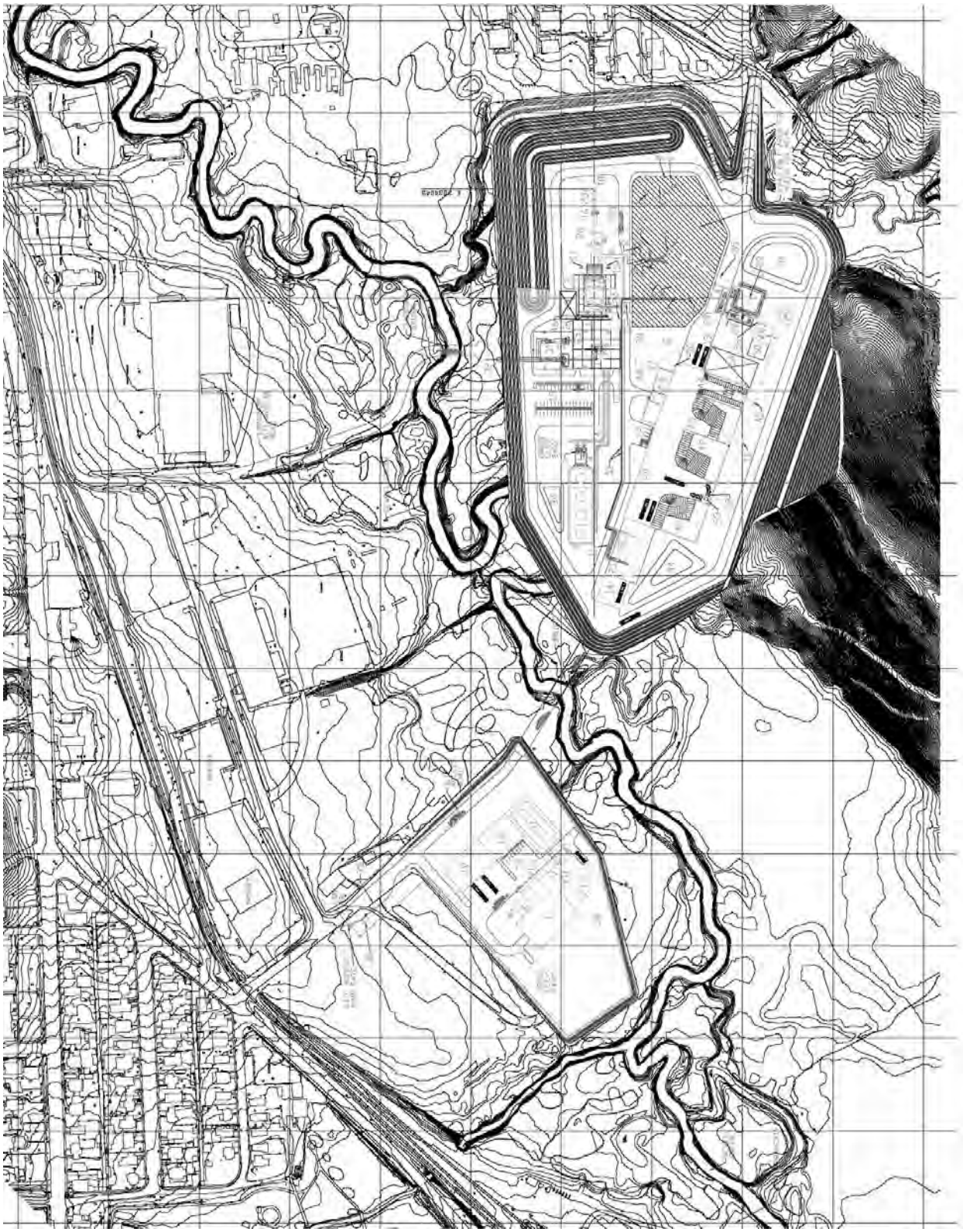


Figure 3.2 Site Layout – Alternative B

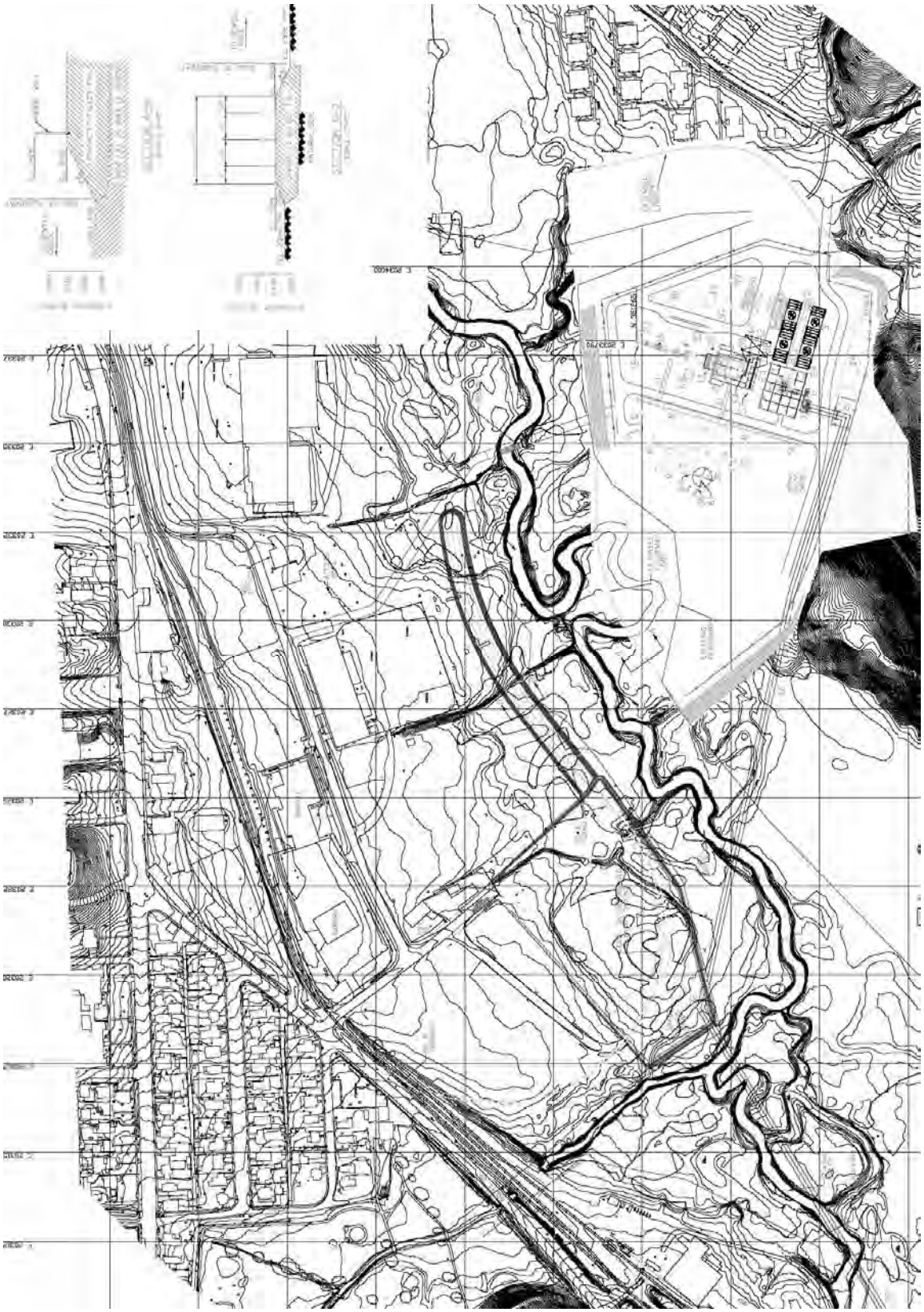


Figure 3.3 Site Layout – Alternative C

3.4 Facility Footprint - Alternative C

This alternative includes providing rail access to the site and to the coal refuse sites, but would not be economically feasible. The cost associated with infrastructure upgrades, including rail spurs at the site and coal refuse piles, and upgrade requirements for unused sections of the rail line, was a key consideration when evaluating the rail option. The ability of the site layout to accommodate a rail line was also a key factor, as were the material handling requirements at both the plant and coal refuse sites. In addition to increased costs, 18 acres of floodplain and wetlands would be affected under this alternative (Figure 3.3).

Like Alternative A, the unnamed intermittent stream east of the proposed power plant site would be affected by construction of an emergency access road entering the site facility in the southeast quadrant of the project area. Approximately 100 linear feet of intermittent streambed would be affected by the placement of the culvert. It is expected that the culvert design would allow sufficient water to pass though the culvert without creating significant back water flooding or other adverse environmental impacts. The land bordering the intermittent stream is currently characterized as a mowed grassy upland field and provides low magnitude wildlife habitat, flood attenuation and water quality functions. Potentially disturbed areas would be restored to their original grade, where feasible, and planted with native vegetation. Best management practices would be implemented to minimize adverse environmental during construction of the road crossing. The intermittent stream (Wolfpen Creek) situated upstream from the power plant would not be adversely affected by the Proposed Action.

3.5 Temporary Bridge

A temporary bridge would be constructed for access to the E&R Property during construction and would remain in place until the permanent DOH bridge is operational. The temporary bridge would be located upstream of the confluence of Sewell Creek and the unnamed tributary. Temporary changes in local hydrology around the temporary bridge site could occur while the bridge is in place. However, these changes would be limited to backwater effects caused by the bridge during storm events that could cause Sewell Creek over flow its banks. In such instances, backwater to the height of the temporary bridge top could occur, at which point surcharges would flow over the bridge. Areas that could potentially be affected by this backwater are limited to lower, undeveloped areas in the EcoPark and on the E&R Property that are immediately upstream of the temporary bridge. These impacts would be considered minor because the temporary bridge would be close to the existing site grade and would be overtopped during flood events. Wolfpen Creek would not be adversely affected by the Proposed Action.

3.6 Cooling Water Intake Structure

For the power plant processes, WGC is proposing to use up to 100 percent of the RSTP effluent and to supplement remaining water requirements with the Meadow River and/or local wells, as explained in Section 4.4.3.3 of the EIS (Volume 1). Under Option B a permanent structure, including a cooling water intake structure (CWIS), pump house, and pipeline, would be used to withdraw water from the river. Based on conceptual designs, the CWIS would be located in areas bordering the Meadow River and a well head bordering Sewell Creek. From the CWIS, the water pipeline would generally traverse in a southwestern direction and cross Sewell Creek beneath an existing railroad track. From the railroad track, the pipeline would continue along Sewell Creek and connect to a well near the RSTP. The locations of the ancillary components associated with the intake structure (i.e., pipeline and maintenance road) have not yet been finalized; however, WGC is currently looking at the best locations for these facilities to minimize disturbance of wetlands and floodplains.

Prior to construction of a permanent intake structure WGC would be required to obtain Section 404 and 401 permits under the CWA, both issued by the USACE and West Virginia Department of Environmental Protection (WVDEP), respectively. The Water Quality 401 Certification would be required to ensure that the project would not violate the state's water quality standards or stream designated uses. The Section 404 Authorization permit would be required as a result of water resources impacts, including wetlands impacts.

Depending upon the final design, additional wetlands and "waters of the U.S." could be impacted (approximately up to 1 acre [0.4 hectare] and 120 linear feet [40 meters], respectively). The current conceptual design for the intake structure would be approximately 16 feet wide and 56 feet long. Based on the conceptual plan and field studies of the proposed location, the intake structure could impact approximately 60 linear feet of the Meadow River. The floodplain channel bank would taper landward for an approximate distance of 22 feet. Design modifications of the intake structure are ongoing and would likely change toward a smaller footprint than the current conceptual plan.

Field studies indicate that the upgrade and extension of an existing road (that would provide maintenance access to the intake structure) would not impact any wetlands. The proposed access road, approximately 15 feet wide, would cross over railroad tracks and enter a vacant field. From this point, the proposed access road would travel northwest and pass through a young forest using an abandoned road leading to the intake structure. The last 200 to 300 feet of the proposed access road would require the removal of mid-sucessional trees, and thus, may result in habitat fragmentation.

The location of the intake structure and access road would be verified during the wetland permitting phase. WGC is in the process of consulting with the USACE for the wetland permitting process to identify wetland impacts and methods for avoiding and minimizing impacts and developing suitable forms of wetland mitigation. See Section 4.3 of this asssessment for an updated discussion on the current status of the permit applications and wetlands mitigation plans for the overall project.

3.7 Transmission Corridor

The options for power transmission from the proposed WGC power plant to the Grassy Falls substation, as described in Chapter 2 of Volume 1, share common corridors identified as Segments A and B. Segment C would involve approximately 18 miles of new transmission corridor right-of-way (ROW). As planning decisions by WGC evolved relating to the power line transmission corridor, several surveys and studies were conducted.

The option of constructing a new power transmission line would require a 100-foot wide linear corridor to be created from the project area in Rainelle to an existing substation at Grassy Falls. This action would require the clearing of a 100-foot-wide swath, as needed, along the entire approximately 18-mile route, which would result in a loss of vegetation and wildlife habitat. Several former strip mines and areas of former commercial logging are located along the proposed route. In addition, approximately 60 percent of the land within Segment C is currently managed by or belongs to timber companies. It is assumed that areas owned by the timber companies contain marketable timber, which would be harvested and sold prior to construction of the proposed transmission line corridor.

The construction activities would be regulated under a CWA Section 404 permit and, at a minimum, the BMPs specified in the permits would be implemented.

Several wetland areas were identified within Segments B and C of the proposed corridor. Along segment B, there are eight potential wetland areas comprising approximately 2.3 acres (0.9 hectares). To date, estimates for the acreages for wetlands impacted within the

transmission line corridor for Segment C total 3.074 acres, of which 0.786 acres are open water, 1.479 acres are emergent, 0.4 acres are scrub-shrub, and 0.379 acres are forested wetlands. Most of the wetlands impacts would be temporary and the areas would be restored to their pre-existing conditions when construction activities have ceased. Impacts to forested wetlands would result in a permanent habitat conversion and a change in wetland functions would occur. Over time the restored wetlands would develop a similar or greater functional capacity compared to the pre-disturbance condition. Operational wetland impacts in the transmission corridor would consist of maintaining vegetated areas as a scrub-shrub cover type, which would prevent wooded areas from transitioning into a forested cover type.

3.8 Coal Refuse Sites

WGC has entered into a Memorandum of Understanding (MOU) with WVDEP which states that in return for using coal refuse at Anjean, WGC would use the proposed facility's waste ash in reclamation processes and be responsible for remediation and reclamation plans as approved by WVDEP. The use and reclamation of the Joe Knob, Green Valley and Donegan coal refuse would be subject to the same conditions as stated in the Anjean MOU with WVDEP. Anjean Mountain has not yet been reclaimed and acid mine drainage (AMD) problems continue to exist at Anjean and the coal refuse piles at Joe Knob, Green Valley, and Donegan. The use of alkaline ash, as described in Chapter 2 of the EIS and as stated in the MOU, is anticipated to reduce the acidity in soils and improve the water quality of the runoff.

Generally, because of AMD, the existing vegetation at the coal refuse sites can be described as a pioneer community tolerant of a low pH and as having low water quality functions. One small isolated emergent wetland was identified at the Anjean site; however, because the site was created to deposit coal fines, it is unlikely that the wetland would be considered a jurisdictional water resource subject to regulation by the USACE.

Extraction of coal refuse from Joe Knob, Green Valley, and Donegan is not expected to occur within the next five years. Because USACE-verified wetland boundary determinations are valid for a five-year period and wetland boundary conditions can change over time, extensive investigations for wetlands at the remaining coal refuse sites were not conducted for this EIS. However, prior to any disturbance activities at these sites, WGC would conduct a wetland investigation and identify potential wetlands that could be affected by the anticipated disturbance.

4. MITIGATION MEASURES

In accordance with 10 CFR Part 1022.12(a)(3), DOE must address measures to mitigate the adverse impacts of actions in a floodplain or wetlands, including but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas. Whenever possible, DOE would avoid disturbing floodplains and wetlands and would minimize impacts to the extent practicable, if avoidance was not possible. This section discusses the floodplain and wetland mitigation measures considered in the vicinity of the proposed power plant site and, where necessary and feasible, implemented during construction, operation, and maintenance of the facility. In general, impacts to floodplains and wetlands would be minimized through the implementation of engineering design standards and best management practices.

The majority of wetland impacts at the site would occur during construction and development. Once the facilities begin operation, few additional impacts would occur. The bridge over Sewell Creek and all culverts would be inspected routinely and maintained to avoid potential future impacts on water resources.

All storm water at the plant site would be collected and transported to an onsite retention basin for reuse by the facility as process water. Storm water would be discharged to Sewell Creek only when the capacity of the detention basin would be exceeded (see Section 4.4, Surface Water Resources). The loss of natural runoff from the project area to the wetlands along Sewell Creek is not anticipated to have a significant impact.

4.1 Engineering Design Standards

Adverse impacts to the affected floodplains would be minor. Even during 100-year or greater flood event, it is unlikely that differences in the rate and distribution of erosion and sedimentation caused by construction of a power plant would be measurably different compared to existing conditions. However, DOE would still minimize disturbance of surface areas and vegetation and would maintain natural contours to the maximum extent feasible. DOE would stabilize slopes to minimize erosion and would avoid unnecessary off-road vehicle travel.

Although floodplain areas would be filled, based on the predictive modeling that was conducted using HEC-RAS, none of the siting options would result in changes in surface water elevations that would exceed the FEMA designated height of 1 foot (0.3 meters) for the 100-year event.

4.2 Best Management Practices

A National Pollutant Discharge Elimination System General Construction Permit would be required for construction activities. In accordance with this permit, construction contractors would be required to prepare and submit a Storm Water Pollution Prevention Plan. The Storm Water Pollution Prevention Plan would be consistent with State of West Virginia and federal construction activity standards, and would detail the best management practices to minimize soil loss and degradation to nearby water resources. Table G-6 lists many of the categories of best management practices that would be considered for the construction and operation of the proposed power plant.

Table 4.1. Best Management Practices (BMPs) (page 1 of 2).

Management Practice	Description
Road and Construction Site Practices	
Development Site Plan	A site plan identifies the physical features of the site, the location of proposed development, and the location of temporary and/or permanent BMPs. By utilizing a development site plan the proposed development can be situated to minimize impact to natural resources and the land, and to enable water quality protection measures and runoff conveyance measures to be properly located.
Grading Seasons and Practices	The grading season is determined by the local climate conditions. All grading, clearing, and excavation work should be conducted during this period to avoid climatic conditions that could increase the chances for erosion. Grading and construction activities should be coordinated such that bare and disturbed soil exposure is minimized during the winter snow and rainy seasons.
Erosion and Sediment Controls	
Erosion & Sediment Control Structures	Properly designed, installed, and maintained, erosion and sediment control structures will effectively reduce the transport of sediments, minimize erosion and the degradation of water resources and reduce negative impacts to natural resources (i.e., vegetation, wildlife).
Runoff Interceptor Trench or Swale	Properly designed, installed, and maintained, a runoff interceptor trench or swale will effectively convey surface runoff, minimize soil erosion resulting from surface runoff and reduce the degradation of receiving water resources.
Siltation or Filter Berms	Siltation or filter berms capture and retain runoff from construction sites and allow sediments to settle out, and direct runoff water through filter berms at outlets to stabilized drainage ways.
Filter or Silt Fence	Filter or silt fences are constructed to intercept and capture sediment by decreasing the velocity of surface runoff.
Sediment Basins	Sediment basins are effective in reducing water pollution by to trapping sediment originating from construction sites by providing basins for deposition and storage of silt, sand, gravel, stone, and other debris.

Table 4.1. Best Management Practices (BMPs) (page 2 of 2).

Management Practice	Description
Slope Stabilization Practices	
Slope Shaping	Slope shaping is comprised of designing and modifying cut or fill slopes to reduce the soil erosion and runoff potential. Activities include pre-disturbance planning and design, terraces, benches, serrations, and steps.
Retaining Structures	Retaining structures are walls comprised of wood, rock, concrete or other material, constructed at the toe of a slope in order to protect the slope face or toe from scour and erosion from storm runoff.
Rock Riprap	Rock riprap is a layer of loose rock placed over an erodible soil or surface disturbance in order to protect the soil surface, to provide for slope stabilization on steep slopes, and to reduce soil erosion within a project area.
Watershed Management	
Stream Protection & Stabilization	Stabilization of stream channels and stream banks is an effective treatment to reduce sediment loading, and control erosion and land damage.
Floodwater Retarding Structure	Floodwater retarding structures are installed to reduce flood damages downstream by controlling the release rate from flood flows of predetermined frequencies.
Floodwater Diversion	Floodwater diversions will protect the land, surface Improvements, and the watershed by reducing erosion and sediment delivery to receiving waters.
Urban Resource Management	
Street Runoff Collection	Street runoff collection prevents erosion of roadside shoulders and adjacent roadway slopes from surface runoff.
Storm Drainage Structures	Storm drainage structures include pipes, channels, drop inlets, slotted drains, grease and oil traps, or other facilities used to collect and/or convey surface runoff. Their effectiveness depends on keeping them free from debris or filled with sediment.
Landscaping	Proper landscaping can stabilize disturbed sites in a manner that controls surface drainage and soil erosion.

Best management practices are structural and nonstructural controls used to manage nonpoint source pollution such as sedimentation and storm-water runoff. Structural controls are best management practices that need to be constructed (e.g., detention or retention basins). Non-structural controls refer to best management practices that typically do not require construction, such as planning, education, revegetation, or other similar measures. Sedimentation and storm-water runoff are typically addressed through the use of temporary and permanent best management practices. These include techniques such as grading that would induce positive drainage, and installation of silt fences and revegetation to minimize or prevent soil exposed during construction from becoming sediment to be carried offsite. Best management practices would be implemented, inspected, and maintained to minimize potential for adverse affects to downstream water quality. Therefore, impacts from erosion and sediment runoff associated with construction efforts to be minor.

During large flood events, when water is held on the upstream side of the structure, it is possible that sediment could accumulate on the upstream side of the crossings. Areas upstream of water crossings would be maintained free of alluvial material so that the flood storage volume of the stream would have the capacity to accommodate floods, and avoid overflow during flood events. Sediment removed from these areas would be removed by truck and disposed of appropriately or, depending on the location of the drainage channel, simply moved out of the drainage channel and left on-site. Under normal conditions alluvial sediments would be conveyed downstream and been deposited where floodwaters disperse. Compared to the total amount of sediment that is moved by floodwaters along a stream reach, the amount deposited behind a crossing would be minor. In addition, sediments deposited during the cycle of seasonal flooding provides nutrient to vegetation and habitat for vertebrate and invertebrate wildlife.

Storage of hazardous materials during the construction and operations periods would be in accordance with normal environmental regulatory requirements (e.g., within secondary containment) and best management practices. As practicable, hazardous materials would be stored outside of floodplains. Hazardous materials that would be most susceptible to accidental spills and releases would be the fuels and other petroleum products that would be required to support power and equipment needs for the construction and operation of the proposed rail line.

4.3 Regulatory Mitigation

Wetlands adjacent to jurisdictional waters are also considered jurisdictional waters and would require mitigation for their loss. The required mitigation would be determined by the appropriate state and federal agencies. This might involve construction of replacement wetlands, or the acquisition and placement of existing wetlands in a perpetual conservation easement. The ratios of impacted wetlands to wetlands placed in a conservation easement would also be determined by the state and federal regulatory agencies.

To date, WGC has submitted a revised permit application to the WVDEP and the USACE. Initially, WGC had submitted wetland encroachment permit applications for commercial and institutional development (Nationwide General Permit 39) and a utilities line (Nationwide General Permit 12) permit for the project. However, the cumulative wetland impact exceeded 0.5 acres, which necessitated WGC's submission of an Individual Permit (IP) application. Both the state (401) and federal (404) wetland permit applications discuss temporary and permanent wetland impacts, BMPs and include a compensatory conceptual wetland mitigation plan for impacted wetlands. The conceptual wetland replacement design would be finalized once WVDEP approves the plan.

The WVDEP's wetland replacement criteria indicate that: forest wetlands impacts must be mitigated at a 3:1 replacement ratio; scrub-shrub-wetlands must be mitigated at a 1.5:1 replacement ratio and emergent wetlands must be mitigated at a 1:1 replacement ratio. Therefore, the wetland mitigation for the power plant site would require a total 0.448 acres of replacement wetlands. WGC proposed a 1:1 replacement ratio for wetlands disturbed by the transmission line corridor because there would be no net loss of wetlands; however, WVDEP is requesting a 3:1 replacement ratio because forested wetlands would be impacted and functions would be altered.

The USACE has decided to evaluate the WVDEP's response regarding the compensatory wetland replacement design before it would issue a jurisdictional determination on wetlands delineated by WGC. Therefore, at this time it is unclear how either government agency would respond to the revised wetland mitigation. Identifying wetland impacts and determining an

appropriate form of wetland mitigation is an ongoing process with frequently changing results. Therefore, WGC would be required to continue consultation with the USACE and identify methods for minimizing wetland impacts and establishing a suitable form of wetland mitigation during the permitting phase.

4.4 Storm Water Discharge

Sediment is the primary pollutant generated at construction sites. Runoff from construction and industrial activities has the potential to generate large quantities of sediment and other contaminants if not properly addressed. In response to this common cause of water-quality impairment, the Environmental Protection Agency promulgated regulations requiring the permitting of storm-water-generated pollution under the National Pollutant Discharge Elimination System (Section 402 of the Clean Water Act [CWA]). The West Virginia Department of Environmental Protection has been delegated the authority to administer these federal regulations and has adopted state regulations to administer a National Pollutant Discharge Elimination System Stormwater program. A National Pollutant Discharge Elimination System General Construction Permit would be required for construction activities associated with the Proposed Action or Shared-Use Alternative. In accordance with the National Pollutant Discharge Elimination System, DOE must do the following:

- Prepare a Storm Water Pollution Prevent Plan or plans to address construction of the proposed power plant, including (but not limited to) gob pile sites, transmission corridors, and pipelines.
- Obtain storm water National Pollutant Discharge Elimination System permit(s).
- As part of the National Pollutant Discharge Elimination System permit application, identify proposed measures, including best management practices, to control pollutants in storm-water discharges during and after construction, such as diversion, detention, erosion control, sediment traps, gravel construction entrances, covered storage, spill response, and good housekeeping.

WGC intends to reuse virtually all of the storm water runoff collected onsite. Storm water would be discharged to Sewell Creek only when the capacity of the retention basin would be exceeded. Because the majority of the runoff volume from the proposed plant site would be collected, treated, and reused, the amount and quality of the runoff as a result of the project would not significantly impact the aquatic ecosystem of Wolfpen and Sewell Creek (see Section 4.4.3).

5. REFERENCES

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APPENDIX N

Waste Coal Access Agreement and Memorandum of Understanding for the Anjean Coal Refuse Pile*

**** The content of Appendix N has been changed for the Final EIS. The Conflict of Interest Disclosure Statement that was Appendix N in the Draft EIS has been moved to the end of Chapter 7 (List of Preparers) in Volume 1 of the Final EIS.***

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PROSPECTIVE PURCHASER AGREEMENT
and
WASTE COAL ACCESS AGREEMENT

This Prospective Purchaser Agreement and Waste Coal Access Agreement ("Agreement"), entered into this 12 day of August, 2004, by and between **WESTERN GREENBRIER CO-GENERATION, LLC**, a West Virginia limited liability company ("WGC") and **WESTERN GREENBRIER BUSINESS DEVELOPMENT CORPORATION**, a West Virginia corporation ("BDC"), and the **WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION**, an agency of the State of West Virginia ("DEP," and together with WGC and BDC, the "Parties").

WHEREAS, WGC desires to develop, construct and operate a co-production demonstration project (the "Project"), to demonstrate the feasibility of burning waste coal through use of the inverted-cyclone CFB process and the ability to both create useful ash byproducts and to remediate existing environmental waste coal hazards in the process; and

WHEREAS, it is estimated that more than 4 million tons of waste coal are located upon a certain tract of approximately four hundred (400) acres of real property located on South Fork of Big Clear Creek near Anjean, Greenbrier County, West Virginia—an area previously permitted by Royal Scot Minerals, Inc. pursuant to the West Virginia Surface Coal Mining and Reclamation Act (the "Property"); and

WHEREAS, at a June 19, 2003 bankruptcy court hearing, BDC was the successful bidder to purchase the Property from the bankruptcy estate of Royal Scot Minerals, Inc. (the "BDC Bid"); and

WHEREAS, the BDC Bid provides that as a condition to closing on the purchase of the Property ("Closing"), BDC, WGC, and DEP shall enter into a Prospective Purchaser Agreement ("PPA") to insulate BDC against certain environmental liabilities incident to its purchase and ownership of the Property; and

WHEREAS, BDC, in furtherance of its goal to stimulate economic development in Western Greenbrier County and mindful of the need to protect itself against environmental liabilities associated with the ownership of the Property, desires (i) to execute a PPA with DEP; (ii) to acquire the Property; (iii) to allow WGC to access and remove the waste coal on the Property for use in the Project at no cost; and

WHEREAS, WGC, in furtherance of its desire to provide the United States Department of Energy with documentary evidence of its right to access the waste coal on the Property and mindful of the need to protect itself against certain environmental liabilities associated with its removal of waste coal from the Property, desires (i) to execute a PPA with DEP and BDC; and (ii) to negotiate toward the execution of a no-cost reclamation contract with DEP and to undertake reclamation efforts thereunder, all pursuant to that Memorandum of Understanding

between WGC and DEP dated as of March 2, 2004 ("MOU") and incorporated by reference herein; and

WHEREAS, DEP, to induce WGC to commit to undertake the reclamation efforts identified in the MOU and thereby to secure for the benefit of the State of West Virginia the substantial benefits associated therewith, desires to execute this Agreement.

NOW, THEREFORE, in recognition of the consideration set forth above and other good and valuable consideration, the sufficiency of all of which is hereby acknowledged, the Parties agree as follows:

1. Nothing in this Agreement or the MOU shall be construed to require DEP to issue an air pollution permit to WGC or any other entity.

2. BDC will acquire the Property under separate arrangements with WGC.

3. Before removing coal refuse from the Property, WGC must submit to and receive approval from DEP of a Reclamation Plan and Contract for the Property. In accordance with W.Va. Code § 22-3-28(d), WCG must also submit to DEP a performance bond, acceptable to DEP, that will ensure WGC's faithful performance of the Reclamation Plan and Contract. The Reclamation Plan and Contract shall detail the manner in which WGC will remove coal refuse from the Property and shall detail the manner in which WGC will reclaim the Property areas, including the coal refuse areas, WGC disturbs.

4. The Property is currently producing pollutional discharges that without treatment would cause water pollution and violations of the West Virginia Water Pollution Control Act. In addition, the property currently features the presence of Hazardous and Solid Waste. For so long as BDC and WGC are developing, permitting and financing the Project and properly carrying out the terms of the Reclamation Plan and Contract, DEP will:

a. Agree not to enforce as against BDC or WGC the provisions of (i) the West Virginia Water Pollution Control Act, W. Va. Code §22-11-1, et seq. ("WPCA"), as it relates to the condition of the Property prior to Closing; and (ii) the West Virginia Hazardous Waste Management Act, W. Va. Code §22-18-1, et seq. ("HWMA"), as it relates to the condition of the Property prior to Closing, including the potential existence of hazardous waste that may be buried on site and thus not identified as of the Closing. Notwithstanding the preceding, WGC shall be responsible for: (1) compliance with all environmental laws to the extent WGC's activities create or contribute to new violations of law that are unrelated to the pre-Closing condition of the Property, (2) compliance with all environmental laws to the extent WGC's activities contribute to violations of law occurring on the Property as a result of the pre-Closing condition of the Property.

b. Intervene or otherwise participate in any third party proceeding in which it is alleged that BDC, its successors in ownership of the Property, or WGC are liable under the WPCA or the HWMA for the conditions identified in subsection (a) of this Section, for the purpose of upholding the letter and intent of this Agreement and the MOU.

5. As for the Hazardous and Solid Waste presently on the Property that DEP has identified in various internally generated reports ("Identified Waste"), DEP will arrange and, if necessary, pay for the removal and disposal of all Identified Waste on the Property at the time of Closing. As part of this effort, DEP may require parties other than BDC or WGC to cleanup such Identified Waste. BDC and WGC shall have no obligation to remove and dispose of, and no liability associated with the existence, removal, or disposal of, the Identified Waste that exists on the Property at the time of Closing. If DEP does not choose to or cannot require parties other than BDC and WGC to remove the Identified Waste, DEP's Office of Special Reclamation will itself remove from the Property the Identified Waste.

6.

a. WVDEP's Office of Special Reclamation is currently treating pollutional discharges, including blackwater discharges[1], which are coming from the coal refuse piles on the Property. Up until the time that WGC begins removing coal refuse, WVDEP will continue to treat all pollutional discharges, including blackwater discharges, which emanate from the coal refuse piles on the Property. After WGC begins removing coal refuse, WVDEP will: (1) Not be responsible for treating blackwater discharges which come from the Property, (2) Not be responsible for treating pollutional discharges coming from areas of the Property other than the coal refuse piles, and (3) Treat all pollutional discharges, excluding blackwater discharges, coming from the coal refuse piles on the Property.

b. After it begins its operations on the Property, WGC shall: (1) Assume responsibility for, prevent and eliminate to the extent possible, and treat all non-coal refuse area pollutional discharges it causes and/or contributes to, (2) Undertake reclamation efforts on the Property in accordance with the terms of the MOU and the Reclamation Plan and Contract.

c. When it begins removing coal refuse, WGC shall additionally assume responsibility for, prevent and eliminate to the extent possible, and treat all blackwater discharges that come from the coal refuse areas of the Property. Nothing within this subsection shall be construed to limit the limitation on liability that WGC shall enjoy as a result of Paragraph 4a of this Agreement.

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1 A "blackwater discharge" is a discharge of coal or coal refuse particular that, without treatment, would cause a violation of narrative water quality criteria under the WPCA.

d. The parties understand that, after the entry of this Agreement, the DEP may permit one or more entities to conduct coal mining and coal mining related operations on the Property. This Agreement shall in no way eliminate any duty that such entity(ies) may have to prevent, eliminate, and treat pollutional discharges that such entity(ies) may cause or contribute to.

e. Notwithstanding any of the preceding sections, WGC shall not be held accountable by WVDEP for pollutional, including blackwater, discharges that occur in a water of the State solely as a result of a major storm event (i.e. a 100 year storm event).

f. The Parties understand that DEP may terminate the Reclamation Plan and Contract, this Agreement, the MOU, and WGC's work on the Property if WGC violates the Reclamation Plan and Contract, or environmental laws that DEP may by the terms of this Prospective Purchaser Agreement enforce against WGC, in a negligent, grossly negligent, or more legally egregious manner.

7. Upon Closing, BDC will grant WGC and, to the extent necessary and contemplated by the MOU, DEP: (i) free and full access to the Property and all waste coal located thereon for the purpose of making investigations, inspections, appraisals, surveys (including but not limited to, the cutting of survey lines and putting up markers and driving stubs and stakes), site analyses, engineering studies, core sampling for engineering reports, sampling and analysis of coal, coal fines, and waste coal and the locating of existing rights of way, easements and utilities; (ii) exclusive rights to remove all the waste coal from the Property for use in the Project at no cost, to return alkaline material to the Property, and otherwise to undertake reclamation efforts on the Property in accordance with the terms of the MOU and the Reclamation Plan and Contract.

8. The Parties represent and warrant that each is duly authorized to execute this Agreement and that the Agreement is enforceable according to its terms.

(signature page follows)

Dated as of the date set forth above.

WESTERN GREENBRIER CO-GENERATION, LLC

By: _____
Wayne D. Brown

Its: Co-Manager

WESTERN GREENBRIER BUSINESS DEVELOPMENT CORPORATION

By: _____
Ralph D. Williams

Its: President

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

By: _____
Allyn Turner

Its: Director, Division of Water and Waste Management

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

By: _____
Ken Ellison

Its: Director, Division of Land Restoration

MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding entered into this 2nd day of March, 2004, by and between the **WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION** (the "DEP") and **WESTERN GREENBRIER CO-GENERATION, LLC**, a West Virginia limited liability company ("WGC").

WHEREAS, WGC proposes to construct and operate a clean-coal, co-production demonstration project in Rainelle, West Virginia (the "Project"), utilizing waste coal from various refuse sites in the Project vicinity ("Waste Coal") as a primary fuel component; and

WHEREAS, there are numerous Waste Coal refuse sites in West Virginia, many of which constitute present or future environmental hazards and some of which are or will be the DEP's responsibility to remediate pursuant to applicable laws (collectively, "Waste Coal Sites"); and

WHEREAS, DEP has identified some post-1977 Waste Coal Sites for which the applicable reclamation bonds have been forfeited and for which DEP has the statutory responsibility to remediate with funds from the Special Reclamation Fund ("Forfeited Sites"), including in particular the Royal Scot waste coal site near Anjean, West Virginia (the "Anjean Site"); and

WHEREAS, incident to DEP's statutory obligations and pursuant to its authority to reclaim the Anjean Site and other Forfeited Sites, DEP may hire contractors to develop reclamation plans, hire contractors to assist in implementation of reclamation plans, take possession of and remove Waste Coal from Forfeited Sites, and otherwise exercise control over Forfeited Sites during its reclamation operations; and

WHEREAS, DEP is concerned about the financial impact that reclaiming the Forfeited Sites, including the Anjean Site, may have on the Special Reclamation Fund, and is also concerned with the ongoing adverse impact of the Forfeited Sites on the environment; and

WHEREAS, incident to the operation of the Project, WGC proposes to remove Waste Coal from the Anjean Site for use as a fuel source for the Project and to return alkaline material to the Anjean Site for use in the reclamation processes at that site, all by serving as a no-cost reclamation contractor for, and under the supervision and direction of, DEP (collectively, and described in more detail herein, the "WGC Proposal"); and

WHEREAS, in order to meet certain funding-related Project milestones, WGC seeks to demonstrate to United States Department of Energy that DEP is generally willing to cooperate with WGC to provide WGC with access to Waste Coal from the Anjean Site incident to DEP's statutory reclamation efforts as set forth in the WGC Proposal, and DEP is willing to demonstrate its general willingness to do so in this Memorandum of Understanding.

NOW, THEREFORE, the parties hereto hereby set forth their mutual understandings and intentions in respect of the WGC Proposal as follows:

1. DEP agrees in principal with the WGC Proposal as described herein and will cooperate with WGC to implement the WGC Proposal at the Anjean Site. WGC understands that DEP's agreement and cooperation do not absolve WGC of its responsibility to obtain permits required of it by the DEP that may be necessary for WGC to operate certain facilities in Greenbrier County, such as WGC's proposed co-generation power plant operations. WGC recognizes that this MOU does not serve as DEP's approval or endorsement of those permits, including applicable air pollution permits.

2. WGC will (A) pay for the development of a remediation plan for the Anjean Site ("Remediation Plan"); (B) secure DEP approval of the Remediation Plan; (C) give the Remediation Plan to DEP for it to own, administer and implement; and (D) serve as a no-cost contractor to implement portions of the Remediation Plan at DEP's direction and under DEP supervision pursuant to a no-cost reclamation contract with one or more phases ("Reclamation Contract").

3. The WGC Proposal has the following essential elements with respect to the Anjean Site:

(A) pursuant to the Reclamation Contract, WGC will gradually remove waste coal from the Anjean Site in a series of consecutive phases;

(B) as required by DEP, WGC will provide a performance bond for each phase of the work;

(C) as long as the waste coal does not qualify as "coal" under ASTM standards, WGC will not be required to obtain a West Virginia Surface Coal Mining Act permit for its removal of waste coal from the Anjean site;

(D) WGC will return as much alkaline material to the Anjean Site as DEP may determine is needed to reclaim the Anjean Site in accordance with the Reclamation Contract;

(E) As part of its Reclamation Contract for the Anjean site, WGC will mix the alkaline material with the unused waste material to neutralize it, removing the potential for acid mine drainage at the Anjean Site, thereby

gradually reducing the amount of effort and cost needed to treat the ponds at the Anjean Site; and

(F) by the conclusion of this process, the entire Anjean Site permitted site will be reclaimed in accordance with initial or modified revoked Royal Scot Minerals surface coal mining permit. DEP will be responsible for reclaiming the parts of the permit not disturbed by WGC. In addition, DEP will be responsible for treating pollutional discharges associated with acid mine drainage emanating from all parts of the permit, including those parts of the disturbed by WGC. WGC shall be responsible for reclaiming all other parts of the permit it disturbs and for controlling stormwater or "blackwater" discharges in accordance with the Reclamation Contract during its operations.

4. DEP understands the importance of the WGC Proposal to the development, construction and operation of the Project, and further understands that in order to finance the Project on a tax-exempt basis, WGC may not purchase Waste Coal from any source.

5. DEP and WGC are willing to explore the feasibility of extending the WGC Proposal to (i) other Forfeited Sites and (ii) other Waste Coal Sites covered by the federal Abandoned Mines Land program.

6. DEP believes that the WGC Proposal may enable DEP to carry out its reclamation obligations at the Anjean Site on a more cost-effective basis and thereby reduce the future financial impact on the Special Reclamation Fund of reclamation efforts at the Anjean Site.

7. DEP also believes that the removal of the coal refuse pile will help to minimize present and future adverse environmental effects that the coal refuse pile, if left in place, might otherwise produce.

8. DEP and WGC agree to cooperate on the development of site-specific details with regard to the Anjean Site, including but not limited to the relative areas of responsibility for reclamation (i.e., water treatment, waste coal removal, ash delivery and mixing with unused material, shaping of site, planning, etc.). DEP will retain full and final authority as to these details and otherwise as to the development and implementation of any Remediation Plan and contract specifications.

9. WGC's utilization of coal ash is authorized under this Memorandum of Understanding unless the use of coal ash for the specific purposes proposed by WGC becomes prohibited by law.

(signature page follows)

Dated as of the date first above written.

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

By: Ken Ellison

Its: **Director**

WESTERN GREENBRIER CO-GENERATION, LLC

By:

Its: Co-Manager

APPENDIX O

Air Permit

Appendix O1 – Emission Rates and Calculations*

Appendix O2 – Testimony from Air Modeler on Air Permit R14-0028**

Appendix O3 – Air Quality Board's Ruling on Air Permit R14-0028**

*This appendix contains tables extracted from Appendix B of Western Greenbrier Co-Generation, LLC Addendum to PSD Permit Application, dated October 21, 2005. The addendum was submitted to West Virginia Department of Environmental Protection in November 2005 as part of WGC's PSD permit application. On April 2006, WVDEP DAQ issued a PSD Permit (R14-0028) to WGC for the proposed construction of the waste coal-fired steam electric co-generation facility. The PSD Permit, which is a publicly accessible document, provides detailed information on the emission sources associated with the facility and the conditions under which the facility must be operated.

*****New appendix added for Final EIS.***

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ATTACHMENT 1

Emission Calculations

Line of Performance

Western Greenbrier

Load	MCR
Fuel	Performance Fuel (as of 4-19-05)
Limestone	Performance Limestone (as of 6-05)
Turbine Balance	ISO Ambient - 100% Output Case 159 Rev E

Date	17-Aug-05
Engineer	L.Gatton

Steam Flow	lb/hr	759,136
SH Outlet Temperature	F	1,055
SH Outlet Pressure	psig	1,870
Feed Water Temperature	F	430
Combustor Temperature	F	1,646
Gas Temperature Leaving Air Heater	F	306
Ambient Air Temperature	F	59
Gas Flow Leaving Unit	lb/hr	1,142,800
Air Flow Entering Unit	lb/hr	1,035,600
Excess Air	%	20
Fuel Efficiency	%	82.38
Q Fired	MBtu/hr	1,016.9
Fuel Flow	lb/hr	243,860
Limestone Flow	lb/hr	55,960
Total Ash Flow	lb/hr	192,650
Total Condensate Duty in FBACs	MBtu/hr	5.3

Efficiency

Dry Gas Loss	6.33
Moisture in Fuel	1.63
Combustion of Hydrogen	4.06
Moisture in Air	0.09
Moisture in Sorbent	0.06
Calcination Heat Loss	3.57
Sulfation Heat Loss (Gain)	-2.14
Carbon Loss	3.00
Heat Loss in Ash	1.48
Radiaion Loss	0.24
Manufacturer's Margin	0.00
Unaccounted Loss	0.10
Total Losses	18.42
Fan Credits	0.80
Total Efficiency	82.38

Fuel Analysis (%)

Performance Fuel

Heating Value (HHV) Btu/lb	4,170
Carbon	26.85
Hydrogen	1.62
Nitrogen	0.68
Oxygen	3.06
Sulfur	1.47
Ash	60.51
Moisture	5.81
Total	100.00

Limestone Analysis (%)

Performance

CaCO3	80.00
MgCO3	3.70
Inert	15.30
Moisture	1.00
Total	100.00

Reactivity Medium

45% Calcium Utilization 60X100M@160min

Line of Performance

Western Greenbrier

Load	MCR
Fuel	Design High Sulfur/Ash Coal High Moisture (as of 4-19-05)
Limestone	Design Limestone (as of 6-13-05)
Turbine Balance	100% Output - Design Fuel Case 259 Rev A

Date	17-Aug-05
Engineer	L.Gatton

Steam Flow	lb/hr	759,136
SH Outlet Temperature	F	1,055
SH Outlet Pressure	psig	1,870
Feed Water Temperature	F	430
Combustor Temperature	F	1,600
Gas Temperature Leaving Air Heater	F	317
Ambient Air Temperature	F	59
Gas Flow Leaving Unit	lb/hr	1,290,900
Air Flow Entering Unit	lb/hr	1,159,700
Excess Air	%	20
Fuel Efficiency	%	78.40
Q Fired	MBtu/hr	1,068.5
Fuel Flow	lb/hr	313,450
Limestone Flow	lb/hr	84,950
Total Ash Flow	lb/hr	267,200
Total Condensate Duty in FBACs	MBtu/hr	10.2

Efficiency

Dry Gas Loss	7.07
Moisture in Fuel	2.40
Combustion of Hydrogen	4.35
Moisture in Air	0.10
Moisture in Sorbent	0.09
Calcination Heat Loss	4.60
Sulfation Heat Loss (Gain)	-2.40
Carbon Loss	3.00
Heat Loss in Ash	2.87
Radiaion Loss	0.24
Manufacturer's Margin	0.00
Unaccounted Loss	0.10
Total Losses	22.42
Fan Credits	0.82
Total Efficiency	78.40

Fuel Analysis (%)

Performance Fuel

Heating Value (HHV) Btu/lb	3,409
Carbon	23.31
Hydrogen	1.41
Nitrogen	0.59
Oxygen	2.66
Sulfur	1.35
Ash	63.71
Moisture	6.97
Total	100.00

Limestone Analysis (%)

Performance

CaCO3	70.00
MgCO3	5.60
Inert	23.40
Moisture	1.00
Total	100.00
Reactivity	Low

25% Calcium Utilization 60X100M@160min

TABLE B-1
WESTERN GREENBRIER, LLC
Facility-Wide Maximum Potential Emissions

	All Values in tons/year								
POLLUTANT	CFB	Kiln	Cooling Tower	Material Handling	Storage Pile	Roads	Oil Storage Tank	Fire Pump	TOTALS
CRITERIA									
PM	134	4.86	3.45	1.09	0.072	12.33		0.13	156
PM10	134	4.86	3.45	0.49	0.034	1.90		0.13	145
SO2	624	23						0.003	646
NOx	445	159						1.86	607
CO	891	96						0.40	988
VOC	26.7	4.56					0.027	0.15	31
Pb	0.22	0.003							0.227
H2SO4	26.73	0.97							28
METAL HAPS									
Antimony compounds	9.61E-03	1.22E-04							0.0097
Arsenic compounds	2.19E-01	2.77E-03							0.2218
Beryllium compounds	1.12E-02	1.42E-04							0.0114
Cadmium compounds	2.72E-02	3.44E-04							0.0276
Chromium compounds	1.39E-01	1.76E-03							0.1406
Cobalt compounds	5.34E-02	6.75E-04							0.0541
Manganese compounds	2.62E-01	3.31E-03							0.2650
Mercury compounds	1.34E-02	4.86E-04							0.0138
Nickel compounds	1.50E-01	1.89E-03							0.1514
Selenium compounds	6.94E-01	8.78E-03							0.7031
ORGANIC HAPS									
PAH	1.11E-02	1.40E-04							0.0112
Acetaldehyde	3.04E-01	3.85E-03							0.3083
Acetophenone	8.01E-03	1.01E-04							0.0081
Acrolein	1.55E-01	1.96E-03							0.1568
Benzene	6.94E-01	8.78E-03							0.7031
Benzyl chloride	3.74E-01	4.73E-03							0.3786
Bis(2-ethylhexyl)phthalate	3.90E-02	4.93E-04							0.0395
Bromoform	2.08E-02	2.63E-04							0.0211
Carbon disulfide	6.94E-02	8.78E-04							0.0703
2-Chloroacetophenone	3.74E-03	4.73E-05							0.0038
Chlorobenzene	1.18E-02	1.49E-04							0.0119
Chloroform	2.08E-02	2.63E-04							0.0211
Cumene	2.83E-03	3.58E-05							0.0029
Cyanide	1.34E+00	1.69E-02							1.3522
2,4-Dinitrotoluene	1.50E-04	1.89E-06							0.0002
Dimethyl sulfate	2.56E-02	3.24E-04							0.0260
Ethyl benzene	5.02E-02	6.35E-04							0.0508
Ethyl chloride	2.24E-02	2.84E-04							0.0227
Ethylene dichloride	2.14E-02	2.70E-04							0.0216
Ethylene dibromide	6.41E-04	8.10E-06							0.0006
Formaldehyde	1.28E-01	1.62E-03							0.1298
Hexane	3.58E-02	4.52E-04							0.0362
Isophorone	3.10E-01	3.92E-03							0.3137
Methyl bromide	8.55E-02	1.08E-03							0.0865
Methyl chloride	2.83E-01	3.58E-03							0.2867
Methyl ethyl keytone	2.08E-01	2.63E-03							0.2109
Methyl hydrazine	9.08E-02	1.15E-03							0.0919
Methyl methacrylate	1.07E-02	1.35E-04							0.0108
Methyl tert butyl ether	1.87E-02	2.36E-04							0.0189
Methelyene chloride	1.55E-01	1.96E-03							0.1568
Phenol	8.55E-03	1.08E-04							0.0087
Propionaldehyde	2.03E-01	2.57E-03							0.2055
Tetrachloroethylene	2.30E-02	2.90E-04							0.0233
Toluene	1.28E-01	1.62E-03							0.1298
1,1,1-Trichloroethane	1.07E-02	1.35E-04							0.0108
Styrene	1.34E-02	1.69E-04							0.0135
Xylenes	1.98E-02	2.50E-04							0.0200
Vinyl acetate	4.06E-03	5.13E-05							0.0041
Total PCDD/PCDF	1.30E-04	1.65E-06							0.0001
OTHER HAPs									
HCl	5.34	0.07							5.409
HF	8.55	0.11							8.654
TOTAL HAPs									**20.63**

TABLE B-2
WESTERN GREENBRIER, LLC
Estimated Criteria Emissions from CFB and Kiln

OPERATING DATA			
	CFB		Kiln
	Short Term	Long Term	
	Design Fuel	Preferred Fuel	
Hours per year		8,760	8,760
Input (MMBtu/hr)	1,070	1,017	37
Coal HHV (Btu/lb)	3,409	4,170	12,000
Input (tons coal/hr)	157	122	2
Capacity (ton/day)			208

POLLUTANT	CFB				KILN				STACK [4]	
	EMISSION FACTOR		EMISSION RATE		EMISSION FACTOR		EMISSION RATE		EMISSION RATE	
	factor	units	LB/HR	TON/YR	factor	units	LB/HR	TON/YR	LB/HR	TON/YR
CRITERIA POLLUTANTS										
PM - Annual [3]	0.03	lb/MMBtu	30.5	133.6	0.03	lb/MMBtu	1.11	4.9	31.6	138.5
PM - 24 Hr [3]	0.03	lb/MMBtu	32.1		0.03	lb/MMBtu	1.11		33.2	
SO2 - Annual	0.14	lb/MMBtu	142	623.6	0.14	lb/MMBtu	5.18	22.7	147.6	646
SO2 - 3 hr Short Term	0.14	lb/MMBtu	150		0.14	lb/MMBtu	5.18		155.0	
SO2 - 24 hr Short Term	0.14	lb/MMBtu	150		0.14	lb/MMBtu	5.18		155.0	
NOx - Annual	0.10	lb/MMBtu	102	445.4	36.40	lb/hr	36.40	159.4	138.1	605
NOx - Short Term	0.10	lb/MMBtu	107		36.40	lb/hr	36.40		143.4	
CO - Annual	0.20	lb/MMBtu	203	890.9	2.54	lb/ton clinker	22.01	96.4	225.4	987
CO - Short Term [5]	0.20	lb/MMBtu	214		2.54	lb/ton clinker	22.01		236.0	
VOC- Annual	0.006	lb/MMBtu	6.10	26.7	0.120	lb/ton clinker	1.04	4.56	7.1	31
VOC - Short Term	0.006	lb/MMBtu	6.42		0.120	lb/ton clinker	1.04		7.5	
H2SO4	0.006	lb/MMBtu	6.42	26.7	0.006	lb/MMBtu	0.22	0.97	6.6	28
Pb	0.00042	lb/ton coal	0.07	0.224	0.00042	lb/ton coal	0.00065	0.0028	0.067	0.227

1 "Annual Emissions" are based on the expected annual average fuel, designated "Performance Fuel"
2 "Short Term Emissions" are based on the worst case fuel, designated "Design Fuel"
3 PM includes particulate and condensable
4 Kiln and CFB exhaust combined at entrance of stack
5 CO lb/MMBtu only valid at full load, lb/hr are worst case.

TABLE B-2A
WESTERN GREENBRIER, LLC

	Long Term Preferred Coal						Short Term Design Coal					
LOAD												
CFB, %	100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	75%	50%
CFB Firing Rate, MMBtu/hr	1017	763	508	1017	763	508	1070	803	535	1070	803	535
Kiln, %	100%	100%	100%	0%	0%	0%	100%	100%	100%	0%	0%	0%
Kiln Firing Rate, MMBtu/hr	37.3	37.3	37.3				37.3	37.3	37.3			
Stack Data												
Stack Diameter	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Stack Exhaust Flow, acfm	379,136	288,143	197,151	355,398	270,102	184,807	423,222	321,649	220,075	399,483	303,607	207,731
Stack Exhaust Velocity, ft/s	55.90	42.5	29.1	52.4	39.8	27.2	62.40	47.4	32.4	58.9	44.8	30.6
Stack Exhaust Temperature, F	150	150	150	150	150	150	150	150	150	150	150	150
Emission Rates, lb/hr												
NOx [1]	138.1	112.7	87.3	101.7	76.3	50.9	143.4	116.7	89.9	107.0	80.3	53.5
PM10, Annual [2]	31.6	24.0	16.4	30.5	22.9	15.3						
PM10, 24-hr	31.6	24.0	16.4	30.5	22.9	15.3	33.2	25.2	17.2	32.1	24.1	16.1
CO	225.4	220.3	210.2	203.4	198.3	188.1	236.0	230.7	220.0	214.0	208.7	198.0
SO2, Annual [2]	147.6	112.0	76.4	142.4	106.8	71.2						
SO2, 24-hr	147.6	112.0	76.4	142.4	106.8	71.2	155.0	117.5	80.1	149.8	112.4	74.9
SO2, Short Term, 3-hr	147.6	112.0	76.4	142.4	106.8	71.2	155.0	117.5	80.1	149.8	112.4	74.9

1 Class II modeling based on Annual Preferred Case, for Class I analysis the Design Case (Short Term) cases were utilized
2 Annual Emission based only on Preferred Case
3 Short Term could be either Preferred or Design Cases

Western Greenbrier CO Performance versus % Load

	Performance Fuel			Design Fuel		
Load	Q Fired, mmb	CO, lb/mmbtu	CO, lb/hr	Q Fired, m	CO, lb/mmbt	CO, lb/hr
100%	1,017	0.20	203	1,070	0.20	214
75%	763	0.26	198	803	0.26	209
50%	509	0.37	188	535	0.37	198

TABLE B-3
WESTERN GREENBRIER, LLC
Estimate of HAP Emissions from CFB and Kiln

COAL OPERATING DATA			
	CFB		Kiln
	Long Term	Short Term	
Hours of operation per year	8,760		8,760
Input (MMBtu/hr)	1,017	1,070	37
Coal HHV (Btu/lb)	4,170	3,409	12,000
Input (tons coal/hr)	122	157	2

POLLUTANT	EMISSION FACTOR		REFERENCE	EMISSION RATE						
	factor	units		CFB		Kiln		Stack		
				LB/HR	TON/YR	LB/HR	TON/YR	LB/HR	TON/YR	lb/MMBtu
HAZARDOUS AIR POLLUTANTS										
METAL HAPS										
Antimony compounds	1.80E-05	lb/ton	AP-42, Table 1.1-18	2.82E-03	9.61E-03	2.78E-05	1.22E-04	0.0029	0.0097	2.80E-06
Arsenic compounds	4.10E-04	lb/ton	AP-42, Table 1.1-18	6.43E-02	2.19E-01	6.32E-04	2.77E-03	0.0650	0.2218	6.39E-05
Beryllium compounds	2.10E-05	lb/ton	AP-42, Table 1.1-18	3.30E-03	1.12E-02	3.24E-05	1.42E-04	0.0033	0.0114	3.27E-06
Cadmium compounds	5.10E-05	lb/ton	AP-42, Table 1.1-18	8.00E-03	2.72E-02	7.86E-05	3.44E-04	0.0081	0.0276	7.67E-06
Chromium compounds	2.60E-04	lb/ton	AP-42, Table 1.1-18	4.08E-02	1.39E-01	4.01E-04	1.76E-03	0.0412	0.1406	3.91E-05
Cobalt compounds	1.00E-04	lb/ton	AP-42, Table 1.1-18	1.57E-02	5.34E-02	1.54E-04	6.75E-04	0.0158	0.0541	1.50E-05
Manganese compounds	4.90E-04	lb/ton	AP-42, Table 1.1-18	7.69E-02	2.62E-01	7.55E-04	3.31E-03	0.0777	0.2650	7.37E-05
Mercury compounds	3.00E-06	lb/MMBtu	Vendor Estimate	3.21E-03	1.34E-02	1.11E-04	4.86E-04	0.0033	0.0138	3.15E-06
Nickel compounds	2.80E-04	lb/ton	AP-42, Table 1.1-18	4.39E-02	1.50E-01	4.32E-04	1.89E-03	0.0444	0.1514	4.21E-05
Selenium compounds	1.30E-03	lb/ton	AP-42, Table 1.1-18	2.04E-01	6.94E-01	2.00E-03	8.78E-03	0.2060	0.7031	1.95E-04
ORGANIC HAPS										
PAH	2.07E-05	lb/ton	AP-42, Table 1.1-13	3.25E-03	1.11E-02	3.19E-05	1.40E-04	0.0033	0.0112	3.11E-06
Acetaldehyde	5.70E-04	lb/ton	AP-42, Table 1.1-14	8.95E-02	3.04E-01	8.79E-04	3.85E-03	0.0903	0.3083	8.57E-05
Acetophenone	1.50E-05	lb/ton	AP-42, Table 1.1-14	2.35E-03	8.01E-03	2.31E-05	1.01E-04	0.0024	0.0081	2.26E-06
Acrolein	2.90E-04	lb/ton	AP-42, Table 1.1-14	4.55E-02	1.55E-01	4.47E-04	1.96E-03	0.0460	0.1568	4.36E-05
Benzene	1.30E-03	lb/ton	AP-42, Table 1.1-14	2.04E-01	6.94E-01	2.00E-03	8.78E-03	0.2060	0.7031	1.95E-04
Benzyl chloride	7.00E-04	lb/ton	AP-42, Table 1.1-14	1.10E-01	3.74E-01	1.08E-03	4.73E-03	0.1109	0.3786	1.05E-04
Bis(2-ethylhexyl)phthalate	7.30E-05	lb/ton	AP-42, Table 1.1-14	1.15E-02	3.90E-02	1.13E-04	4.93E-04	0.0116	0.0395	1.10E-05
Bromoform	3.90E-05	lb/ton	AP-42, Table 1.1-14	6.12E-03	2.08E-02	6.01E-05	2.63E-04	0.0062	0.0211	5.86E-06
Carbon disulfide	1.30E-04	lb/ton	AP-42, Table 1.1-14	2.04E-02	6.94E-02	2.00E-04	8.78E-04	0.0206	0.0703	1.95E-05
2-Chloroacetophenone	7.00E-06	lb/ton	AP-42, Table 1.1-14	1.10E-03	3.74E-03	1.08E-05	4.73E-05	0.0011	0.0038	1.05E-06
Chlorobenzene	2.20E-05	lb/ton	AP-42, Table 1.1-14	3.45E-03	1.18E-02	3.39E-05	1.49E-04	0.0035	0.0119	3.31E-06
Chloroform	3.90E-05	lb/ton	AP-42, Table 1.1-14	6.12E-03	2.08E-02	6.01E-05	2.63E-04	0.0062	0.0211	5.86E-06
Cumene	5.30E-06	lb/ton	AP-42, Table 1.1-14	8.32E-04	2.83E-03	8.17E-06	3.58E-05	0.0008	0.0029	7.97E-07
Cyanide	2.50E-03	lb/ton	AP-42, Table 1.1-14	3.92E-01	1.34E+00	3.85E-03	1.69E-02	0.3962	1.3522	3.76E-04
2,4-Dinitrotoluene	2.80E-07	lb/ton	AP-42, Table 1.1-14	4.39E-05	1.50E-04	4.32E-07	1.89E-06	0.0000	0.0002	4.21E-08
Dimethyl sulfate	4.80E-05	lb/ton	AP-42, Table 1.1-14	7.53E-03	2.56E-02	7.40E-05	3.24E-04	0.0076	0.0260	7.22E-06
Ethyl benzene	9.40E-05	lb/ton	AP-42, Table 1.1-14	1.48E-02	5.02E-02	1.45E-04	6.35E-04	0.0149	0.0508	1.41E-05
Ethyl chloride	4.20E-05	lb/ton	AP-42, Table 1.1-14	6.59E-03	2.24E-02	6.48E-05	2.84E-04	0.0067	0.0227	6.32E-06
Ethylene dichloride	4.00E-05	lb/ton	AP-42, Table 1.1-14	6.28E-03	2.14E-02	6.17E-05	2.70E-04	0.0063	0.0216	6.01E-06
Ethylene dibromide	1.20E-06	lb/ton	AP-42, Table 1.1-14	1.88E-04	6.41E-04	1.85E-06	8.10E-06	0.0002	0.0006	1.80E-07
Formaldehyde	2.40E-04	lb/ton	AP-42, Table 1.1-14	3.77E-02	1.28E-01	3.70E-04	1.62E-03	0.0380	0.1298	3.61E-05
Hexane	6.70E-05	lb/ton	AP-42, Table 1.1-14	1.05E-02	3.58E-02	1.03E-04	4.52E-04	0.0106	0.0362	1.01E-05
Isophorone	5.80E-04	lb/ton	AP-42, Table 1.1-14	9.10E-02	3.10E-01	8.94E-04	3.92E-03	0.0919	0.3137	8.72E-05
Methyl bromide	1.60E-04	lb/ton	AP-42, Table 1.1-14	2.51E-02	8.55E-02	2.47E-04	1.08E-03	0.0254	0.0865	2.41E-05
Methyl chloride	5.30E-04	lb/ton	AP-42, Table 1.1-14	8.32E-02	2.83E-01	8.17E-04	3.58E-03	0.0840	0.2867	7.97E-05
Methyl ethyl keytone	3.90E-04	lb/ton	AP-42, Table 1.1-14	6.12E-02	2.08E-01	6.01E-04	2.63E-03	0.0618	0.2109	5.86E-05
Methyl hydrazine	1.70E-04	lb/ton	AP-42, Table 1.1-14	2.67E-02	9.08E-02	2.62E-04	1.15E-03	0.0269	0.0919	2.56E-05
Methyl methacrylate	2.00E-05	lb/ton	AP-42, Table 1.1-14	3.14E-03	1.07E-02	3.08E-05	1.35E-04	0.0032	0.0108	3.01E-06
Methyl tert butyl ether	3.50E-05	lb/ton	AP-42, Table 1.1-14	5.49E-03	1.87E-02	5.40E-05	2.36E-04	0.0055	0.0189	5.26E-06
Methelyene chloride	2.90E-04	lb/ton	AP-42, Table 1.1-14	4.55E-02	1.55E-01	4.47E-04	1.96E-03	0.0460	0.1568	4.36E-05
Phenol	1.60E-05	lb/ton	AP-42, Table 1.1-14	2.51E-03	8.55E-03	2.47E-05	1.08E-04	0.0025	0.0087	2.41E-06
Propionaldehyde	3.80E-04	lb/ton	AP-42, Table 1.1-14	5.96E-02	2.03E-01	5.86E-04	2.57E-03	0.0602	0.2055	5.71E-05
Tetrachloroethylene	4.30E-05	lb/ton	AP-42, Table 1.1-14	6.75E-03	2.30E-02	6.63E-05	2.90E-04	0.0068	0.0233	6.47E-06
Toluene	2.40E-04	lb/ton	AP-42, Table 1.1-14	3.77E-02	1.28E-01	3.70E-04	1.62E-03	0.0380	0.1298	3.61E-05
1,1,1-Trichloroethane	2.00E-05	lb/ton	AP-42, Table 1.1-14	3.14E-03	1.07E-02	3.08E-05	1.35E-04	0.0032	0.0108	3.01E-06
Styrene	2.50E-05	lb/ton	AP-42, Table 1.1-14	3.92E-03	1.34E-02	3.85E-05	1.69E-04	0.0040	0.0135	3.76E-06
Xylenes	3.70E-05	lb/ton	AP-42, Table 1.1-14	5.81E-03	1.98E-02	5.70E-05	2.50E-04	0.0059	0.0200	5.56E-06
Vinyl acetate	7.60E-06	lb/ton	AP-42, Table 1.1-14	1.19E-03	4.06E-03	1.17E-05	5.13E-05	0.0012	0.0041	1.14E-06
Total PCDD/PCDF	2.44E-07	lb/ton	AP-42, Table 1.1-12	3.83E-05	1.30E-04	3.76E-07	1.65E-06	0.0000	0.0001	3.67E-08
OTHER HAPS										
HCl	0.01	lb/ton		1.57	5.34	0.02	0.07	1.58	5.41	1.50E-03
HF	0.016	lb/ton		2.51	8.55	0.02	0.11	2.54	8.65	2.41E-03
							TOTAL HAPS		**20.63**	

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TABLE B-4
WESTERN GREENBRIER, LLC
Estimate of Emissions During Startup of CFB and Kiln

CFB OPERATING DATA		
	Coal	Oil
Input (MMBtu/hr)	1,017	400
HHV (Btu/lb)or (Btu/gal)	4,170	140,000
Fuel, ton/hr or gal/hr	122	2,857

POLLUTANT	CFB - Normal Operation				CFB - Oil Fired for Startup			
	EMISSION FACTOR		REFERENCE	EMISSION RATE	EMISSION FACTOR		REFERENCE	EMISSION RATE
	factor	units		LB/HR	factor	units		LB/HR
CRITERIA POLLUTANTS								
PM/PM10	0.03	lb/MMBtu	Vendor - baghouse	30.5	3.3	lb/1000 gal	AP-42, Fuel Oil Comb	9.43
SO2	0.14	lb/MMBtu	Vendor - FDA	142.4	0.05	lb/MMBtu	Oil Sulfur content= 0.05%	20.29
NOx	0.10	lb/MMBtu	Vendor - SNCR	101.7	0.25	lb/MMBtu	Vendor	100.00
CO	0.20	lb/MMBtu	Vendor	203.4	0.07	lb/MMBtu	Vendor	28.00
VOC	0.006	lb/MMBtu	Similar Unit - AVG	6.1	0.013	lb/MMBtu	Vendor	5.20
Pb	0.00042	lb/ton	AP-42, Table 1.1-18	0.0512	0.000009	lb/MMBtu	AP-42, Table 1.3-10	0.0036
H2SO4	0.006	lb/MMBtu	Vendor	6.1	0.006	lb/MMBtu		2.40

KILN OPERATING DATA		
	Coal	Oil
Input (MMBtu/hr)	37	37
HHV (Btu/lb)or (Btu/gal)	12,000	140,000
Fuel, ton or gal/hr	2	264

POLLUTANT	Kiln - Normal Operation				Kiln - Oil Fired for Startup			
	EMISSION FACTOR		REFERENCE	EMISSION RATE	EMISSION FACTOR		REFERENCE	EMISSION RATE
	factor	units		LB/HR	factor	units		LB/HR
CRITERIA POLLUTANTS								
PM/PM10	0.03	lb/MMBtu	Vendor	1.11	3.3	lb/1000 gal	AP-42, Fuel Oil Comb	0.87
SO2	0.14	lb/MMBtu	Vendor - FDA	5.18	0.05	lb/MMBtu	Oil Sulfur content= 0.05%	1.88
NOx	36.4	lb/hr	Vendor	36	0.25	lb/MMBtu	Vendor	9.25
CO	22	lb/hr	Vendor	22	0.07	lb/MMBtu		2.59
VOC	0.12	lb/MMBtu	Assume Same as FBC	4.44	0.013	lb/MMBtu		0.48
Pb	0.00042	lb/ton	AP-42, Table 1.1-18	0.0155	0.000009	lb/MMBtu	AP-42, Table 1.3-10	0.00033
H2SO4	0.006	lb/MMBtu	Vendor	0.2220	0.006	lb/MMBtu	Vendor	0.22

POLLUTANT	CFB/Kiln Normal	CFB/Kiln Startup
	LB/HR	
CRITERIA POLLUTANTS		
PM/PM10	31.62	10.3
SO2	147.56	22.2
NOx	138.10	109.3
CO	225.41	30.6
VOC	10.54	5.7
Pb	0.07	0.004
H2SO4	6.32	2.62

1 Application based on CFB and Kiln operating at full load 8,760 hours
2 CFB and Kiln not expected to startup in same hour.

TABLE B-5
WESTERN GREENBRIER, LLC
Estimate of Emissions from Cooling Tower

Cooling Tower Data

Water Circulation Rate	50,000	gpm
Drift	0.0005	%
Drift Loss	0.25	gpm
Total Dissolved Solids(TDS)	6,300	ppm
Operating hours	8,760	hours per year

PM Emission Rate Calculation

Particulate matter (PM) emissions from the induced draft mechanical cooling tower were estimated using procedures from USEPA AP42, Section 13.4, Wet Cooling Tower.

PM = Drift loss x TDS

PM= (Gal/min) x (ppm) x (1/E06) x (60 min/hr) x (8.345 lb/gal)

Emission Estimates

lb/hr	ton/yr
0.79	3.45

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TABLE B-6
WESTERN GREENBRIER, LLC
Material Handling Emission Estimates

Reference	Source ID	Source Description	Vent Point/Control	Vent ID	Control ID	Operating Capacity				Flow Rate	Stack Height	Emission Factor Uncontrolled lb/ton		Control	Building Credit	Emissions - Uncontrolled lb/hr		Emissions - Uncontrolled ton/yr		Emissions - Controlled lb/hr		Emissions - Controlled ton/yr		TOTALS ton/yr	
						hr/day	day/week	tph	tpy	(ACFM)	(Feet)	PM	PM10	%	%	PM	PM10	PM	PM10	PM	PM10	PM	PM10	PM	PM10
COAL HANDLING OPERATIONS																									
46	C-01	Coal from Dump Trucks To Coal Pile	Outdoor Unloading	EP-37	WS-01	16	5	630	2,620,800			2.98E-04	1.41E-04	50%		0.188	0.089	0.391	0.185	0.0940	0.0445	0.1956	0.0925		
44	C-02	Coal from Wheel Loader to Coal Loading Feeder Hopper	Outdoor Coal Loading Area/Sprays	EP-02	WS-02	24	7	300	2,620,800			2.98E-04	1.41E-04	70%		0.090	0.042	0.391	0.185	0.0269	0.0127	0.1173	0.0555		
44	C-03	Coal Loading Feeder to Silo Feed Conveyor	Outdoor Coal Loading Area/Sprays	EP-02	WS-02	24	7	300	2,620,800			2.98E-04	1.41E-04	70%		0.090	0.042	0.391	0.185	0.0269	0.0127	0.1173	0.0555		
65	C-19	Silo Feed Conveyor to Coal Day Silo Distribution Conveyor	Head Chute Transfer/Dust Collector	EP-07	FF-04	11	7	300	1,201,200	2,500	100	2.98E-04	1.41E-04	90%		0.090	0.042	0.179	0.085	0.0090	0.0042	0.0179	0.0085		
69	C-20	CFB Coal Day Silo A	Coal Day Silo A Dust Collector	EP-08	FF-05	5.5	7	300	600,600	3,500	110	2.98E-04	1.41E-04	90%		0.090	0.042	0.090	0.042	0.0090	0.0042	0.0090	0.0042		
70	C-21	CFB Coal Day Silo B	Coal Day Silo B Dust Collector	EP-09	FF-06	5.5	7	300	600,600	3,500	110	2.98E-04	1.41E-04	90%		0.090	0.042	0.090	0.042	0.0090	0.0042	0.0090	0.0042		
L	C-22	Kiln Coal Day Silo	Kiln Silo Dust Collector	EP-10	FF-07	1	7	30	10,920	2,000	62	2.98E-04	1.41E-04	90%		0.009	0.004	0.002	0.001	0.0009	0.0004	0.0002	0.0001		
																								0.4663	0.2205
LIMESTONE HANDLING OPERATIONS																									
42	L-01	Limestone From Dump Trucks to Pile	Outdoor Unloading	EP-11	WS-05	16	5	52.5	218,400			5.27E-04	2.49E-04	50%		0.028	0.013	0.058	0.027	0.0138	0.0065	0.0288	0.0136		
74	L-02	Limestone Reclaim Feeder to Limestone Reclaim Conveyor	Head Chute Transfer/Sprays	EP-12	WS-05	6	7	100	218,400			5.27E-04	2.49E-04	90%		0.053	0.025	0.058	0.027	0.0053	0.0025	0.0058	0.0027		
Bldg # 81	L-03	Limestone Reclaim Conveyor to Limestone Distribution Conveyor	Limestone Preparation System Dust Collector	EP-13	FF-08	6	7	100	218,400	10,000	100	5.27E-04	2.49E-04	90%	50%	0.053	0.025	0.058	0.027	0.0026	0.0012	0.0029	0.0014		
Bldg # 81	L-04	Limestone Distribution Conveyor to Limestone Bin A	Limestone Preparation System Dust Collector	EP-13	FF-08	3	7	100	109,200			5.27E-04	2.49E-04	90%	50%	0.053	0.025	0.029	0.014	0.0026	0.0012	0.0014	0.0007		
Bldg # 81	L-05	Limestone Distribution Conveyor to Limestone Bin B	Limestone Preparation System Dust Collector	EP-13	FF-08	3	7	100	109,200			5.27E-04	2.49E-04	90%	50%	0.053	0.025	0.029	0.014	0.0026	0.0012	0.0014	0.0007		
Bldg # 81	L-06	Limestone Bin A to Limestone Crusher A Inlet Feeder	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			5.40E-03	2.40E-03	90%	50%	0.189	0.084	0.413	0.183	0.0095	0.0042	0.0206	0.0092		
Bldg # 81	L-07	Limestone Bin B to Limestone Crusher B Inlet Feeder	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			5.40E-03	2.40E-03	90%	50%	0.189	0.084	0.413	0.183	0.0095	0.0042	0.0206	0.0092		
Bldg # 81	L-08	Limestone Crusher A Inlet Feeder to Limestone Crusher A	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			5.40E-03	2.40E-03	90%	50%	0.189	0.084	0.413	0.183	0.0095	0.0042	0.0206	0.0092		
Bldg # 81	L-09	Limestone Crusher B Inlet Feeder to Limestone Crusher B	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			5.40E-03	2.40E-03	90%	50%	0.189	0.084	0.413	0.183	0.0095	0.0042	0.0206	0.0092		
Bldg # 81	L-10	Limestone Crusher A to Limestone Crusher A Outlet Feeder	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			5.27E-04	2.49E-04	90%	50%	0.018	0.009	0.040	0.019	0.0009	0.0004	0.0020	0.0010		
Bldg # 81	L-11	Limestone Crusher B to Limestone Crusher B Outlet Feeder	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			5.27E-04	2.49E-04	90%	50%	0.018	0.009	0.040	0.019	0.0009	0.0004	0.0020	0.0010		
Bldg # 81	L-12	Limestone Crusher A Outlet Feeder to Limestone Screen A	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			2.50E-02	8.70E-03	90%	50%	0.875	0.305	1.911	0.665	0.0438	0.0152	0.0956	0.0333		
Bldg # 81	L-13	Limestone Crusher B Outlet Feeder to Limestone Screen B	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	35	152,880			2.50E-02	8.70E-03	90%	50%	0.875	0.305	1.911	0.665	0.0438	0.0152	0.0956	0.0333		
Bldg # 81	L-14	Limestone Screen A Overs to Limestone Oversize Conveyor	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	10	43,680			5.49E-03	2.59E-03	90%	50%	0.055	0.026	0.120	0.057	0.0027	0.0013	0.0060	0.0028		
Bldg # 81	L-15	Limestone Screen B Overs to Limestone Oversize Conveyor	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	10	43,680			5.49E-03	2.59E-03	90%	50%	0.055	0.026	0.120	0.057	0.0027	0.0013	0.0060	0.0028		
Bldg # 81	L-16	Limestone Oversize Conveyor to Bucket Elevator	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	20	87,360			5.49E-03	2.59E-03	90%	50%	0.110	0.052	0.240	0.113	0.0055	0.0026	0.0120	0.0057		
Bldg # 81	L-17	Bucket Elevator to Limestone Distribution Conveyor	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	20	87,360			5.49E-03	2.59E-03	90%	50%	0.110	0.052	0.240	0.113	0.0055	0.0026	0.0120	0.0057		
Bldg # 81	L-18	Limestone Screen A Unders to Limestone Product Surge Bin A	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	25	109,200			5.49E-03	2.59E-03	90%	50%	0.137	0.065	0.300	0.142	0.0069	0.0032	0.0150	0.0071		
Bldg # 81	L-19	Limestone Screen B Unders to Limestone Product Surge Bin B	Limestone Preparation System Dust Collector	EP-13	FF-08	12	7	25	109,200			5.49E-03	2.59E-03	90%	50%	0.137	0.065	0.300	0.142	0.0069	0.0032	0.0150	0.0071		
10	L-20	Limestone Product Surge Bin A to CFB Limestone Day Silo	CFB Limestone Day Silo Vent Filter	EP-14	FF-09	12	7	25	109,200	7,500	62	5.49E-03	2.59E-03	90%		0.137	0.065	0.300	0.142	0.0137	0.0065	0.0300	0.0142		
10	L-21	Limestone Product Surge Bin B to CFB Limestone Day Silo	CFB Limestone Day Silo Vent Filter	EP-14	FF-09	12	7	25	109,200			5.49E-03	2.59E-03	90%		0.137	0.065	0.300	0.142	0.0137	0.0065	0.0300	0.0142		
F and G	L-22	Kiln Limestone Day Bin	Dust Filter	EP-15	FF-10	3	7	30	54,600	2,500	62	5.49E-03	2.59E-03	90%		0.274	0.130	0.150	0.071	0.0274	0.0130	0.0150	0.0071		
																								0.4587	0.1907
ASH HANDLING OPERATIONS																									
21	A-01	CFB Flyash Silo	Dust Filter	EP-17	FF-11	12	7	45	196,560	6,720	107	3.67E-03	1.73E-03	90%		0.165	0.078	0.360	0.170	0.0165	0.0078	0.0360	0.0170		
22	A-02	CFB Bottom Ash Silo	Dust Filter	EP-18	FF-12	12	7	45	196,560	14,500	107	1.46E-04	6.91E-05	90%		0.007	0.003	0.014	0.007	0.0007	0.0003	0.0014	0.0007		
E	A-03	Kiln Bottom Ash Silo	Dust Filter	EP-19	FF-13	2	7	54	39,312	5,000	62	1.46E-04	6.91E-05	90%		0.008	0.004	0.003	0.001	0.0008	0.0004	0.0003	0.0001		
	A-04	Ash Loadout		EP-16		24	6	105	786,240			1.46E-04	6.91E-05			0.015	0.007	0.057	0.027	0.0153	0.0073	0.0574	0.0271		
																								0.0952	0.0450
KILN/CLINKER PRODUCTION																									
A	K-01	Alumina Silo	Bin Filter 200-170	EP-20	FF-14	1	5	25	6,500	2,500	62	1.02E-03	4.81E-04	90%		0.025	0.012	0.003	0.002	0.0025	0.0012	0.0003	0.0002		
A	K-02	Wood Waste Silo	Bin Filter 500-520	EP-21	FF-15	18	7	1	6,552	2,500	62	3.85E-04	1.82E-04	90%		0.00039	0.00018	0.00126	0.00060	0.00004	0.00002	0.00013	0.00006		
C	K-03	Fly Ash Silo		EP-22	FF-16	18	7	3	19,656	2,500	62	3.67E-03	1.73E-03	90%		0.011	0.005	0.036	0.017	0.0011	0.0005	0.0036	0.0017		
X	K-04	Gypsum Bin	Bin Filter 600-310	EP-23	FF-17	18	7	1	6,552	2,500	50	1.46E-04	6.91E-05	90%		0.00015	0.00007	0.00048	0.00023	0.00001	0.00001	0.00005	0.00002		
F	K-05	Limestone/Cal Mount - A	Bin Filter 200-010	EP-24	FF-18	18	7	5	32,760	2,500	62	5.27E-04	2.49E-04	90%		0.003	0.001	0.009	0.004	0.0003	0.0001	0.0009	0.0004		
G	K-06	Limestone/Cal Mount - B	Bin Filter 200-010	EP-24	FF-18	18	7	5	32,760			5.27E-04	2.49E-04	90%		0.003	0.001	0.009	0.004	0.0003	0.0001	0.0009	0.0004		
J	K-07	Raw Mix Conveyor - Limestone	Dust Filter 200-290	EP-25	FF-19	18	7	10	65,520	2,500	25	5.27E-04	2.49E-04	90%		0.005	0.002	0.017	0.008	0.0005	0.0002	0.0017	0.0008		
J	K-08	Raw Mix Conveyor - Bottom Ash	Dust Filter 200-290	EP-25	FF-19	18	7	4	26,208			1.46E-04	6.91E-05	90%		0.001	0.0003	0.002	0.001	0.0001	0.0000	0.0002	0.0001		
J	K-09	Raw Mix Conveyor - Fly Ash	Dust Filter 200-260	EP-26	FF-20	18	7	3	19,656	2,500	25	1.46E-04	6.91E-05	90%		0.000	0.0002	0.001	0.001	0.000044	0.000021	0.0001	0.0001		
J	K-10	Raw Mix Conveyor - Alumina	Dust Filter 200-260	EP-26	FF-20	18	7	2	13,104			1.02E-03	4.81E-04	90%		0.002	0.001	0.007	0.003	0.0002	0.0001	0.0007	0.0003		
J	K-11	Raw Mix Conveyor	Dust Filter 300-040	EP-27	FF-21	18	7	19	124,488	2,500	25	3.85E-04	1.82E-04	90%		0.007	0.003	0.024	0.011	0.0007	0.0003	0.0024	0.0011		
K	K-12	Raw Mill Grinding and Drying	COMBINED WITH KILN																						
D	K-13	Raw Mill Homogenizing Silo	Bin Filter 300-240	EP-28	FF-22	18	7	17	111,384	2,500	84	3.85E-04	1.82E-04	90%		0.007	0.003	0.021	0.010	0.0007	0.0003	0.0021	0.0010		
M	K-14	Kiln Coal Mill	Dust Filter 500-140	EP-29	FF-23	24	7	0.5	4,368	2,500	60	0.0200	0.0094	90%		0.010	0.005	0.044	0.021	0.0010	0.0005	0.0044	0.0021		
M	K-15	Coal Feeders	Dust Filter 500-323	EP-30	FF-24	24	7	0.5	4,368	2,500	60	2.98E-04	1.41E-04	90%		0.0001	0.0001	0.001	0.000	0.000015	0.000007	0.0001	0.0000		
	K-16	Clinker Crusher	Fabric Filter 400-300	EP-31	FF-25	24	7	9	78,624	12,000	60	0.0054	0.0024	90%		0.049	0.022	0.212	0.094	0.0049	0.0022	0.0212	0.0094		
V	K-17	Clinker Storage (including off spec. clinker bin - point K-17A)	Fabric Filter 600-030	EP-32	FF-26	24	7	9	78,624	2,500	55	3.85E-04	1.82E-04	90%		0.003	0.002	0.015	0.007	0.0003	0.0002	0.0015	0.0007		
Y	K-18	Clinker Conveyor	Fabric Filter 600-100	EP-33	FF-27	18	7	12	78,624	2,500	25	3.85E-04	1.82E-04	90%		0.005	0.002	0.015	0.007	0.0005	0.0002	0.0015	0.0007		
Y	K-19	Clinker Vibrator	Fabric Filter 600-100	EP-33	FF-27	18	7	12	78,624			3.85E-04	1.82E-04	90%		0.005	0.002	0.015	0.007	0.0005	0.0002	0.0015	0.0007		
Y	K-20	Clinker Weightbelt Feeder	Fabric Filter 600-100	EP-33	FF-27	18	7	12	78,624			3.85E-04	1.82E-04	90%		0.005	0.002	0.015	0.007	0.0005	0.0002	0.0015	0.0007		
Y	K-21	Clinker Belt to Ball Mill	Fabric Filter 600-100	EP-33	FF-27	18	7	12	78,624			3.85E-04	1.82E-04	90%		0.005	0.002	0.015	0.007	0.0005	0.0002	0.0015	0.0007		
Z	K-22	Clinker Finish (Ball) Mill	Fabric Filter 600-150	EP-34	FF-28	18	7	12	78,624	12,000	50	0.0054	0.0024	90%		0.065	0.029	0.212	0.094	0.0065	0.0029	0.0212	0.0094		
																								0.068	0.031
WOODBRICK OPERATIONS																									
VII	W-01	Clinker Storage Silos - Three units	Bin Filter	EP-35	FF-29	18	7	12	78,624	2,000	25	3.85E-04	1.82E-04	90%		0.005	0.002	0.015	0.007	0.0005	0.0002	0.0015	0.0007		
V	W-02	Woodchip Silo	Bin Filter	EP-36	FF-30	3	5	20	15,600	2,000	25	3.85E-04	1.82E-04	90%		0.008	0.004	0.003	0.001	0.0008	0.0004	0.0003	0.0001		
VII	W-03	Cementitious Material Silo	Bin Filter	EP-38	FF-31	18	7	12	78,624	2,000	25	3.85E-04	1.82E-04	90%		0.005	0.002	0.015	0.007	0.0005	0.0002	0.0015	0.0007	0.003	0.002
																								1.0911	0.4886

TABLE B-7
WESTERN GREENBRIER, LLC
EMISSION FACTORS FOR MATERIAL HANDLING

Emission Unit	Pollutant		Units	Reference
	TSP	PM_{10}		
Coal Transfer	0.000298	0.000141	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Limestone Transfer	0.000527	0.000249	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Ground Limestone Transfer	0.0055	0.0026	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Bottom Ash Transfer	0.000146	0.000069	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Fly Ash Transfer	0.003667	0.001735	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Alumina Transfer	0.001017	0.000481	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Wood Waste Transfer	0.000385	0.000182	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Fly Ash/ Gypsum Mixture	0.000146	0.000069	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Raw Meal Transfer	0.000385	0.000182	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Clinker Transfer	0.000385	0.000182	lb/ton	AP-42 Fifth Edition, Table 13.2.4-1 and Equation (1)
Screening Operation	0.0250	0.0087	lb/ton	AP-42 Fifth Edition, Table 11.19.2-2
Screening Operation - Coal	0.1	0.047	lb/ton	WVDEP General Permit 10
Crushing - Limestone/Clinker	0.0054	0.0024	lb/ton	AP-42 Fifth Edition, Table 11.19.2-2
Crushing - Coal	0.02	0.0094	lb/ton	WVDEP General Permit 10

Wind speed	7	mph	Per WVDEP guidance Documents
Waste coal moisture content	12	%	Engineering Estimate
Limestone moisture content	8	%	Engineering Estimate
Ground Limestone	1.5	%	Engineering Estimate
Ash / Gypsum moisture content	20	%	Engineering Estimate
Fly ash moisture content	2	%	Engineering Estimate
Aluminia moisture	5	%	Engineering Estimate
Raw Meal moisture	10	%	Engineering Estimate
Clinker moisture	10	%	Engineering Estimate
Wood Waste moisture	10	%	Engineering Estimate
Days with >=0.01 in rain per year	170	days	Per WVDEP guidance Documents

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TABLE B-8
WESTERN GREENBRIER, LLC
Road Emissions

Road Segment	Source	Annual Throughput (TPY)	Load (Ton)	Truck (Ton)	Trips in	Trips out	W (Ton)	k PM10	k TSP	sL	f	C lb/vmt	P	E (lbs/vmt) PM10	E (lbs/vmt) TSP	L (mi)	VDT/yr (mi)	Emission (TPY) PM10	Emission (TPY) TSP
P-1	Waste Coal Delivery	2,620,800	40	15	65,520		52	0.016	0.082	8.2	0.9	0.00047	170	0.24	1.24	0.170	11,168	1.35	6.94
In to plant	Limestone Delivery	218,400	20	15	10,920												1,861	0.23	1.16
	Ash Loadout	786,240	40	15													0	0.00	0.00
	Quality Coal Delivery	10,400	40	15	260												44	0.0054	0.0275
	Alumina	5,200	20	15	260												44	0.0054	0.0275
P-1 Total																		**1.35**	**8.15**
P-2	Waste Coal Delivery	2,620,800	40	15		45,864	26	0.016	0.082	8.2	0.95	0.00047	170	0.04	0.22	0.170	7,818	0.31	1.58
Out	Limestone Delivery	218,400	20	15		10,920											1,861	0.07	0.38
	Ash Loadout	786,240	40	15		19,656											3,350	0.13	0.68
	Quality Coal Delivery	10,400	40	15		260											44	0.0017	0.0089
	Alumina	5,200	20	15		260											44	0.0017	0.0089
P-2 Total																		**0.31**	**2.65**
P-3	Waste Coal Delivery	2,620,800	40	15	65,520	45,864	39	0.016	0.082	8.2	0.95	0.00047	170	0.08	0.40	0.034	3,797	0.15	0.77
	Limestone Delivery	218,400	20	15	10,920	10,920											745	0.03	0.15
	Ash Loadout	786,240	40	15		19,656											670	0.03	0.14
	Quality Coal Delivery	10,400	40	15	260	260											18	0.0007	0.0036
	Alumina	5,200	20	15	260	260											18	0.0007	0.0036
P-3 Total																		**0.15**	**1.06**
P-4	Wood Chips	15,600	20	15	780	780	26	0.016	0.082	8.2	0.9	0.00047	170	0.08	0.43	0.10	156	0.02	0.10
	Woodbrick	10,400	20	15	520	520											104	0.01	0.06
	Ash Product	52,000	20	15	2,600	2,600											520	0.06	0.32
P-4 Total																		**0.09**	**0.48**
																		1.90	**12.33**

E=[(k)(sL/2)^0.65*(W/3)^1.5-C](1-P/4N)(1-f)
Emission equations taken from AP-42 13.2.1
k = Particle size multiplier
sL-silt loading - g/m^2 (From Table 13.2.1-4 for quarry)
C= Emission Factor for brake, exhaust and tire wear from Table13.2.1-2

VDT/yr-annual vehicle distance traveled
W-Mean Vehicle Weight (tons)
L = Length of paved roadway
t-trips/yr
P = Number of wet days, from Figure13.2.1-2

f=Control efficiency
watering/sweeping
N = Number of days in averaging period
Assume = 260
based on 5 day/week

Operation Schedule	truck/day	day/week
Waste Coal Deliveries	160	5
Quality Coal	1	5
Limestone	27	5
Ash Loadout	64	5
Ash Product	10	5
Alumina	1	5
Wood Chips	3	5
Woodbrick	2	5

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TABLE B-9
WESTERN GREENBRIER, LLC
Estimate of Emissions from Storage Piles

Source ID No.	Emission Point ID	Stockpile Description	Silt Content of Material %	Stockpile base area Max. sqft	Control Device ID Number	Control Efficiency %	E lb/acre/day	Emissions - Controlled			
								lb/hr		ton/yr	
								PM	PM10	PM	PM10
C-01	EP-02	Waste Coal Pile	2.2	8,160	WS-01	50%	2.759	0.011	0.005	0.047	0.022
L-01	EP-11	Limestone Pile	1.6	5,915	WS-05	50%	2.006	0.006	0.0027	0.025	0.012
TOTAL								0.016	0.008	0.072	0.034

Source:
Air Pollution Engineering Manual

Storage Pile Wind Erosion (Active Storage)

E = 1.7*[s/1.5]*[(365-p)/235]*[f/15] = (lb/day/acre)

Where:

		Value	Basis
s =	silt content of material		AP-42 Fifth Edition, Table 13.2.4-1
p =	number of days with >0.01 inch of precipitation per year	170	Table B - General Permit GC-10
f =	percentage of time that the unobstructed wind speed	20	WVDEP recommended default
	exceeds 12 mph at the mean pile height		

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TABLE B-10
WESTERN GREENBRIER, LLC
Emissions from Emergency Fire Pump

	Emission Factor		Emissions per Unit			Total
	lb/hp-hr		lb/hr	ton/yr		ton/yr
NOx	0.031		9.30	1.86		1.86
CO	0.007		2.00	0.40		0.40
PM	0.0022		0.66	0.13		0.13
VOC	0.0025		0.74	0.15		0.15
SO2			0.015	0.00		0.003

1	Number of Diesel Fire Pumps	1	Units
2	Rated at	300	hp
3	Annual operating hours	400	hr/yr
4	Emissions Factors for NOx, CO, PM and VOC from US EPA, AP-42, Section 3.3 "Gasoline and Industrial Engines"		
5	Emission Rate for SO2 based on	0.05%	Sulfur in Fuel
6	All HAPs have "E" rating - not utilized.		
7	Fuel heating value	140,000	Btu/gal
8	Assumed fuel consumption	7,000	Btu/hp-hr
		2.1	MMBtu/hr
		15	gal/hr
		6,000	gal/yr

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Special Information: Testimony of Chris Arrington in the Sierra Club, et al. v. Division of Air Quality hearing dated August 30, 2006. If you have any questions, please contact Skipp at 304-340-1192 or on his cell at 304-539-1850. Thank you.

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MR. ARRINGTON: Yes.

(WHEREUPON,

CHRIS ARRINGTON

WAS CALLED AS A WITNESS, PREVIOUSLY SWORN, AND TESTIFIED AS FOLLOWS BEGINNING AT 9:43 A.M.:)

DIRECT EXAMINATION

BY MR. HUSON:

Q Would you state your name for the record, please?

A Chris Arrington.

Q And would you tell the Board about your educational background?

A I have a Bachelor's degree in Electrical Engineering from West Virginia University in 1991. I went to graduate school for Environmental Engineering at Marshall Graduate College that next fall. I graduated from that in 1994. During that period I acted as graduate assistant for Dr. Kresser. Some of you may know him. I acted in that capacity doing air dispersion modeling work for him. I wrote my Master's thesis, final project, for that degree in air dispersion modeling in West Virginia and the

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appropriate choice of models and application of those models in the state.

I have been in this capacity -- Excuse me. I have been in this capacity with the State since November 1994, approximately 12 years now. Eight of those years I've been the senior of the two modelers we typically keep in this office. I have worked on PSD permits. Basically every one since I have been here since the Apple Grove pulp and paper mill way back when till today I have been involved in some capacity. So I have done quite a few of these.

I participate nationally in modeling work. I'm the state's representative to the Regional Planning Organization. Excuse me, I'm sorry, I'm a little hoarse today. So I'm the state's representative to these large technical organizations that do modeling on a regional basis. I have participated in EPA work groups. I recently was a co-author on the Air Model Implementation Guide. That's a new model that's being introduced for use. And I'm one of the people that EPA asked me my expertise to help write this guidance to tell -- excuse me -- to tell other states, you know, what's the best way to

apply these models.

I have also been working on a work group called -- it was initially called the IWAQM group, the Interagency Work Group on Air Quality Models. That is a group that helps write the guidance for the Class I area modeling, the federal parks, the Forest Service, that sort of modeling.

MR. HUSON: At this point I would offer Mr. Arrington as an expert in air dispersion modeling.

BY MR. HUSON:

Q One additional question. Have you ever testified before this Board as an expert?

A Yes, several times before this Board and the Environmental Quality Board.

MR. HUSON: I would offer him as an expert in air emission -- air dispersion modeling.

MR. LOVEIT: No objection.

MR. KROPP: No objection.

MR. KOON: All right. We'll recognize him as an expert in air dispersion modeling, then. Go ahead and proceed, Mr. Huson.

BY MR. HUSON:

Q Would you explain briefly for the Board?

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what is meant by modeling and what the general procedures are for modeling with regard to a permit application?

A Well, a model is a simulation. I think it's been discussed by the doctor and several other people you take input data, you take emissions calculations, in this case we used the numbers from the permit, you input them into the model. There's two different types of models that you do for a permit like this type, a Class II, the local area, and a Class I, which is those special protected areas. You need meteorology, which has been discussed. Meteorology is what drives the pollutants and moves that pollutants out into the environment. And, of course, there's algorithm that compute that dispersion. That will give you a final estimation or a computer simulated concentration of what -- that you then compare against national standards, such as National Ambient Air Quality Standards and the PSD increments, which were also discussed earlier.

Q Are there different kinds of models? For instance, what is ISC, which Dr. --

A Sure.

Q -- Sahu indicated he has worked with?

A As with any kind models, or even levels of experience in engineering, you have different levels of expertise. With modeling, you're basic model for the last 15, 20 years has been the ISC model, Industrial Source Complex model. That model is being replaced currently by the AERMOD model that I just mentioned. But that's your basic level of model.

Then you go up through some more complicated models, for instance, one called Complex Terrain. It's called CT screen. It's a Complex Terrain screening model. Then you would step up to the next level of expertise would be the model called CALPUFF, which deals with long range transport modeling. That special Class I area we discussed earlier, that's a type of modeling.

And then the most comprehensive difficult and the resource intensive modeling is atmospheric chemistry models. They're on a regional scale. You know, we're talking the entire southeast, everything east of the Mississippi. And those models are used for ozone modeling and fine particulate modeling.

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Q What is the difference between -- the technical difference between ISC and CALPUFF, for example?

A ISC is what's called a straight line model. Basically think of it as a lighthouse. Think of the lighthouse as being the stack, the pollutant, and the pollutant, itself, being the beam of light as it goes out. That beam of light moves one time every hour. That's the meteorology. So you have one set of wind speed, one wind direction, one temperature, and the other variables that go into that. So you have one set of meteorology.

CALPUFF is what's called a puff model. It's a long range transport model that basically simulates the meteorology over a very large area. It's a grid model. It breaks it up into little tiny grid pieces, both X and Y and Z. So in CALPUFF where -- well, ISC, where you may have one set of meteorology that drives the pollutants, in CALPUFF you could literally have tens of thousands, depending on how small of blocks you break it down into. So CALPUFF is much more resource intensive and requires much more expertise and experience in applying it to

determine that the meteorology that you're building in the simulation is appropriate for what you're doing.

Q There was testimony yesterday that for the meteorology you need it is required that there be a year's worth of data. Is that correct?

A Not specifically, no. What the guidelines says, the guideline on air quality models -- It's Section 8.3, Meteorology. Basically it says you must have one year of onsite data or five years of representative data. Now, in this case -- Would you like me to elaborate about that?

Q Please. Please. Please.

A Okay. In this case when the initial pre meetings with URS and Western Greenbrier came in they did propose using ISC with the airport data for this facility as its basic model for the Class II. As an agency we agreed with the doctor and said, "That is inappropriate." And maybe I could draw a diagram to help with his?

Q Please.

A Maybe this will allow me to explain somewhat better. The issue here is that in modeling certain models are appropriate for certain situations.

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That's really the key in modeling. I mean, anybody with computer programming and whatnot can throw numbers in and get a number out, but knowing how to apply it is the key, knowing how that applies to the guidance. That's the difference between a professional modeler and someone who just blends a model here and there. Okay. My drawings tend to look like kindergarten crayon drawings, so please forgive me. Okay. So we have the base of the valley here (indicating), and here's our stack (indicating). This was brought up yesterday. You have your stack height and then you have the plume that comes out (indicating), and the plume will come up and basically disperse in this manner. Now, the final plume height, how high this plume gets is important. Basically the plume, you don't just consider the stack height. You have to consider the thermal bucyancy, you know, the heat pushes it up and it rises. You can see that when you drive past a power plant. It comes up, gets to a certain point, then levels off. That's called the thermal heat.

Now, when you're looking at a terrain where everything is pretty flat, which is the case in

quite a bit of the U.S., this would be called simple terrain. It's very simple in relation to the stack and the plume height. Unfortunately in West Virginia we don't have that luxury. We have hills, river valleys, and of course frequently the stacks are shorter than what the hills around you are. Now, let's assume that as a backdrop here I'm going to draw a range of hills. I realize this is not just like behind the stack, it's in all directions around it, so it's a crude two dimensional representation of a three dimensional effect (indicating). You know, you'll have some mountains that will be below stack height and somewhere there might be one below it. It may be like that, and it applies in all directions.

Now, in modeling terms, anything below the stack height is simple terrain. Anything between the final plume height to stack top is called intermediate terrain. And anything above it, well, is called complex terrain. Now, in this case there were several hills around the facility that fell into this intermediate or complex terrain, principally one ridge line to the south of the facility and there was one ridge line to the north of the facility. Now, when

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you have simple terrain you can use meteorology that's more area wide. The doctor brought up synoptic. That's appropriate in the guidance and pretty commonly used. And airport data, if it's in the same region and sees the same kind of meteorology, is commonly accepted as appropriate.

Now, in the same diagram let's assume that the distance -- We discussed the Beckley Airport data. This here is quite representative of the drawing. So that Beckley Airport data, which monitors this region here where the plume goes up to, is what steers meteorology, the synoptic meteorology. So the data from the Beckley Airport is appropriate for the area wide modeling simulations. That's called the simple terrain. Now what is not appropriate, and this is a determination we made, is those areas where you have intermediate terrain and complex terrain. That's where it's critical to have representative meteorology. That's what the guidance says.

Now obviously the applicant in this case and their consultant did not have that specific onsite meteorology. But remember the guidance doesn't say you have to have onsite meteorology, what it says

is representative data. Now, EPA has anticipated this. They have anticipated you will not always have a met tower right where a source is going to be. So they have developed some models that's called screening models. And what those models do is they look at a wide range of meteorology and have developed a matrix to develop worse case meteorology conditions that you can apply in this situation where you don't have that onsite. Now, there's a tradeoff. In all modeling there's an attempt to be conservative. You always want to make sure that the model develops a number that's a worse case estimate. But in this situation where you have a screening model the level of that conservatism is greatly increased. In other words, you will get much, much higher numbers out of the screening model than you would out of this normal model like ISC that -- if you use onsite meteorology.

Now, in this case what we did was this, EPA developed a method back in 1990 -- 1995, and actually it was pioneered in this state. And when I started here with the agency I worked on it somewhat. But it's become a recognized technique. It's documented in the Model Clearinghouse Guidance. What

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it says is, "Here's a technique to combine the results from ISC for the simple terrain, the area wide," and then you use a model called CT Screen which computes the concentrations for those intermediate and complex terrain areas, principally those two ridge lines, one to the south, one to the north, for those areas. And what you do is you take those two results, you take the worse case results from each model so not only are you modeling with one model, you're modeling with two models, and then you're taking the worse case numbers and using that to judge against the standards. Now, in this case we did that and I will guarantee you, or I can go back and show you, that every single number that you compare against the National Ambient Air Quality Standards and the numbers against the PSD increments was computed with CT Screen. Now, if we would have went back and found appropriate meteorology for here I can guarantee you that those numbers would be lower, in my professional judgement, than the numbers we got from that CT Screen model.

Q When did you do your modeling? And there was some testimony earlier today, a question about whether modeling was done before or after the

BACT analysis and whether or not that's appropriate.

A Sure.

Q When did you do your modeling?

A A PSD permit is a very fluid process, as has been testified to the last two days. A lot of the design work is ongoing as the permitting work is done -- excuse me -- so therefore numbers change as you go along. You know, maybe a determination is made that a limit should be lowered or tightened and so basically the modeling changes over time. So when we get a modeling application in we'll look at it and see if it's generally the approach that we agreed on with the applicant.

Now, the actual modeling is not actually done or reviewed for us until the very last stage, that way we get the final numbers in the permit, we get the final input data, and we get the final emissions levels so that our modeling reflects what the permit is trying to do. So it's actually the very last stage of the permitting process in our office.

Q There's -- The very first stage in the modeling is the development of a modeling protocol?

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A Correct.

Q And that protocol is the guide by which the company does its modeling?

A Correct. Typically before a company does a permit application we'll have a pre-meeting. They'll come in and they will talk to us. They'll say, "Here's the approaches," or they'll ask what our guidance is. They will propose what approaches they are thinking of doing. We'll give our guidance and like, yes, in general we agree with this method or not. And then we have them submit a modeling protocol. The modeling protocol is like any other protocol. It sets out, "Here's how we're going to do it, here's the model we're going to use, here's the options we're going to use, here's the meteorology we're going to use." Typically the State will then review that. If it's a case of a Class I modeling protocol the Federal Land Managers will review that, as well. And EPA also typically is given a courtesy copy of that and they'll tell us what they think about it and then we'll do a formal approval or disapproval. And then the company, once they receive an approval, will do their modeling and submit it as part of the

application.

Q And is part of your job to check to see that they follow the protocol?

A Correct.

Q You mentioned the Class I areas. There was some discussion yesterday about a 50 kilometer --

A Correct.

Q -- versus 20 kilometer situation.

A Sure.

Q Would you discuss that for the Board, please?

A The discussion centered on the fact that in this case Western Greenbrier used a meteorological domain. That's that area, that computer simulation of meteorology in the X, Y, and Z that had been used previously. That is not uncommon. Developing a meteorological domain is an extremely time and resource intensive project. It takes -- There's a very small subset of modelers that do it, that have that kind of expertise and skill. It typically takes months of collecting data from different agencies like NOAA. We also get what's called prognostic data. In other words, data from

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other weather models that the Weather Service uses, and use that as input into our model. And then it can take weeks or months to run these -- this data through.

And commonly these areas will overlap. So if we do a project here in West Virginia, a project is done in Pennsylvania or Virginia, we're all concerned about the same Class I areas. There's four of them in West Virginia and they're all located along the West Virginia/Virginia border. So these regions will overlap. So it's not uncommon if there's already a domain there that the work is already done, you don't need to re-event the wheel to do it.

The concern in this case, though, was is that typically when you do a project you set up a buffer zone on the edges of this domain, because basically in a simulation anything that goes over the edge disappears. For the simulation this domain is the world, there is nothing else. So if a puff of pollutant moves along and gets to the edge it ceases to exist. Now, the concern here is that in this three dimensional meteorology is that puffs don't move in straight lines anymore. Pollutants don't go like a

lighthouse beam out to infinity. They will meander and move and rise and fall and follow terrain. So the idea is you don't want a puff to disappear and to cease to exist in a case where it's important. So you build this buffer zone in. Now, that is a general guideline to do that. That guidance comes from, I believe, that interagency work group on air quality modeling that I discussed earlier that -- So basically that's the guidance, and that's what you're trying to do.

But the thing of it is, you have to take a professional look at this to understand dominant wind directions, what the model does, how the pollutants move. In our case the applicant's facility was towards the western side of the domain. Now, with the predominant wind directions blowing towards the east and given the size and location of the facility it was our professional judgement that in this case you would not see many pollutant puffs make this transition of moving in a clockwise direction and coming back onto the area of interest that we have.

Now, we discussed this with the Federal Land Managers. They were well aware of it. There's

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e-mails in the record, I know. And they initially expressed concern, and we discussed it further with them. After these discussions they were comfortable with the idea. It's documented in the e-mails that they felt our assertion that the conditions that would lead to maximum impacts would not occur, in other words, it wouldn't be a problem what we were doing. They concurred with that.

EPA Region III, their meteorologist, reviews all this modeling as part of the permit process. They get a copy of all of it. They did not have concerns in that situation. And one thing I was kind of confused about in the doctor's testimony was even he said that the FLM's reviewed this and were not concerned. So I wasn't quite sure why that was brought up as a point before the Board, because we reviewed it, the Federal Land Managers reviewed it, the EPA had reviewed it, and everyone with the expertise to look at this had said that they did not believe it was an issue for this permit.

Q In your experience, are the Federal Land Managers shy or bashful?

A We have a long working history with

them. I'm sure all you guys remember Longview and they participated in some of that work. The Federal Land Managers take their jobs very seriously. They are not shy in any way, shape or form about commenting on anything that they feel uncomfortable about. Neither is Region III. Region III is known to be very strict in the nation for modeling work. And if they feel you're stepping outside the bounds they will definitely comment upon it.

Q The last point I would like to cover with you is Dr. Sahu testified, I believe, that he felt that the Department had -- in its modeling had either forgotten or ignored the PM issue.

A No, of course not. We did model for PM10. I think his statement was that we neglected in some way to do a model of analysis for PM2.5. Now, I think it's been brought up in here previously, I think some of this testimony was yesterday after I had to leave, but the Scites memo that has been referenced several times -- and I do have a date for that memo.

Q What was the date for that?

A The date for that memo was October 1997. This is a common piece of guidance that's well

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known for people doing PSD work, you know, over the last five years. And, in short, I mean, this memo states that there are extreme difficulties with implementing modeling and guidance right now for PM2.5. They're working on it. They have not released any guidance whatsoever. But what they have told us to do in this memo is to use PM10 as a surrogate. And so when you do the PM10 work and it passes the PM10 standards, therefore you are meeting the requirements to model PM2.5 as of this time.

MR. HUSON: I tender the witness.

MR. KOON: I tell you what, let's take a break and then we can continue with Mr. Kropp after that. Okay? Let's take ten minutes.

(WHEREUPON, a recess was taken from 10:09 a.m. to 10:25 a.m., after which the following proceedings were had.)

MR. KOON: Okay, let's go ahead and start back. Mr. Kropp, do you have some questions for this witness?

MR. KROPP: I have no questions, Mr. Chairman.

MR. KOON: Mr. Lovett?

MR. LOVETT: Very few.

CROSS-EXAMINATION

BY MR. LOVETT:

Q Do you know what the final plume height is in this case?

A The final plume height would be within the models. I don't know off the top of my head. It's part of the calculations in the modeling.

Q You considered that in the modeling?

A Yes.

Q So you know what -- the agency knows what's in the modeling?

A Yes.

Q You don't know it now?

A No.

Q Now, is it CT Screen? Is that what the model is called?

A Correct.

Q Did you testify that was used for the complex terrain?

A Correct.

Q What was used for the intermediate

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terrain?

A You run both models. You run the CT Screen, as well as the ISC, and you look at the maximum result for each and you take the maximum concentration. Almost always it's CT Screen. In this case I believe it was CT Screen gave us the maximum concentrations for the analysis.

Q I guess, really, if you're using these conservative models there's really no reason to have -- to require a company ever to get site specific data, you would always just rely on these models. Is that correct?

A No, actually we don't.

Q Okay. What experience have you had with getting site specific data?

A Well, we had a large project in Marshall Company where we installed four 100 meter met towers with what's called a sonar unit, it's a ranging unit. We had a project for Cabot Corporation where we installed onsite met data. And there may be a few others.

Q Why did they use that instead of the CT Screen? Why did they go to all that trouble?

A They go to that trouble because the screening model does give very high results, so, therefore, that's usually detrimental to the permit or the application of the applicant. So it's usually beneficial. In this case it's a very small source relatively and so they have the benefit of -- Even though it's estimating very high concentrations relatively to the other model it still falls within that National Ambient Air Quality Standards and the PSD increments.

Q Do you know which five years the meteorological data were used in this?

A I can look in my memo and see.

Q I mean, I can tell you, I think.

A (Witness examines document.) 1996 to 2000.

Q '96 to 2000. That's not what --

A That's what's in the memo. I had to go back and check.

Q Is that memo in the record?

A Yes, it is. That's my modeling memo on the Class II area modeling review.

Q Okay. Now, is there any site specific

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data showing that the predominant wind blows east, or is that just general knowledge?

A Are you talking about the synoptic flow area wide?

Q You testified, I think -- You testified -- We're talking about the grid.

A Okay.

Q I think you testified that you didn't feel the need to go to the west any further because, you know, EPA raises an issue and your judgement was that because the wind blows to the east you were okay over there on the western edge of it?

A EPA did not raise an issue, neither did the Federal Land Managers. We raised the issue --

Q You raised it. Okay.

A -- and after looking at it made the determination. Part of it is there are available data that show historically in the eastern United States, in West Virginia, you can look at wind roses, which are statistical data that shows the wind directions and wind speeds, and it shows that generally from the southeast -- I mean, southwest to the northeast and the from the west to the east are the general wind

patterns.

Q Okay. So that's what you relied on, were wind roses? Just your general experience with wind roses in the state made you believe that?

A Not just the state. This is data published by the Weather Service from NOAA, from looking at other modeling results which takes onsite data -- or site specific data and develops these domains.

Q How does that apply -- How do those wind roses and that data apply to Rainelle, specifically, or to this area, for that matter?

A It applies specifically to that -- There's wind roses for the Raleigh County Airport. Basically what that is is representative of the synoptic flow. Those measurement sites are up on plateaus so they read the higher winds. If you look at the diagram, they read the higher winds that are representative of the area wide meteorology. And so if you look at that for several areas, for all the meteorological stations you have, and from the published data, it gives you the result that I have described.

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Q Well, is the Raleigh County Airport representative of the wind pattern a mile west of this grid down in the Greenbrier Valley?

A In general, yes, because regional winds are consistent over large areas. They're not specific to one small valley down in the valley or to a specific site. So, yes, it is representative of the general area wide meteorology.

Q Okay. And the two ridges that you were worried about in the topographic irregularities, you know, the area down in the valley, do you think that the general wind data from the Beckley Airport, the Raleigh County Airport, is representative of what would happen down there?

A Okay. The plume does not move directly from the stack down into the valley.

Q Right.

A The plume goes up into the atmosphere, into this regional wind pattern, and the regional wind pattern moves that plume out before it starts to disperse and comes down. So, yes, it is representative of the movement of that plume and how that plume will disperse.

Q As I understood it -- Okay. So you think that all that matters is the general wind pattern. The global wind patterns don't matter for the plume or any of the pollutants falling on the Rainelle area?

A Once the plume moves up into the regional meteorology, of which --

Q That wasn't my question. Because I don't understand this well enough to ask you that question. Forget once it moves up into the higher atmosphere. I just want to know if the wind patterns in -- the localized wind patterns will impact the fallout from the pollutants onto Rainelle?

A That's my point. The localized wind patterns do not affect that plume. That plume moves up in the stack height in thermal lift, the buoyancy of the plume, where it is moved by the meteorology. Well, the meteorology that moves it is the regional synoptic flow, not the flow in the valley where Rainelle is. So, therefore, that data is representative of what we need to do for this modeling.

Q And now are you aware of any PM2.5

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modeling done from EPA?

A The modeling guide is for PM2.5, as stated, using PM10 is the surrogate.

Q You're not aware of anything that tells you how to actually model the PM2.5 without using PM10 as a surrogate?

A The only -- For NSR that is the guidance. The modeling for PM2.5 is a regional model which usually takes, I want to say, four to five years to complete solely, includes large regions of the United States, thousands of sources. It's just not done and it is not the guidance of EPA to apply those models at this time for NSR.

Q In this region or nationally?

A Nationally.

MR. LOVETT: That's all I have.

MR. KOON: Mr. Huson, any re-direct?

RE-DIRECT EXAMINATION

BY MR. HUSON:

Q The guidance that you were just discussing, the PM2.5 guidance, and the -- it's based on regional sampling and -- What's its purpose? What's the purpose of the --

A The PM2.5 modeling?

Q Yeah, the 2.5 modeling.

A The purpose of the PM2.5 modeling that's conducted is to address non attainment areas. PM2.5 is a pollutant. It's not like sulfur dioxide, nitrogen oxides. It doesn't -- PM2.5 is what's called a secondary pollutant. It interacts with other pollutants within the atmosphere and transforms as it's there. So it's not like -- It's not similar to the kind of modeling we use for PSD work. So what that is for is to usually examine large urban areas or urban corridors, like the northeast, and determine how to get back into attainment for PM2.5. It's not used to model single sources. And that's the reason why there's not guidance, is because EPA does not know how to do it.

MR. HUSON: No further questions.

MR. KROPP: No further questions.

MR. KOON: Any questions of the Board members?

EXAMINATION

BY MR. CURTIS:

Q Just one, just a curiosity question

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which probably has no applicability to the Greenbrier site. But I'm assuming it's possible that you could have major sources in close proximity so that you would have another major source in the same, I believe domain is the term you used. What happens, then? Is there a way that these models are integrated for over land, or how are those taken into account?

A If you're talking about the Class I modeling where you're looking at those large areas, you know, the protected valley sides and Otto Creek and Shenandoah National Park, you do include other large major sources in those. That's called a PNC, a Cumulative Increment Analysis. And so in this case, I believe for this plant they have a limit to say where you're significant. Significant means you have a significant impact on those areas. And if you have a significant impact, then you have to model all the other large sources and look at their combined impact. In this case Western Greenbrier was insignificant. Their impact on these Class I areas was so small that EPA deems you need to go no further to include those other sources because the individual impact is very tiny.

MR. KOON: Any other questions?

MR. FOSTER: Yeah.

EXAMINATION

BY MR. FOSTER:

Q Do you consider -- Your statement says consider all sources, minor, as well as major, or do you just consider major sources?

A That is a very complicated description. Typically what is done is you look at all major sources, which in West Virginia is Reg 14's. Of course you look at other states, as well, and the guidance from Federal Land Managers. Then you look at what they deem large, minor sources within 50 kilometers of the Class I area. Those are very rare in this state because our Class I areas are very rural and away from industry, so.

MR. FOSTER: Okay. Thank you.

MR. KOON: Thank you.

(WITNESS STANDS ASIDE AT 10:35 A.M.)

MR. HUSON: I have just one other witness. I call Roger Green.

MR. KOON: Mr. Green has been sworn in, right?

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BEFORE THE AIR QUALITY BOARD
CHARLESTON, WEST VIRGINIA

SIERRA CLUB, WEST VIRGINIA HIGHLANDS CONSERVANCY, GREENBRIER RIVER WATERSHED ASSOCIATION,

Appellant,

v. **Appeal No. 06-03-AQB**

JOHN BENEDICT, DIRECTOR, DIVISION OF AIR QUALITY, WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Appellee,

and

WESTERN GREENBRIER CO-GENERATION, LLC,

Intervenor.

FINAL ORDER

I. PROCEDURAL HISTORY

Appeal No. 06-03-AQB was filed by the Sierra Club, West Virginia Highlands Conservancy, and Greenbrier River Watershed Association ("Appellants") with the West Virginia Air Quality Board ("Board") on May 25, 2006. The basis of this appeal is the issuance of PSD Permit Number R14-0028 to Western Greenbrier Co-Generation, LLC ("Intervenor") by the West Virginia Department of Environmental Protection's Division of Air Quality ("Appellee") on April 26, 2006, which allows for the proposed construction of a waste coal-

fired steam electric co-generation facility located in Rainelle, Greenbrier County, West Virginia.

An evidentiary hearing before a quorum of the members of the Board was held on August 29-30, 2006. Joseph M. Lovett, Esquire represented the Appellants. Roland T. Huson, III, Esquire, of the Department of Environmental Protection Office of Legal Services, represented the Appellee, and Edward L. Kropp, Esquire, of Jackson Kelly PLLC, represented the Intervenor. The Board was comprised of J. Michael Koon, Chairperson; Dick Calvert; Randy E. Curtis; Robert Foster; R. Thomas Hansen; and Douglas E. Hudson.

Prior to the hearing, Intervenor filed a "Motion for Protective Order" on August 28, 2006. Intervenor requests the Board grant this Motion to protect Proposal No. 7240604 to Intervenor from Alstom dated November 11, 2005 from public disclosure and further requests the Board rule that it is exempt from public disclosure under FOIA's "trade secret" exception. Finding it proper to do so, the Board **GRANTS** Intervenor's "Motion for Protective Order."

Subsequent to the hearing, Appellee and Intervenor both filed motions to strike revisions to Appellants' Proposed Findings of Fact and Proposed Conclusion of Law on November 15, 2006 and November 17, 2006, respectively. Appellee and Intervenor request that the Board strike Appellants' revisions as being unwarranted and unauthorized. Finding it proper to do so, the Board hereby **DENIES** Appellee's and Intervenor's motions to strike revisions to Appellants' Proposed Findings of Fact and Proposed Conclusions of Law, which were filed with the Board on November 9, 2006.

Also subsequent to the hearing, Intervenor filed a "Motion to Supplement Response to Appellants' Proposed Findings of Fact and Conclusions of Law" to incorporate the

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Pennsylvania Environmental Hearing Board's decision in EHB Docket No. 2005-246-R into Intervenor's Response to Appellants' Proposed Findings of Fact and Conclusions of Law. Finding it proper to do so, the Board **GRANTS** Intervenor's motion to supplement its response to Appellants' Proposed Findings of Fact and Conclusions of Law.

In deciding this appeal, the Board reviewed and considered the certified file, the relevant law and regulations, the Notice of Appeal, all written filings and memoranda, the testimony of the witnesses, exhibits, and arguments by counsel. In accordance with *West Virginia Code* §22B-1-7(g)(1), the Board **AFFIRMS** Appellee's issuance of Permit Number R14-0028 to Western Greenbrier Co-Generation, LLC on April 26, 2006.

All proposed findings submitted by the parties have been considered and reviewed in relation to the adjudicatory record developed in this matter. All argument of counsel, proposed findings of fact and conclusions of law have been considered and reviewed in relation to the aforementioned record, as well as to applicable law. To the extent that the proposed findings of fact, conclusions of law and arguments advanced by the parties are in accordance with these findings of fact, conclusions and legal analysis of the Board and are supported by evidence, they have been adopted in their entirety. To the extent that the proposed findings, conclusions, and arguments are inconsistent therewith, they have been rejected. Certain proposed findings and conclusions have been omitted as not relevant or necessary to a proper decision. To the extent that the testimony of the various witnesses is not in accord with the findings stated herein, it is not credited.

II. STANDARD OF REVIEW

The Board hears appeals of enforcement actions in accordance with *West Virginia Code* §22B-1-7. The applicable standard of review of the Appellee's action is *de novo* review. *West Virginia Code* §22B-1-7(c). Pursuant to *de novo* review, the Board does not afford deference to the decision of the Department of Environmental Protection, but rather, the Board acts independently on the evidence before it. *West Virginia Division of Environmental Protection v. Kingwood Coal Company*, 200 W.Va. 734, 745, 490 S.E. 2d 823, 834 (1997).

To prevail in the appeal, the Appellant must raise an issue with sufficient evidence to support a finding that the Appellee's decision was incorrect. If sufficient evidence supported such a finding, then the Appellee would have to produce the evidence demonstrating why its decision was sound, regardless of the Appellant's evidence. The Appellant has an opportunity to show that the evidence produced by the Appellee is pre-textual or otherwise deficient. This shifting burden of proof standard was set out in *Wetzel County Solid Waste Authority v. Chief, Office of Waste Management, Division of Environmental Protection*, Civil Action Number: 95-AA-3 (Circuit Court of Kanawha County, 1999). While *Wetzel County* is merely persuasive authority, the Board agrees with the analysis and has used that test here.

III. DISCUSSION

This Appeal involves PSD Permit No. R14-0028, issued by Appellee to Intervenor on April 26, 2006, for the proposed construction of a waste coal-fired steam electric co-generation facility.

Appellants allege that the issuance of the permit is arbitrary, capricious, and contrary to law and fact, and threatens to cause injury to Appellants and to its members in the form of

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increased exposure to air pollution and to water pollution caused by atmospheric deposition, increased risk of illness, restriction of recreational enjoyment, and deprivation of the right of meaningful participation in the permitting process.

The thrust of Appellants' argument is that the Best Available Control Technology ("BACT") analysis performed was contrary to law and fact for all emission units because it (1) failed to identify all available control technologies, (2) improperly eliminated technologies based on cost; (3) failed to evaluate lowest achievable emission rate technologies at the top control option, (4) limited the control options to only those used on the same type of boiler burning waste coal, (5) improperly eliminated control options as not cost effective based on incremental costs, (6) rejected BACT decision by other permitting authorities because they were not yet operating, and (7) failed to consider all available sources of information.

Appellants persuaded the Board that BACT is technology forcing. However, the Board disagrees with Appellants in its assertion that this was a "bottom up" analysis and finds that the West Virginia Department of Environmental Protection made an informed determination about the best available control technology.

The New Source Review Manual (Appellants' Ex.11) states that in determining the technical feasibility of "available" control technologies:

> "[a] source would not be required to experience extended time delays or resource penalties to allow research to be conducted on a new technique. Neither is it expected that an applicant would be required to experience extended trials to learn how to apply a technology on a totally new or dissimilar source type."
> (Page B. 18)

The Board finds that it is appropriate to make each individual BACT determination on a "case-by-case" basis using available and applicable technologies. The Board finds that a BACT

permittee is not required to innovate or to push technology beyond what is available and applicable.

IV. FINDINGS OF FACT

1. Intervenor is a non-profit, limited liability company, owned by three small West Virginia municipalities: Rupert, Rainelle, and Quinwood, Greenbrier County, West Virginia.
2. The Department of Energy ("DOE"), through its Clean Coal Power Initiative Project, has committed to provide Intervenor with $107,500,000.00 in public funding in order that Intervenor "demonstrate" Alstom Power Company's "inverted cyclone circulating fluidized bed boiler ("CFB Boiler").
3. An inverted cyclone CFB Boiler of this size and scale uses coal ash and/or limestone to make a "bed" of particulate matter. Combustion air is passed through the bed causing the particulate matter to become partially supported and circulated. This results in a circulating fluidized mass which in turn allows the combustion process to be adjusted to limit emissions. Specifically, the CFB Boiler's temperature can be controlled to reduce the amount of nitrous oxide ("Nox") created by the combustion process.
4. The proposal submitted by Intervenor involved the construction of a seventy-five megawatt (now a ninety megawatt) electric co-generation facility and cement production facility to be located in Rainelle, West Virginia. The electric co-generation facility would initially be fueled by waste coal taken from the nearby Anjean waste coal mountain.

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5. The facility is designed so that emissions generated from the electric co-generation facility and the cement production facility are exhausted through the same stack fitted with emission control technologies. Specifically, the facility as proposed includes the use of a CFB Boiler and selective non-catalytic reduction ("SNCR") to remove the NOx, the injection of limestone into the fluidized bed coupled with a flash dryer absorber ("FDA") to remove sulfur dioxide ("SO2"), and a baghouse or fabric filter to remove particulate matter.

6. On March 1, 2005, Intervenor submitted its first iteration of the application and the twelve-thousand dollar ($12,000.00) application fee.

7. On March 2, 2005, Appellee sent a copy of Intervenor's permit application to the Rainelle Public Library so that the permit would be available to the public.

8. On March 28, 2005, Joe Kessler, Division of Air Quality Permit Engineer on this project, sent Intervenor a letter notifying them of several deficiencies within the application, such as (1) a class one area air quality impact analysis was not included for Dolly Sods/Otter Creek Wilderness Areas, Shenandoah National Park, and James River Face Wilderness Area, (2) a class two area air quality impact analysis was not included, (3) an additional impacts analysis was not included, (4) a process flow diagram was not included, and (5) an original affidavit of publication verifying that a class one legal advertisement was placed in a paper of general circulation in the area where the source is to be constructed was not included.

9. On May 18, 2005, Intervenor submitted a revised permit application to Appellee completely replacing the prior application and stating that all prior deficiencies had been corrected.

10. On May 18, 2005, Appellee sent a copy of Intervenors's revised permit application to the Rainelle Public Library so that the permit would be available to the public.

11. On June 13, 2005, Mr. Kessler sent Intervenor a letter of deficiency notifying them of the application's lack of computer modeling files and failure to include updated tables.

12. On June 15, 2005, Intervenor sent Appellee a hard drive containing the files utilized in both the Class I and Class II ambient impact analysis and the updated tables, as requested.

13. On October 25, 2005, Intervenor revised its permit application in the form of an addendum including the following information: (1) additional waste fuel cases, (2) revision to exhaust configuration for kiln and boiler, (3) deletion of certain waste coal processing operations, and (4) additional documentation and cost analysis to support the BACT analysis.

14. On October 26, 2005, Appellee sent a copy of Intervenor's revised permit application to the Rainelle Public Library.

15. On November 14, 2005, Intervenor submitted updated Section 6 and 7 Air Quality Analyses and one hard drive containing the Class I and II modeling files.

16. On January 13, 2006, in response to a meeting between Intervenor and Appellee, Intervenors again revised the permit application by: (1) proposing a smaller kiln size, (2) analyzing coal benefication, and (3) correcting the NAAQS analysis for SO2.

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17. On January 17, 2006, Appellee sent a copy of Intervenor's revised permit application to the Rainelle Public Library so that the permit would be available to the public.

18. On March 8, 2006, Appellee issued its preliminary determination, proposed permit, public notice for a thirty (30) day comment period, and direct notice by mail to all those who had commented during the process.

19. On April 26, 2006, Appellee issued Permit No. R14-0038 to Intervenor.

20. On May 25, 2006, Appellants filed a Petition for Appeal with the Board alleging that Appellee's actions in granting the permit were arbitrary, capricious, and contrary to law and fact.

21. A hearing on the merits was held on August 29-30, 2006.

22. Appellants' only witness in the August 29-30, 2006 hearing before the Board was Dr. Ron Sahu.

23. Appellee and Intervenor presented three witnesses in the August 29-30, 2006 hearing before the Board: Jerry Joseph, a registered professional engineer: Joe Kessler, a registered professional engineer; and Chris Arrington, an air quality dispersion modeling expert.

24. During the hearing, Appellants did not introduce evidence to support Dr. Sahu's contention that (1) SCR was economically feasible, (2) that SCR could have been placed in a high dust pre-baghouse position, and (3) SNCR was not BACT.

25. At the hearing, Appellants did not move to admit evidence supporting Dr. Sahu's assertion that: (1) limestone injection coupled with an FDA was not BACT for SO2, (2)

a wet scrubber was economically feasible, and (3) the 5,000/ton-pollutant removed EPA guideline was a bright-line rule.

26. During the hearing, Appellants failed to introduce evidence support Dr. Sahu's claim that use of PM10 as a surrogate for PM2.5 somehow flawed the BACT analysis.

27. At the hearing, Appellants did not offer evidence supporting Dr. Sahu's claim that Hydrogen Fluoride was treated as a Fluoride under the CAA, and therefore, Appellee/Intervenor's BACT analysis was flawed for failure to consider Hydrogen Fluoride. Furthermore, Dr. Sahu himself conceded on cross examination that Hydrogen Fluoride was not treated as a Fluoride for purposes of the CAA, and therefore, Appellee/Intervenor's BACT analysis had not been flawed due to the proper omission of a hydrogen fluoride analysis.

28. Appellants did not introduce evidence supporting Dr. Sahu's unqualified opinion that the modeling done in this case was defective.

29. As set forth in its original and revised applications, Intervenor, with the assistance of URS Corporation ("URS"), a design and engineering firm, conducted a BACT analysis for the control of major sources of pollutants, including Nox, SO2, PM, CO, and H2SO4.

30. Appellee independently reviewed Intervenor's BACT analysis and properly conducted a top down BACT analysis, as required by EPA guidelines. Based on this review, Appellee approved the use of a CFB Boiler and SNCR to remove Nox, the injection of limestone into the fluidized bed coupled with an FDA to remove SO2, and a baghouse or fabric filter to remove PM. Appellee concluded that serious technical, economic,

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environmental and energy considerations prevented selection of: (1) SCR for Nox removal and (2) Wet Flue Gas Desulphurization Scrubber ("wet scrubber") for removal of SO2.

31. The BACT analysis resulted in the use of an SCR being properly excluded as being "economically infeasible." The cost analysis revealed that the average cost effective of SCR was $30,224/tons-SO2 removed and resulted in an additional for combustion of 9.5 millions gallons/year of fuel oil for reheat, 23 tons per year of CO emissions and 37 tons per year of SO2 emissions, and added NH3 emissions from ammonia slip.

32. According to Joe Kessler and Jerry Joseph, Alstom Power Company, a vendor of SCR systems, and a separate BACT review conducted by Pennsylvania, SCR cannot feasibly be placed in a high dust, pre-baghouse position without significant catalyst fouling.

33. The BACT analysis resulted in the installation of a wet scrubber being properly ruled out as being "economically infeasible" where a cost analysis revealed that the average cost effectiveness of limestone injection with a wet scrubber was $4,604/tons-SO2 removed in addition to the environmental impacts of additional water usage, waste water disposal and solid waste disposal.

34. The air dispersion modeling was properly conducted based on the fact that Chris Arrington testified that: (1) both models were simulated according to the guidelines and were even more conservative than necessary, (2) the guidelines require "representative data," not just on-site (local) meteorology, and (3) he took predominate wind directions and the size and location of the facility into consideration when determining that

pollutant "puffs" would not rotate in a clockwise direction and move against the predominate wind direction into the area of concern raised by Dr. Sahu.

35. The Appellee analyzed PM10 as a surrogate for PM2.5 in its air quality dispersion modeling analysis of Intervenor's facility.

V. CONCLUSIONS OF LAW

1. Intervenor conducted a BACT analysis for pollutants the proposed facility has the potential to emit in significant amounts. This analysis was conducted in accordance with applicable laws and regulations.

2. Appellee issued Permit No. R14-0028 in compliance with *West Virginia Code* §45-14-8.2; *West Virginia Code* § 45-14-2.12; West Virginia Code §45-14-4; and West Virginia Code §45-14-9.

3. In issuing Permit No. R14-0028, Appellee complied with procedural requirements as required by applicable laws and regulations.

4. BACT is defined as an emission limitation (based on the maximum degree of reduction for each regulated NSR pollutant, which would be emitted from any proposed major stationary source) which the reviewing authority, on a case-by-case basis, taking into account energy, environment, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combination techniques for control of such pollutant. . . . If the reviewing authority determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the

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imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard or combination thereof, may be prescribed instead to satisfy the requirement for the application of BACT.

5. The Board hears appeals of permitting actions under a *de novo* standard, pursuant to West Virginia Code §22B-1-7(e) and, therefore, the Board does not afford deference to the Director's action, but rather, the Board acts independently on the evidence before it. *West Virginia Div. Of Env't Prot. V. Kingwood Coal Co.*, 200 W.Va. 734, 745, 490 S.E. 2d 823, 834 (1997).

6. When pursuing an appeal before the Board, the Appellant has the burden to provide sufficient evidence to support a finding that the Appellee's action was incorrect. If the Appellant provides sufficient evidence, the burden shifts over to the Appellee who must then produce sufficient evidence to support its decision. At that point, the burden shifts back to the Appellant who has the final opportunity to show that the evidence produced by the Appellee is pre-textual or otherwise deficient. *Wetzel County Solid Waste Authority v. Chief, Office of Waste Management, Division of Environmental Protection*, Civil Action Number 95-AA-3 (Circuit Court of Kanawha County, 1999)

VI. CONCLUSION

For all the reasons set forth in these Findings of Fact and Conclusions of Law, the Board hereby **AFFIRMS** the Division of Air Quality's April 26, 2006 final determination to issue Permit No. R14-0028.

It is so ordered on this 28th day of February, 2007.

R. Thomas Hansen, Vice-Chairperson
Air Quality Board

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BEFORE THE WEST VIRGINIA AIR QUALITY BOARD
CHARLESTON, WEST VIRGINIA

SIERRA CLUB, WEST VIRGINIA HIGHLANDS CONSERVANCY,
GREENBRIER RIVER WATERSHED ASSOCIATION,

Appellant,

v. Appeal No. 06-03-AQB

DIRECTOR, DIVISION OF AIR QUALITY,
DEPARTMENT OF ENVIRONMENTAL PROTECTION,

Appellee,

and

WESTERN GREENBRIER CO-GENERATION, LLC,

INTERVENOR.

CERTIFICATE OF SERVICE

This is to certify that I, Jackie D. Shultz, Clerk for the Environmental Quality Board, have this day, the 28th day of February, 2007, served a true copy of the foregoing "FINAL ORDER" to all parties in Appeal No. 06-03-AQB, by mailing the same via United States Mail, with sufficient postage, to the following address:

via certified mail:

Joe Lovett, Esquire
Appalachian Center for the Economy
And the Environment
PO Box 507
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John Benedict, Director
Division of Air Quality
WV Department of Environmental Protection
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Jackie D. Shultz
Jackie D. Shultz, Clerk

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APPENDIX P*

Coal Refuse Remediation – Ash Application Studies

New appendix added for Final EIS.

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Table 1. Summary of Case Studies of Ash Application for Mine Land Reclamation and AMD Mitigation.

Case	Name	Description	Results
1	Wyodak Mine, WY	Placement of coal ash in an active surface mine.	No significant change in groundwater quality following placement.
2	Keenesburg Mine, CO	Placement of coal ash in a closed surface mine.	No significant change in groundwater quality.
3	Trapper Mine, CO	Placement of coal ash in an active surface mine.	Elevated sulfate levels in groundwater. No significant change in other analytes.
4	Savage Mine, MT	Placement of coal ash in an active surface mine.	Slight increase in arsenic at two wells, as well as TDS and sulfate.
5	Storm Strip Mine, WV	Placement of coal ash in an active surface mine.	No significant change in groundwater quality.
6	Universal Mine, IN	Placement of coal ash in a closed surface mine.	*Groundwater*: Arsenic and boron increased slightly; iron, sulfate and manganese decreased. *Mine seep*: Boron, pH and alkalinity increased; acidity, iron, manganese and sulfate decreased.
7	Midwestern Abandoned Mine, IN	Capping of an abandoned and reclaimed mine using an ash mix.	Recharge of water into AMD site reduced, resulting in reduced AMD generation.
8	Arnold Willis Mine, IN	Injection of scrubber sludge into a closed underground mine.	Heavy metals in groundwater unaffected but TDS increased.
9	Clinton County, PA	Injection of CFB ash to encapsulate AMD-producing materials in a reclaimed surface mine.	Groundwater pH increased temporarily, and As, Cd and Al decreased. pH later decreased and Al increased, but As and Cd remained low.
10	Red Oak Mine, OK	Injection of FBC ash into a closed underground mine.	pH of mine seep increased, Al, Mn, Fe decreased.
11	Frazee Mine, MD	Injection of ash grout into a closed underground mine.	pH of mine seep increased by 1 unit. Fe, Al, sulfate and trace metals decreased; Na, K, Ca and Cl increased.
12*	Ebensburg, PA	Use of bituminous coal refuse (gob) from an abandoned deep mine, followed by FBC ash application to reclaim the disturbed land.	Acidity, aluminum and sulfate declined steadily, as well as volume of flow. As and Se increased early on, but have declined steadily since.
13*	McDermott, PA	Remining and use of alkaline ash to reclaim a closed surface mine.	Acidity, sulfate and iron increased in groundwater as well as mine seep.
14*	Abel-Dreshman Site, PA	Use of alkaline ash to reclaim a closed surface mine.	Alkalinity and pH in mine seep increased and aluminum decreased.
15	Wheelabrator Frackville, PA	Use of anthracite coal refuse (culm) as fuel, followed by FBC ash application to reclaim the refuse site.	No significant change in water quality.
16	Mount Carmel, PA	Use of anthracite coal refuse (culm) as fuel, followed by CFB ash application to reclaim the refuse site.	Acidity and sulfate in groundwater decreased, while alkalinity increased.

**Discussed in greater length in this appendix – in paper "Coal Ash Beneficial Use on Bituminous Mine Sites" (Kania and Tarantino)*

PENNSYLVANIA GENERAL ASSEMBLY

JOINT LEGISLATIVE AIR AND WATER POLLUTION CONTROL AND CONSERVATION COMMITTEE

REPORT ON

A PROPOSED MORATORIUM ON THE USE OF FLY ASH IN MINE RECLAMATION PROJECTS

(Without Appendices)

February, 2004

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TO: **All Members of the General Assembly**

FROM: **Representative Scott E. Hutchinson, Chairman**
Senator Raphael J. Musto, Vice Chairman

SUBJECT: **A Proposed Moratorium on the Use of Fly Ash in Mine Reclamation Projects**

DATE: **February, 2004**

The following report is a result of a public hearing held by the Joint Legislative Air and Water Pollution Control and Conservation Committee on July 9, 2003 in Tamaqua, Pennsylvania. The purpose of the hearing was to discuss a proposed moratorium on the use of fly ash in mine reclamation projects. The recommendations presented in this report are the result of that hearing.

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EXECUTIVE SUMMARY

The Joint Legislative Air and Water Pollution Control and Conservation Committee (Committee) has been asked to offer the Pennsylvania General Assembly a recommendation on whether there should be a statewide moratorium on the use of coal combustion waste (CCW), also referred to as fly ash and coal ash, for mine reclamation purposes. In order to gather the necessary information to make such a recommendation, the Committee conducted a public hearing on July 9, 2003 in Tamaqua, Pennsylvania, a site where fly ash is being used to reclaim an abandoned mining pit, and where expanded use of fly ash is being considered.

The issue is both an emotional and technical one and the debate over the use of CCW is marked by impassioned opinions as much as empirical evidence. There have been many questions posed and a number of questions unanswered. The Committee has sought diligently to find the facts using solid, peer-reviewed science to make its recommendations surrounding the use of fly ash in an attempt to answer the many questions posed. While the facts are foremost, they are not the only consideration. Testimony received by the Committee indicated there are many concerns about the use of fly ash, but there are also serious statewide implications about coal mine safety in terms of acid mine drainage, pedestrian safety around abandoned mine workings, and mine subsidence. Just as there are concerns about the impact of fly ash on water quality, there are concerns about the future of cogeneration and its impact on jobs and the economy in Pennsylvania. And, just as there are concerns about the dirt, dust, and transportation impacts, there are concerns about the progress of abandoned mine reclamation throughout the state.

These issues were the subject of testimony at the Committee's public hearing. The testimony reflected differences in opinion and presented differences in matters of fact and interpretation. It is our mandate to weigh the facts, both agreed upon and subject to debate, consider both shared and conflicting concerns, seek reconciliation and use good science to make judgment and recommendation.

The Committee prides itself on its rich history and vital role in offering legislation and recommendations to the General Assembly that have helped strengthen and enhance Pennsylvania's environment over the past 35 years. The Committee has been a pioneer in assisting in the cleanup of abandoned coal mines and has offered legislative recommendations regarding mining and reclamation practices in the past.

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The protection of water quality and the conservation of natural resources in Pennsylvania is a Committee priority. Ample evidence has been provided by industry, environmental organizations, academia, federal and state regulatory agencies demonstrating the significant economic and environmental benefits fly ash plays in the reclamation activities of abandoned mine lands if properly managed. The Committee believes that the *improper* use of fly ash can pose a significant environmental and public health threat. However the Committee also believes that proper fly ash use can and is adequately enforced by state and federal regulatory agencies in Pennsylvania.

After reviewing the issue surrounding the use of fly ash for coal reclamation projects, it has become increasingly obvious that Pennsylvania has a carefully crafted regulatory scheme that is a model for the nation. It draws upon 30 years of experience in using fly ash for mine reclamation and integrates the state's residual waste management program with its federally approved surface mining program. The effects of the program on the environment, natural resources, public health and safety, and the economy have been evaluated by the General Assembly and reviewed by related agencies, the Environmental Quality Board and the Independent Regulatory Review Commission, as part of their adoption of legislation, regulations, policies and guidance.

The program, as set forth in historical detail to follow, has peer-reviewed uniform standards for fly ash quality and placement that are implemented in the permitting process and incorporate site-specific considerations of geology and hydrology. The program mandates frequent and detailed monitoring of both fly ash quality at its source and the groundwater quality at the mine site as part of the permitting conditions. Finally, the Pennsylvania Department of Environmental Protection (DEP) exercises extensive oversight, inspection and enforcement power to ensure compliance with the requirements of Pennsylvania's Solid Waste Management Act, 35 P.S. Chapter 6018.101 et seq., the Surface Mining Conservation and Reclamation Act, 52 P.S. Chapter 1396.1 et seq., and the Clean Streams Law, 35 P.S. Chapter 691.1 et seq.

Therefore, the Committee makes the following recommendations with regard to a moratorium on the use of fly ash in Pennsylvania:

1. **The Committee does not recommend or support a statewide moratorium on the use of fly ash in coal mine reclamation projects as requested in the public hearing on July 9, 2003. The beneficial use of coal ash, including mine reclamation, has been well documented and the potential risks have been thoroughly examined and these results have been reported to local, state and federal agencies. The Committee has researched data from a dozen sites in Pennsylvania and found that coal ash can be effectively and safely used when properly managed. The information also demonstrates the significant economic and environmental benefits coal ash plays in the reclamation activities in the Commonwealth.**
2. **The Committee recommends the continued research into the environmental effects of fly ash on soils and waters of the Commonwealth and the impacts posed by trace elements contained in the material. While the Committee believes that improper use of fly ash can pose a threat to public health and the environment, proper fly ash use is being adequately enforced by state and federal regulatory agencies. However, there is room for improvement. The Committee does, in fact, recognize citizen questions and concerns about the possible presence of certain chemicals in fill material (i.e., hexavalent chromium) and has therefore requested an independent study to be conducted to further investigate the biology, chemistry, placement and use of the ash material in mine reclamation projects in Pennsylvania.**
3. **As an added protection measure to the current regulatory program, the Committee recommends that a statewide, third party oversight subcommittee be established through the Mining Reclamation and Advisory Board or the Citizen's Advisory Council with a specific charge to oversee the state regulatory program. The subcommittee would include representation from groups or individuals concerned with the beneficial use of fly ash on abandoned mine lands. The statewide subcommittee would review results of biological, chemical and physical tests, and make necessary recommendations for changes to the current regulatory standards set by DEP and the United States Environmental Protection Agency (EPA).**
4. **DEP, environmental organizations, industry and the newly established oversight subcommittee should also consider and study the undocumented threat coal refuse piles themselves pose to human health and the environment and evaluate the safety hazards posed by abandoned mines throughout the Commonwealth such as dangerous high walls and water filled pits. The question of whether these unremediated sites may pose significantly more hazards to the environment if they are not beneficially remediated needs to be addressed.**
5. **The electric utility industry needs to address the issue of public education and the utilization of CCW. Environmental performance data needs to be developed and made available to the public from full-scale demonstrations of beneficial use applications. The information that industry, federal and state governments have generated needs to**

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be made more available to regulators and the citizens of the Commonwealth and others.

6. **The CCW industry needs to be vigilant about the use of appropriate testing and monitoring methods and interpretation of data, and to communicate with state and federal agencies on the further development of regulatory guidelines for CCW management.**

LEGISLATIVE AND REGULATORY REVIEW OF COAL ASH USE IN PENNSYLVANIA

Prior to examining the regulatory program, it may be important to look at the legislative and regulatory pathway that led to Pennsylvania's coal ash management program. In deciding under what circumstances a material may be beneficially used, the General Assembly has to examine all sides of an issue and balance environmental impacts with social and economic concerns, public health and safety issues, along with the use of our natural resources. Legislative and regulatory control of the beneficial use of CCW began in 1986 when the overwhelming passage of House Bill 2274 amended the Solid Waste Management Act to include the recycling and beneficial reuse of CCW. (Following an extensive review process, HB 2274 passed the House by a 195-2 vote and the Senate by a 49-0 vote and was signed into law as Act 168 on December 12, 1986.)

Such amending legislation authorized the establishment of siting criteria and design and operating standards for the beneficial use of coal ash for use as structural fill, soil substitutes and additives. In its mandate to fulfill Article I, Section 27 of the Pennsylvania Constitution, the General Assembly looked at the nature of coal ash, the economic and environmental impacts of coal ash disposal in landfills, the public health and safety benefits of removing mine hazards, the economic and environmental benefits of abating acid mine drainage and the reclamation of mine sites versus the impact of beneficial uses of coal ash. The General Assembly concluded that any potential adverse impacts associated with the beneficial use of coal ash for mine fill and other purposes were minimal compared to the environmental and social benefits of its use.

At the same time, the Environmental Quality Board (EQB) an independent legislative body charged with promulgating regulations for the management of coal ash adopted the regulations governing coal ash in 1992, and the subsequent amendments in 1997 and 2001. EQB's rulemaking, which provided the public with comment periods that extended well beyond the required periods mandated by the Regulatory Review Act, 71 P.S. Chapter 745.1 et seq, made a reasoned judgment based on scientific, technical environmental and social benefits to adopt the regulatory program now in place.

In conjunction with the General Assembly and the EQB, the Independent Regulatory Review Commission (IRRC), an independent executive agency, reviewed the beneficial use regulations on three separate occasions and in doing so, also considered all of the same impacts that the previous legislative bodies had considered and concluded that the regulations were in fact, in the public interest.

All three separate bodies reviewed the science, technology and data associated with the beneficial use of coal ash and concluded that the regulatory program is protective of the environment and public health and the adverse impacts, if any, are minimal and balanced by the overall environmental, economic and social benefits of the current program. Nothing that has been presented to the Committee has altered that conclusion.

However the list of oversight doesn't stop there. The General Assembly created the Mining and Reclamation Advisory Board (MRAB) in 1984 by Act 181. The purpose of the board's creation was to assist DEP in expanding reclamation funds provided by the Surface Mining Conservation and Reclamation Act and to *advise* DEP on public matters pertaining to mining and reclamation and abandoned mine reclamation issues.

DEP also solicits and receives input on proposed changes to the mining program from the Citizen's Advisory Council (CAC). The council**,** created in 1971, is the only legislatively mandated advisory committee with the comprehensive charge to review all environmental legislation, regulations and policies affecting DEP. Both the MRAB and the CAC have weighed in on this issue. Both the MRAB and the CAC are supportive of DEP's regulatory program and do not support a moratorium on the use of fly ash.

DEP REGULATIONS

CCW is regulated under Pennsylvania's Solid Waste Management Act (PASWMA). In 1986, the act was amended to establish provisions for the beneficial use of the material. The provisions for beneficial use apply not only to fly ash but also other ash materials derived from the combustion of coal. Regulations regarding the beneficial use of CCW were adopted in 1992 as a part of Pennsylvania's Residual Waste Management Regulations for the use of coal ash as a soil substitute or soil additive and as placement for fill material at surface mines, coal refuse reprocessing operations and coal refuse disposal sites.

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DEP administers the program and the Bureaus of Mining and Reclamation and District Mining Operations have the responsibility of managing coal ash on active coal mining operations. The Bureau of Abandoned Mine Reclamation has program responsibilities for use of the material on abandoned mines. The Bureau of Land Recycling and Waste Management has the program responsibility for the beneficial use of coal ash at sites other than coal mining operations.

The Solid Waste Management Act and the residual waste management regulations authorize the beneficial use of coal ash as a structural fill; soil substitute or additive; for reclamation at an active surface coal mine site, a coal reprocessing site, or a coal refuse disposal site; for reclamation at an abandoned coal or an abandoned non-coal industrial mineral site; in the manufacture of concrete; for the extraction or recovery of one or more materials contained within coal ash; for mine subsidence and control, mine fire control and mine sealing as a drainage material or pipe bedding and as a stabilized product where the physical and chemical characteristics are altered so that the potential of the coal ash to leach constituents into the environment is reduced. All of these uses must comply with specified state regulations.

The Pennsylvania regulations reference the federal regulations exempting fly ash and other waste generated primarily from coal combustion or other fossil fuels as hazardous waste (25 PA Code Chapter 261.A.1.4). As mentioned above, CCW is regulated under the Solid Waste Management Act and the residual waste management regulations. In December 1986, this act was amended to authorize the beneficial use of coal ash. Beneficial use of coal ash was implemented through DEP guidelines under the residual waste management regulations, 25 PA Code Chapter 287, which was amended in July 1992 to include the beneficial use of coal ash, 25 PA Code Chapter 287.661-287.666. In January 1997, the beneficial use of coal ash regulations 25 PA Code Chapter 287.663 and 287.664 were amended to change the requirements concerning groundwater monitoring, reporting requirements, beneficial uses and the amounts of coal ash that can be used at active coal mine and abandoned mine sites.

Coal ash is defined in Pennsylvania as fly ash, bottom ash or boiler slag resulting from the combustion of coal.

Pennsylvania residual waste management regulations provide that coal ash may be beneficially used:

- As structural fill upon approval from DEP.
- As a soil substitute or soil additive.
- For reclamation at an active surface coal mine site, a coal refuse reprocessing site, or coal refuse disposal site if the use complies with all the specified requirements under PA Code Chapter 287.663, the Clean Stream Law and regulations promulgated there under, the Surface Mining Conservation and Reclamation Act (52P.S. Chapter 1396.1-1396.19a), the Coal Refuse Disposal Control Act (52 P.S. Chapter 30.51), and the applicable provisions of 86-90.
- For reclamation at an abandoned coal mine site, the use must comply with 25 PA Code Chapter 287.664 and the applicable environmental statutes stated above.
- In the manufacture of concrete.
- For mine subsidence control, mine fire control and mine sealing, as a drainage material or pipe bedding, if the person or municipality proposing the use gives advance written notice to the DEP and the range of pH of the coal ash is in a range that will not cause or allow the ash to contribute to water pollution and is consistent with applicable DEP requirements.

Much of the criticism of Pennsylvania's regulatory program voiced during the Committee's public hearing focused on isolated regulations taken out of a larger context of the residual waste management and mining activity regulatory programs. Critics focused on groundwater quality issues and criticized legislation addressing remining of areas with preexisting pollutional discharges. Clearly, the residual waste regulations at 25 Pa. Code prohibit the placement of coal ash within specific distances (eight feet) of the regional groundwater table, unless it can be proved to DEP that groundwater contamination will not occur as part of an abatement project.

When addressed specifically, the allegations made against the program proved to be unsubstantiated, without technical, scientific or peer-reviewed facts. After examination of the three most significant sites alleged to have caused damage relating to the placement of ash at mine reclamation sites, Ernest, Revloc, and Maple Coal, the sites showed no evidence of environmental damage. In fact, information relating to the groundwater damage cited in testimony were temporary results related to initial disturbance and removal of coal refuse and monitoring of water quality. In some cases, water quality improved over pre-placement levels.

With regard to ash placement versus common soils in the area, independent tests, studies and agency monitoring data all show levels of trace elements and major elements in soils including arsenic, mercury, lead, chromium, cadmium, and others that are comparable to the levels of those elements in ash produced at power plants in the area. If the volume of exposed area of the local soils is compared with ash placement, the soils in the surrounding area contain greater amounts of

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background elements than is contained in the placement of ash. This also holds true for culm and gob piles. Although concentrations of trace elements in refuse coal are similar to ash, burning of coal refuse decreases the mobility and toxicity of these elements. Therefore the amount of mobile toxic elements in the abandoned coal refuse piles exceeds the amount in the ash.

Pennsylvania's program has been crafted in cooperation with the federal Office of Surface Mining Enforcement and Reclamation and EPA. The program takes into account the potential for groundwater degradation and effects on human health and the environment by addressing site-specific characteristics prior to ash placement at any mine site. The use of coal ash *must* comply with the SMCRA and the provisions of the regulations and meet certification guidelines for acceptable chemical and physical properties of the ash as set in 25 Pa Code. Those guidelines, which specify maximum leachate concentrations are outlined in the Certification Guidelines for Beneficial Uses of Coal Ash Documents (Document 563-2112-224) and the Coal Ash Beneficial Use Application (Form 5600-PM-MR0011). Coal ash quality data must be submitted as a part of the mining permit application and certified every six months.

In addition to the information regarding the coal ash quality, the permit application must include information regarding the "geology, hydrology and water quality… of all lands within the proposed permit area, the adjacent area and the general area" (25 Pa Code Chapter 88.23) and the geology of the proposed permit area and the adjacent areas, down to and including the aquifer must be described in detail in the permit application. The description must include coal seam thickness, location of mine pool or subsurface water, chemical analysis of the coal, groundwater hydrology, including depth to groundwater, uses of groundwater, and the chemical characteristics (25 Pa Code Chapter 88.25). The permit applicant must describe the placement of the coal ash in relation to the regional groundwater table. The permit application must also include a plan for collecting groundwater and surface water data, including monitoring location and testing frequency.

As mandated by regulation, DEP must conduct a thorough review of site-specific geology and hydrology prior to ash placement. It is evident that Pennsylvania's regulatory program as it has operated for over 15 years, and through testimony presented and a review of the program, has all the elements to ensure that coal ash of the appropriate quality is placed at mine sites with suitable geologic and hydrologic characteristics and is in compliance with approved reclamation plans and permit conditions. The quality of coal and the groundwater is routinely and frequently monitored by the generator/operator.

DEP routinely inspects this data and has the authority to immediately act on any issue that may arise from the placement of coal ash at a particular site. Under DEP's mine regulations, monitoring is required up until Stage II bond release, which does not occur until backfill and revegetation is completed. On the average, this is usually several years after the ash work is finished. After completion of Stage II, if any signs of discharge appear, the Stage III of the bond release is initiated which requires further monitoring for five years from the time of revegetation.

FLY ASH GENERATION, USES AND BENEFITS

Approximately 90 million tons of CCW are generated annually by the electric utility industry in the United States. Of the amount generated, approximately 19 million tons are beneficially used, primarily as a Portland cement replacement in concrete and concrete products. The remaining 71 million tons is disposed of in surface impoundments (special purpose, on-site landfills) or commercial landfills. The identification of cost-effective, technically sound, and environmentally responsible programs for the beneficial use, rather than disposal, of these materials has been the goal of many power generating facilities and research and demonstration projects in Pennsylvania and throughout the United States.

Approximately 5 million tons of fly ash is produced by Pennsylvania's cogeneration plants each year. Approximately 90 percent or more of this is used for mine reclamation projects and filling of pits and the reclamation of abandoned coal refuse areas. (See Appendix A.) One reason that Pennsylvania dedicates a much higher percentage to mine reclamation is due to the abundance of coal refuse and the many abandoned mines found within the state. Another 5 percent to 8 percent is used as a replacement for lime for acid mine drainage prevention or as a soil amendment/replacement at mining sites. The remaining 2 percent (approximately) is used for other beneficial uses such as anti-skid for roadways and pipe bedding, and other uses as previously mentioned.

Today the Federal Highway Administration (FHWA) recognizes CCW as a valuable material for utilization in concrete, road sub-bases and structural fills including embankments. In doing so the FHWA has stated, *"The trace element concentrations in many fly ashes are similar to those found in naturally occurring soils. Although the leachates of some fly ashes may contain trace elements that exceed drinking water quality standards, this is also true of certain soils. State environmental regulatory agencies can guide you through applicable test procedures and water quality standards..."*

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What would happen to this material if it were not beneficially used? The material would be landfilled. Landfilling this material, as discussed later in this report (see Economic and Environmental Consequences of a Moratorium), would be cost prohibitive for waste coal facilities and utilities, and would not utilize a valuable mine reclamation material. If ash can be used for other purposes that are publicly and environmentally safe, cost-effective and productive, then the material should be beneficially used. Keep in mind, that 15 of 19 cogeneration plants in the United States are located in Pennsylvania. (See Appendix B and B1.) Much of the reason for that is the abundance of waste coal piles in close proximity to the cogeneration plants. As a result, as mentioned above, 90 percent or more of the ash produced from cogeneration facilities is used for mine reclamation in Pennsylvania. (See Appendix C.) Elsewhere in the nation, currently between 10 percent and 15 percent of the coal ash produced from power plants is used in some type of mine reclamation and another 20 percent goes to other beneficial uses such as asphalt filler, cement sand, anti-skid material and structural fill. Between 65 percent and 70 percent of the ash generated from power plants is landfilled.

REVIEW OF TESTIMONY

The management of Pennsylvania's ash program, its implementation, its history and enforcement brought us to the event of July 9, 2003. The following is a brief summary of the testimony presented at the public hearing in Tamaqua:

Pennsylvania Department of Environmental Resources

The department was represented by **Mr. Jay Scott Roberts, Deputy Secretary of the Office of Mineral Resources Management, and Nicholas A. DiPasquale, Deputy Secretary of the Office of Air, Recycling and Radiation Protection**.

Mr. Roberts testified that Pennsylvania carries the nation's heaviest burden of abandoned coal mines, and an attendant variety of serious health and safety problems, including water-filled pits, dangerous vertical highwalls, open shafts, 800 abandoned coal refuse sites, mountains of coal waste, acid mine drainage and the threat of buildings collapsing into subsidence holes. On average, four persons are killed each year in accidents related to abandoned mine lands. Mr. Roberts estimated a cost of $4.6 billion just to rectify extreme danger and health and safety problems at land reclamation sites and to restore some but not all streams and rivers. Still unaccounted for are the costs of subsidence stabilization and infrastructure replacement. Federal funding from Title IV of the Surface Mining Reclamation and Control Act is the mainstay of reclamation efforts, but that funding amounts to only about $25 million each year.

The department further testified that to supplement inadequate funding, the department has sought innovative programs to encourage private industry to reclaim abandoned mine sites. Coal combustion products, particularly the coal or fly ash produced by the burning of waste coal at cogeneration facilities, has proven effective in reclamation and has been used at about 150 mine reclamation sites in Pennsylvania to help address these problems. Approximately 21 million tons of coal ash are produced annually in Pennsylvania from both coal burning power plants and cogeneration plants. The amount being used beneficially amounts to about 25 percent to 28 percent of the total. Beneficial uses, aside from mine reclamation, include concrete products, asphalt production, construction and anti-skid materials, and grout or structural fill. Because limestone is mixed with waste coal during burning, the ash produced is of an alkaline nature good for remediation of acid mine drainage, in the department's opinion.

Mr. Roberts and Mr. DiPasquale stated that extensive research by state and federal agencies, various universities and the private sector, and years of monitoring data, have found that, "…coal ash, when regulated and used properly, does not pose a threat to the environment or the residents of the Commonwealth." Not all coal ash is appropriate for use in mine reclamation, and before coal ash can be used for that purpose, it must be analyzed and receive a Beneficial Use Ash Certification from DEP. Prior to placing the ash, the department conducts reviews of local hydrogeology to ensure there will be no contamination or pollution of nearby aquifers or groundwater sources. Post-placement sampling is done and the department has accumulated 15 years of groundwater monitoring with no detrimental effects.

The department acknowledged the possibility of adverse impacts in cases where the ash is not properly managed, tested and monitored. The department disputed claims of sites in western Pennsylvania where the placement of ash caused groundwater contamination, saying contamination is due to acid mine drainage that existed prior to remining and reclamation of the sites.

The department's (and other nationally recognized) testing and monitoring data indicated the following:

- coal ash is an effective means to reclaim abandoned mine sites when used properly and closely monitored;

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- use of coal ash eliminates public safety hazards associated with highwalls, subsidence and mine collapses, reduces acid mine drainage, improves water quality and removes the visual blight of historic mining operations.

United States Environmental Protection Agency

Mr. Paul Gotthold, Chief, PA Operations Branch of the U.S. Environmental Protection Agency (EPA) Region III (Philadelphia) made three specific points regarding EPA's stance on the use of coal combustion products.

The first is that EPA has affirmed three times (in 1980, 1993 and 2000) that coal combustion products do not warrant regulation under the federal hazardous waste program. The agency has concluded, however, that regulation of coal combustion products as a non-hazardous waste is warranted.

The second point is that EPA has not confirmed any specific project where placement of coal combustion products in coal mines has caused damage to human health or to the environment. No failures of minefilling projects have been confirmed. EPA is still developing national regulatory guidelines, but does not expect future rules to ban the use of coal combustion products in minefilling, but rather to how best manage and control its use – probably on a case-by-case basis.

The third point is that EPA is allowing states to assess the environmental impacts of minefilling and assessing the states' effectiveness in doing so. In Mr. Gotthold's opinion, Pennsylvania ranks "…at the top tier of states for regulation of these [coal combustion products] issues."

ARIPPA

Ms. Billie Ramsey, Executive Director and General Counsel for ARIPPA, a Pennsylvania trade association comprised of 13 power plants that use coal refuse for fuel presented testimony to the Committee.

Ms. Ramsey summarized the work performed by Pennsylvania's cogeneration circulating fluidized bed (CBF) combustion system plants as follows: ridding the state of coal refuse; emitting NOx at extremely low rates; capturing particulate emissions efficiently in state-of-the-art bag houses; capturing sulfur through limestone injections; and converting an acid bearing material (waste coal) into an alkaline material (coal or fly ash) ideal for use in mine reclamation.

She testified that coal combustion products have been used for mine reclamation since 1988, with no adverse effects on groundwater, well water or surface water.

She testified that a statewide moratorium on the use of fly ash in mine reclamation would hurt Pennsylvania's environment and economy in the coal regions because it would shut down cogeneration plants – putting some 1,000 people out of work (at an average annual wage of $50,000 per employee). As explained in more detail under "Economic and Environmental Consequences of a Moratorium", based on a survey of costs of landfills, forcing cogeneration plants to landfill ash would impose a cost increase equivalent to 75 percent of gross revenues, a blow the industry could not withstand.

A moratorium would also end the reclamation work that cogeneration facilities are doing. That reclamation work includes: removal of 8 million tons of coal refuse each year, reclaiming an average of 240 acres of abandoned mine lands each year, and providing 5 million tons of alkaline ash each year for reclamation at no cost to taxpayers. She challenged moratorium supporters to explain how such a volume of work would be done if a moratorium were imposed.

Pennsylvania State University

The ensuing witness was **Dr. Barry E. Scheetz, Ph.D, Professor, Graduate Materials Program – Materials Research Institute Civil and Environmental Engineering and Mechanical and Nuclear Engineering Departments, at Penn State University (PSU)**.

After describing the peer-reviewed research that he and his students had conducted over the past 10 years into the large-volume utilization of coal combustion by-products, Dr. Scheetz stated that coal combustion by-products should not be considered as a hazardous waste. Dr. Scheetz, who is in his 28th year at PSU, concludes, "I have worked with coal ash in a variety of applications for the past 25+ years and found coal ash to be a useful and valuable material whose many environmental and construction benefits far out strip potential negative connotations that may be attributed to it from rare, isolated examples."

He provided details of a recent project at the "Big Gorilla" site in McAdoo, Schuylkill County, PA, where the addition of fly ash to the mine pool there increased the alkalinity of the deep mine water, lowered levels of aluminum, magnesium, manganese and iron, and, except for sulfate residual content, created water of almost drinking water standards. The Big Gorilla pool was also filled in by cementatious product. He noted that he did not test for PCBs and dioxins

because they are pre-screened out of the ash under the Commonwealth's screening procedures.

(According to DEP, the Big Gorilla project is basically completed in that the backfilling has eliminated nearly all of the mine pool water. More coal ash, to be performed under DEP's Surface Mine Permit, will be added to reach the approximate original contour. Monitoring will continue and a report on the demonstration project will be prepared.)

Earthtech, Inc.

Mr. Dennis Noll, President of Earthtech, Inc., a consultant to ARIPPA, presented testimony. Mr. Noll is also a Registered Professional Geologist with 15 years experience with coal ash placement.

Mr. Noll described a study his firm prepared in 2000 for ARIPPA that looked at the occurrence and fate of selected trace elements in CBF combustion byproducts. After extensive literature and on-site research at 14 ash-placement sites, the conclusions were that combustion and utilization of fly ash for mine reclamation (versus not disturbing abandoned waste coal piles) "significantly diminishes the risk of environmental pollution" from arsenic, cadmium, chromium, lead, mercury, nickel and selenium. Updating of the study data upholds the validity of the conclusions regarding the trace elements, as well as for additional parameters tested to include pH, acidity, alkalinity, iron, manganese, sulfates, calcium, chloride, copper, magnesium, potassium, zinc, total dissolved solids and total suspended solids and other chemistries.

Mr. Noll also described water testing performed by ARIPPA-member plants from 1987-1999 at the 14 placement sites (854 water samples from 66 sampling sites), where a preponderance of CFB generated ash is placed. Noll related that he had personally visited 10 of the 14 sites and for the others relied on maps, logs and interviews. After noting that the median value of the trace elements listed above in the water from coal refuse areas exceeded the median value found in ash placement areas in every instance except for mercury – which was well below laboratory detection limits in both cases- the conclusion was that there was no negative effect upon Commonwealth waters with respect to both the toxic trace elements and more common mine-related pollutants. Conversely, allowing coal refuse piles to remain undisturbed will continue "the negative effect upon the environment that has led to contamination of the waters of the Commonwealth by the pollutants discussed above."

Mr. Noll theorized that if there were to be negative environmental effects from ash placement at the sites described above, he would be "very surprised" if such effects did not appear in the first 14 years.

Schuylkill Headwaters Association

Testimony was presented by **Mr. William Reichert, president of the Schuylkill Headwaters Association** and a part-time employee of the U.S. Department of Agriculture.

Mr. Reichert testified that studies the association, in conjunction with other agencies, had conducted in 2000 and 2001, identified more than 160 acid mine drainage (AMD) discharges within the headwaters of the Schuylkill River. The assessments won Governor's Awards for Watershed Stewardship.

Based on the organization's studies, its members believe that fly ash used for mine land reclamation is safe and can be beneficial for the environment. Mr. Reichert testified that finding a beneficial use for the ash is "just plain common sense." He noted that 15 years of testing by DEP and plant operators has found no negative impact on the water or the environment.

Mr. Reichert stated that cogeneration plants provide economic activity and employment, waste piles are reduced and backfilling mine pits with fly ash eliminates safety hazards, reduces outflow from mine pools and restores natural beauty.

Mr. Reichert acknowledged fly ash issues regarding dust and truck traffic, but suggested these issues are like any other trucking operation and could be solved by relocating truck traffic patterns and more vigilant dust reduction efforts.

Army for a Clean Environment

The following witnesses were Dante Picciano, who works for the law firm of Bell, Boyd and Lloyd in Chicago and who represents the Army for a Clean Environment (ACE) in Tamaqua, Pennsylvania, and Farley Toothman, an attorney and a Greene County Commissioner.

Mr. Picciano stated ACE's opposition to the following: dumping of hazardous and toxic waste into unlined stripping pits as an excuse for mine reclamation; electric utilities dumping fly ash into stripping pits to reduce expenses and maximize profits; uncontrolled and unproven dumping of fly ash

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into stripping pits as an excuse for treating acid mine drainage; mixing and dumping of fly ash with hazardous and toxic waste under the guise of beneficial use.

Mr. Picciano presented letters regarding the plans of the Lehigh Coal and Navigation Company to use cement kiln dust to reclaim a stripping pit, citing and criticizing language that would make it a beneficial use if the dust were to be mixed with fly ash.

Mr. Picciano stated the ACE believes there is a coordinated plan among DEP and the states of New York and New Jersey to dump a "toxic mixture" of fly ash and NY-NJ harbor sludge into stripping pits throughout Pennsylvania, and submitted several pieces of correspondence and press clippings he stated proved the existence of such a plan.

Under questioning, Mr. Picciano at first indicated that he had never said anything about a statewide moratorium on the use of fly ash, but later stated he favored a "…moratorium on dumping fly ash into the water table."

In response to a question about whether he [Mr. Picciano] was not willing to look at any use of fly ash at all in mine reclamation as part of a cost-benefit analysis, Mr. Picciano stated, "No, I would be willing to consider the use of fly ash. If it could be shown to be properly placed under proper conditions, it could be properly used."

While providing no written testimony, Mr. Toothman spoke generally of the impact of coal mining in his home county - Greene County in Southwest Pennsylvania. He acknowledged that Greene County had no fluidized bed power plants and he was not sure if Greene County had the same fly ash as that described as being produced by cogeneration plants.

He spoke of the output of toxic materials from coal burning power plants, suggesting that the industry is improperly regulated.

Geo-Hydro, Inc.

Mr. Charles Norris, Licensed Professional Geologist with Geo-Hydro, Inc., a geologic consulting firm from Denver, Colorado, was the next witness. His appearance was supported by the Clean Air Task Force of Boston and ACE.

Mr. Norris supports a moratorium on coal ash placement in mines and testified that Pennsylvania has moved the use of coal ash from proposal to practice to policy with insufficient evaluation. He further claims that water degradation is "frequently" associated with ash placement in mines in Pennsylvania. He cited four examples: the McDermott site in Cambria County; the "Big Gorilla" in Schuylkill County; the Revloc Refuse Site in Cambria County and the Ernest Mine in Indiana County.

Mr. Norris further claimed that contrary to studies of the beneficial uses of coal ash due to its alkaline nature, coal ash is not effective at abating acid mine drainage, citing the Ernest Mine as evidence. Further, he stated, testing for in-field behavior of fly ash is insufficient, inappropriate and of insufficient duration.

Mr. Norris also called for a moratorium on DEP's General Permit system, which he stated allows for the disposal in non-mine settings of the same or similar ash. He stated that the General Permit system is based on DEP's faulty science in regard to the properties of fly ash.

Under questioning, Mr. Norris stated that he had looked at 10 sites in Pennsylvania without finding evidence of successes in the use of fly ash.

Under further questioning, he acknowledged that he had not conducted any testing on trace elements on any materials or sites in Pennsylvania. The performance criteria Mr. Norris cited came from statutes and regulations as published on DEP's website, through a review of permit documents, and with few exceptions, discussion with DEP staff.

Graphs, charts, and examples accompanied Mr. Norris' testimony.

Clean Air Task Force

The final witness at the hearing was **Mr. Jeffrey Stant, a consultant with the Clean Air Task Force of Boston**. Mr. Stant, whose place of work is Indianapolis, Indiana, provided no written testimony at the hearing.

Mr. Stant testified that there are 17 heavy metals in trace amounts commonly found in coal combustion waste and power plant waste that if not handled properly could do harm.

Mr. Stant presented overhead slides focusing on changes in certain fish species in other states, which he stated were caused by the leaching of fly ash. He cited the Ernest Mine in Pennsylvania, as well as cases in Indiana and New Mexico in which his studies blamed water degradation on fly ash placement.

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He submitted a list of sites, the number of which had varied from 56 when first compiled three years ago to 69 sites presently, that he stated represented cases of contamination from coal ash. He noted differences of opinion on the causes with the EPA.

Under questioning, he noted that some of the problems were caused by improper placement of fly ash.

Mr. Stant concluded that there should be a moratorium on the use of fly ash in mines until there is further review of data and more monitoring, including tissue analysis of populations such as amphibians, clams and fish. He advocated more extensive use of passive treatment projects at mine sites.

ECONOMIC AND ENVIRONMENTAL CONSEQUENCES OF A MORATORIUM

Although the environmental and public health issues of coal ash placement have been addressed, we cannot overlook the economic impact a suggested moratorium would have on the utility industry in Pennsylvania. The issue begs the question, "What would happen to the waste coal industry in Pennsylvania if a moratorium were to be enacted?"

The answer is short and simple. A moratorium, as suggested, would have an immediate and devastating impact on all of Pennsylvania's coal waste facilities. It not only has the potential to result in their immediate closure, in all actuality it would result in their closure. This conclusion is drawn with the understanding that the disposal cost per ton of material at a commercial residual waste facility (landfill) is between $45 and $90, including transportation. These cost figures are based upon a survey of landfill costs. Taking the mid range of cost to be $67.50 per ton, the cost of landfilling 5 million tons of ash produced each year by the Commonwealth's waste coal facilities would be approximately $337.5 million per year. Estimating an internal cost of $5 per ton for using the ash for mine reclamation (an industry accepted figure), the incremental cost to Pennsylvania's coal waste plants would be $312.5 million per year. That is equivalent to approximately 75 percent of the total annual gross revenue of the waste coal facilities. Demanding that such a facility absorb an additional expense of 75 percent or more of its gross revenue is in fact demanding its closure. This would lead to the elimination of more than 1,000 direct jobs with an average salary of $50,000 per year.

The cost of shipping the material to a hazardous waste facility as suggested in testimony would result in even higher costs, and the cost to dispose of the ash in a hazardous waste landfill, as suggested in testimony, would actually exceed the plants' gross revenues.

In a nationwide study of the coal-fired utility industry, consultants Resource Data International, Inc. (RDI) estimate similar impacts. The RDI study estimates that designation of CCW as hazardous waste requiring landfilling would increase annual coal combustion wastes management costs by 60-70 percent. The impact would be even greater, according to the report's estimates, if coal-fired power plants are more fully utilized.

Cogeneration and the independent power producers in Pennsylvania differ from that of the traditional power industry, and this bears some explanation. Cogeneration is a process that uses a single energy source to produce electricity. Traditionally, electricity and heat energy come from separate sources. With cogeneration, heat (in the form of steam) and electric power are produced at the same time. Typically, the steam is used in an industrial process or to heat nearby buildings. Cogeneration is an extremely competitive industry. In Pennsylvania's deregulated electric utility industry, cost increases quickly affect a plant's competitive position. Because coal waste plants must burn a much greater volume of fuel to create BTU's, and create a higher volume of ash, they are more susceptible to cost fluctuations, particularly if required to haul CCW greater distances to landfills. Conventional coal plants, with the much smaller volume of ash, do not face the same landfilling costs as waste coal plants do.

In addition, waste coal plant sizes are generally smaller than conventional coal and gas-fired power plants, but require the same operational oversight. The unique Circulating Fluidized Bed (CFB) boilers are expensive to maintain, and the nature of the coal refuse and the 60 percent rock found in the fuel is abrasive and hard on the machinery, further increasing sensitivity to economic factors.

However cogeneration facilities are not permitted to increase or decrease prices when their facility costs fluctuate. Federal legislation known as the Public Utility Regulatory Policies Act of 1978 (PURPA) created the framework that allowed independent power facilities to be developed. Under this act, cogeneration and other small power production facilities are entitled to sell electricity to utilities at a negotiated price. Utilities purchase this electricity from cogeneration facilities through long-term contracts at a fixed price per kilowatt hour. The contracts typically fix the price for a 20 year period, therefore any cost increases must be absorbed by the facility and cannot be passed on to the rate payer, as with traditional power producers.

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The economic benefits associated with waste coal facilities cannot be ignored. For example:

- Capital investments by waste coal facilities in Pennsylvania exceed $4 billion.
- Pennsylvania waste coal facilities have a direct annual payroll of $50 million (1,000 jobs X $50,000 salary).
- More than $57 million is spent each year by these plants for materials, goods and services.
- Approximately $1.9 million is paid in local and school taxes by these facilities.
- Subcontracted jobs by these facilities add approximately $7 million annually to the payrolls of Commonwealth employers.

These benefits would be lost with the issuance of a moratorium, as well as the environmental benefits these facilities provide. These facilities have greatly improved the local environment. Independent power production facilities that use abandoned mine refuse piles as fuel sources are required by the same federal act that governs their prices, to also remediate the abandoned site, implement erosion and sedimentation control measures and improve aesthetics. More importantly, reclamation makes this land available for other uses and suitable for investment in areas where economic development is needed. (See Appendix D, E and F.)

EXPLANATION OF POSITION/CONCLUSION

The final purpose of the Committee's investigation has always been clear, specific and simple – to issue a recommendation regarding a statewide moratorium on the use of fly ash in mine reclamation. The process of reaching a point where a recommendation can be made has been more complex. It has entailed listening to opinions from many different sources, amassing information, clarifying information, sorting out facts, reviewing the facts and using the facts to reach a conclusion.

It is the conclusion of the Committee that a statewide moratorium is not warranted. The Committee makes that recommendation for several reasons, based on facts garnered during the July 9, 2003 public hearing and from the Committee's subsequent follow-up study.

Prominent among the facts is the long-standing and well documented history and proven use of fly ash, particularly here in Pennsylvania. Coupled with that is the well established and comprehensive regulatory program in the Commonwealth. That regulatory program is marked by detailed design and performance standards, monitoring and review requirements. A review of testimony reveals a consistent theme voiced by nearly all of those testifying – proper use and proper placement of fly ash is key to its beneficial use. Unlike some other states, Pennsylvania has an organized and tested system to provide for proper use and placement.

Also part of the history of fly ash use is the positive environmental and economic benefits resulting from the industry which generates the fly ash. Such a record is rare and needs to be preserved. The record of the cogeneration industry includes the removal of 88 million tons of acid bearing coal refuse and countless culm piles from the Pennsylvania landscape, and the reclamation of 3,400 acres of abandoned minelands at no cost to taxpayers (It is estimated that the cost of such actions would otherwise average $11,000 per acre - a cost savings of $37 million.) The industry is also a sizable employer, providing close to 1,000 jobs with annual salaries averaging approximately $50,000, many in former mining areas hard hit by industry declines due to mine abandonment.

The use of fly ash for mine reclamation in Pennsylvania has a 15-year history, without controversy until recently. As a matter of fact, as cited elsewhere in this report, its use in reclamation in other parts of the state has received high praise from community leaders. The call for a statewide moratorium now is puzzling and inconsistent with Pennsylvania's historical use of fly ash.

It begs the question of whether local issues are not a driving force in this situation. Using site-specific issues, such as noise, dust, traffic and fill materials for example, to formulate statewide policy is not good policy. There are local government agencies whose responsibility it is to deal with local issues, working with the appropriate statewide regulatory bodies, in this case DEP. Both need to exercise their respective authority in regard to site-specific concerns.

The Committee is not ignoring and has not ignored the questions raised about the chemical content/composition of certain materials used in minefill projects as pointed out by the Jefferson Action Group, Inc. in supplemental material provided to the committee. That is why the Committee has recommended further independent study. However, given the extensive level of regulation of fly ash in Pennsylvania and its record, merely raising the question does not justify a statewide moratorium on use. Nor does the mere presence of certain materials necessarily differentiate fly ash from any other soil or allow for the presumption of

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harm. Once again, regulation is prudent and further study sensible, but a moratorium would be misguided, albeit well intentioned, given the facts.

Further, it is the conclusion of the Committee that the testimony presented and subsequent study by Committee staff have answered the questions posed by those requesting a moratorium. The requests for a moratorium on the use of fly ash for mine reclamation, in effect, seek protection from a danger that does not exist. A moratorium, however, would allow very real dangers – acid mine drainage, dangerous highwalls, water-filled abandoned pits, open mine shafts and the like – to go unremediated and untouched.

The Committee thanks all of the individuals and organizations who testified at the hearing, offered written testimony and comments and otherwise communicated concerns and information to the Committee. The issue addressed in this report is not and should not be misconstrued as an "us versus them" argument. It is a situation that the Committee has sought to approach on a scientific basis, in which facts are drawn upon to reach a conclusion. No doubt, concerns, often passionate ones, continue to exist. The Committee stands ready to work with community leaders to address those concerns and broaden the scope of scientific knowledge regarding fly ash and mine reclamation in an effort to improve the administration of public policy for the Commonwealth of Pennsylvania.

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CHAPTER 5. COAL ASH BENEFICIAL USE ON BITUMINOUS MINE SITES

Timothy C. Kania, Joseph M. Tarantino

5.1 INTRODUCTION

Beneficial use of coal ash on bituminous coal mine sites in Pennsylvania is not a new concept and has been practiced for at least 15 years. In 2002 approximately 6,390,000 tons of coal ash were beneficially used on 42 bituminous and anthracite surface mine sites and 5 refuse disposal sites (Dalberto et al., Chapter 1). Several considerations make the recycling of coal ash for use in bituminous mine reclamation a natural fit:

- Coal ash is material that originated on mine sites, although it has been physically and chemically altered through combustion and sometimes through the addition of other materials, such as limestone.
- Some coal ash has chemical and physical characteristics that enhance mine site reclamation.
- Recycling suitable coal ash through mine site beneficial use preserves valuable space at waste disposal sites.
- Coal ash often can be hauled to mine sites by trucks on return trips from power plants, making it an economical form of recycling.

Much of the coal ash currently beneficially used on Pennsylvania surface mine sites is from waste coal power plants using fluidized bed combustion (FBC) technology in which limestone is injected into the boiler with the fuel stream. In 2002 approximately 79 per cent or 5,054,000 tons of the coal ash beneficially used on Pennsylvania coal mine sites was FBC ash (Dalberto et al.,Chapter 1). FBC ash is typically highly alkaline giving it chemical and physical properties, described in Chapter 3, that make it particularly useful in mine reclamation.

Pennsylvania currently defines the following uses of coal ash on active mine sites as beneficial uses: alkaline addition; low permeability material; soil substitute or additive; placement.

Alkaline addition takes advantage of the potential for some coal ashes to generate alkaline leachate and is used to offset the potential for on-site materials to generate acid mine drainage. Brady and Hornberger, (1990), Perry and Brady (1995) and Skousen et al., (2002) have shown in empirical studies of completed mine sites that post mining water quality correlates more strongly with the amount of alkaline material on a mine site than with the amount of sulfur in the rocks. According to Pennsylvania's current guidelines, to qualify for use as an alkaline addition agent the ash should have a neutralization potential (NP) of at least 100 parts per thousand and a pH of between 7.0 and 12.5. (NP and its determination will be discussed in more detail in section 5.2.2.1.) The amount of coal ash needed to offset potential acid production can be calculated using the methods described by Smith and Brady (1998).

Using ash as a low permeability material usually entails sealing or encapsulating materials on site that have the potential to produce acid mine drainage. Potential uses for ash as a low permeability material on a mine site include paving the pit floor, capping material segregated from the rest of the mine spoil due to its potential to generate acid mine drainage (AMD), encapsulating reject material on coal refuse reprocessing operations, and in some cases capping entire sites or significant parts of sites. For use as a low permeability material on a mine site an ash should have significant pozzolanic characteristics and should be capable of achieving a permeability equal to or less than 1.0×10^{-6} cm/sec under laboratory conditions.

As a soil supplement alkaline coal ash can be used as a liming agent and also to improve the physical characteristics of the soil or soil substitute being used as site cover. In some re-mining settings soil is not readily available, especially on coal refuse reprocessing operations, and coal ash can be used to enhance the characteristics of other on-site material to produce an acceptable growth medium.

The term "placement" covers uses of coal ash on a mine site that do not clearly fit into one of the above categories, such as using ash to re-contour pits or refuse piles on re-mining sites. In practice, coal ash use on a bituminous mine site typically fulfills more than one of the above beneficial use criteria. For example, coal ash being returned to a refuse reprocessing site may serve as an alkaline addition agent, an encapsulating agent (capping), and as a soil additive.

An application for use of coal ash on bituminous mine sites must include chemical analyses of the ash proposed for use showing that the ash is not likely to cause water quality degradation. Appendix 5.A includes a copy of the detailed quality analyses required. Analyses performed on a dry-weight basis are required for pH and sixteen metals. An SPLP leachate analyses is required for pH, sulfate, chloride, plus seventeen metals. In addition, results of a neutralization potential test must be provided if the proposed use is for alkaline addition, and a hydraulic conductivity test must be provided when the proposed use is as a low conductivity material.

5.2 CASE STUDIES

The following sites were chosen as examples of various types of applications of coal ash that have been performed on bituminous coal mine sites. They are intended to illustrate some types of situations where coal ash has been used on bituminous mine sites in Pennsylvania. The results from not one of these sites can be applied to the general class of coal ash usage that they represent. These are site-specific results. One of the primary criteria for choosing the sites was that operations had been completed or had at least progressed enough so that monitoring results could be meaningfully interpreted.

5.2.1 Refuse Pile Reclamation—Ebensburg Power Company Revloc Site

Abandoned coal refuse piles, large and small, dot the landscape of Pennsylvania's bituminous coal region. Coal refuse (also known as gob) is the nonmarketable material that was removed from mines along with the coal. Many of the piles occur near old mine mouths or cleaning plants; most, but not all, are associated with deep mines, but surface mined coal that

was cleaned prior to being marketed also contributed to some piles. In addition to the above ground piles, some coal refuse was also historically buried in abandoned surface mine pits. The aboveground piles typically are toxic to any colonizing vegetation and are highly erosive. Often the refuse was deposited in the lowland areas, below mine entries or cleaning facilities, frequently on stream banks, and sometimes directly in the stream channel. Even decades after refuse placement, each significant precipitation event washes fresh refuse onto adjacent properties and into streams. Most coal refuse contains relatively high percentages of sulfur and, therefore, leaches severe quality AMD. Because the oxidation of pyrite is exothermic, some refuse piles catch fire and burn for decades, adding air pollution to the list of problems they create for the small mining communities that often exist next to them. Under today's regulations, refuse disposal sites must be carefully engineered. They usually are constructed with an under drain system so that leachate can be collected and treated; the piles are also carefully compacted to limit infiltration and prevent combustion and are covered with soil, and planted so that they do not erode.

Abandoned coal refuse piles are especially challenging from the abandoned mine land reclamation (AML) standpoint. To put out the fires, the entire pile sometimes has to be reworked. They can be graded, covered with soil and capped, and while that may solve the erosion problems, it typically does not address the acidic leachate problem. Treating the discharges from abandoned refuse piles is especially challenging for two reasons: First, the discharges usually occur at the interface of the pile with original ground, and because the piles often were placed in stream valleys, those discharges often occur at the stream bank, leaving no room for treatment facilities. Second, the leachate from refuse piles often is extremely poor, very expensive to treat with conventional chemical treatment and beyond the effective capability of present passive treatment technology. Even if the discharges can be treated, that does not address polluted groundwater that leaves the site as diffuse flow.

It was the advent of the use of fluidized bed combustion technology to burn bituminous waste coal as a fuel to generate electricity that provided the first hope for full remediation of coal refuse piles, and their associated environmental impacts on a large scale. Coal waste burning plants can burn low-grade fuel of varying sulfur content and relatively low BTU content. Because ground limestone is injected into the boilers to capture air pollutants, the resulting ash is typically very alkaline (pH 11-12) and contains significant $CaCO_3$ equivalency, most in the form of CaO and $Ca(OH)_2$. So, not only are many waste coal piles now a potential fuel source, the ash generated by burning the piles is a material that can be useful in remediating the sites from which the refuse is extracted.

5.2.1.1 Site characterization/ setting

The Ebensburg Power Company Revloc site is located directly east of the village of Revloc and south of highway US 422 in Cambria County, Pennsylvania. The South Branch of Blacklick Creek (South Branch), a tributary of the Conemaugh River, bisects the pile. The South Branch supports a native brook trout population directly upstream of the Revloc pile, but has been virtually devoid of aquatic life below the pile for decades. Refuse in the pile is from the Bethlehem Mines Corporation Mine 32 Lower Kittanning deep mine that operated during the middle decades of the twentieth century. The refuse was placed in a lowland area where an

unnamed tributary entered the South Branch; the refuse actually dammed the South Branch, producing a pond on the upstream side of the pile.

The depth to the deep mine varies from about 350 to nearly 400 feet beneath the Revloc site. Bedrock of the original land surface beneath the pile is of the Glenshaw Formation, Conemaugh Group. None of the coal seams that occur between the base of the pile and the Lower Kittanning coal has been deep mined. The northwest-southeast trending Johnstown syncline lies just to the southeast of the site, so rock strata beneath the site dip gently to the southeast, at about 2 percent. The shallow monitoring wells drilled for this site show that bedrock immediately beneath the site consists of interbedded shales and sandstones. Ebensburg Power Company reported that no groundwater was encountered when the pile itself was drilled during the exploration. (Ebensburg Power Company, 1988). However, the occurrence of persistent seeps at the refuse pile/soil interface indicates at least a thin saturated zone existed at the base of the pile, prior to present operations. The shallow groundwater flow immediately beneath the pile is likely topographically controlled, with fracture flow dominating over diffuse flow, as is usually the case in these strata. Because the pile in its original configuration is porous, has a complex topography, is visibly heterogeneous (fine compacted refuse, lenses of porous-looking red dog and coarse rock, massive, welded red dog bodies) groundwater flow within the pile, both saturated and unsaturated, is likely to be highly complex. The nature of the pile materials and their effects on water flow through them is an important consideration in attempting to interpret monitoring results from sites such as this. One should expect that once a site is disturbed by a reclamation effort, either through re-mining or otherwise, water quality at down-gradient monitoring will likely fluctuate until a substantial part of the reclamation is completed.

Ebensburg Power Company obtained separate mining permits on the northern and southern sections of the Revloc pile, which are separated by the South Branch. The company permitted the larger northern pile under Surface Mining Permit # 11880201 (Revloc 1), which DEP issued in 1989. Revloc 1 contained approximately 3.8 million tons of coal refuse spread over approximately 56 acres. In 1997, the company obtained Surface Mining Permit # 11960202 (Revloc 2), which included 0.7 million tons of coal refuse (Ebensburg Power Company, 1996).

The Revloc 2 site contained primarily reject material from an earlier, unsuccessful reprocessing attempt by another company on the Revloc 1 area; that previous operation had placed its reject on the Revloc 2 area, covered it with a thin soil layer, and planted it. The planting largely failed, the reject caught fire, and the pile developed two small, but extremely poor quality seeps. So, despite its relatively small size, the Revloc 2 site presented some significant environmental liabilities.

Ebensburg Power Company began removing refuse from the Revloc 1 site at the end of 1990 and began bringing ash back to the site in very early 1991, when its 50-megawatt fluidized bed cogeneration facility, located in Ebensburg, PA, went online. Mining began on the northern end of the site adjacent to Route 422 and has advanced toward the southwest on multiple working faces. The company activated the Revloc 2 site in the fall of 1997; excavation on Revloc 2 began on the eastern side of the pile, in the area known to be burning. Thus, the fire

was extinguished early in the operations to end that source of air pollution and to preserve the useable fuel in the pile. The company operates the two piles concurrently as fuel needs warrant.

5.2.1.2 Mine operations

The mining plan for both Revloc sites is similar. The refuse is screened to remove oversized material. The oversized material and already burned material (red dog) is set aside. While only the Revloc 2 site was actively burning when permitted, sections of the Revloc 1 pile had burned in the past. The fine refuse is sent to the power plant for fuel, and ash is trucked back to the site. The ash is mixed, layered and compacted with the oversized reject and the red dog in an area behind the working face. On the Revloc sites, the operator has been removing the refuse material down to original ground, even in areas where the pile has been extensively burned. This practice, which results in virtually all potentially acid-forming material being encapsulated in alkaline ash, insures that there are no coarse–grained pathways for water or air within the reclaimed site. In some areas, soil buried beneath the pile is recovered for use in final site reclamation.

Once an area has been re-graded to its permitted configuration with the ash/reject mixture, a layer of soil typically one foot thick is spread and then seeded. Because of its large size, obtaining enough soil to reclaim the site is a challenge. Soil used to date has come from beneath the pile, from areas adjacent to the Revloc 2 refuse area, and, in the early stages of the operations was purchased from off site. Once the soil is spread, the area is seeded with a grass/legume mixture. A portion of the Revloc 2 site has also been planted in black locust.

Mining operations on the Revloc 1 site are nearing completion, with about one to two years of mining and reclamation to be completed. The Revloc 2 site is about ½ completed as of this writing, but because of its small size, and because it is being mined concurrently with Revloc 1, it too will likely be completed in the next 1 to 2 years.

Figure 5.1 is a photograph of the Revloc 1 site taken from the Revloc 2 site looking toward the village of Revloc to the northwest. The lighter green area in the center of the photo is recently planted area, while the darker green area on the right side of the photo is area that has been planted for at least two years. The dark area on the left of the photo is an area awaiting soil and vegetation. The refuse in the foreground is a yet-to-be-reclaimed area on the Revloc 2 site, and the small tree line at the base of the reclaimed pile marks the location of the South Branch.

5.2.1.3 Monitoring results to date at the Revloc 1 site

Because the Revloc 1 site has been active for ten years, there is a large body of data available from the site. When DEP permitted the Revloc 1 site, the emphasis on ash site monitoring was on monitoring wells, rather than downgradient discharges, so most of the ash monitoring data available for the Revloc 1 site is from three monitoring wells. (The approximate locations of the monitoring points discussed herein are shown on Figure 5.2.) Well MW-1 is a downgradient well, located just off the south-central edge of pile and between the pile and the South Branch. MW-2 is located along the western side of the pile, between the pile and the village of Revloc, and is located upgradient of the site. Well 3 is located along the north central

edge of the pile, between, the pile and US Route 422, and MW-3 is located transverse to the direction of groundwater flow. The shallow groundwater flow direction at the site is from the northwest toward the southeast, from an upland recharge area in and to the north of the village of Revloc toward the discharge area at the South Branch.



Figure 5.1. Photograph of the reclaimed portions of the Revloc 1 refuse site. Note the contrast with Figure 5.2.

The three monitoring wells on the Revloc 1 site were similarly constructed. Each is a 7-7/8-inch hole drilled approximately 60 feet deep, and is cased to the bottom with 4-inch slotted PVC surrounded by clean sand to within 5 feet of the surface. A 1.5-foot bentonite plug sits atop the sand, with a short section of 6-inch steel casing set in concrete finishing off the top of the hole. The steel casing is fitted with a locking cap. The wells are designed to measure water quality in the shallow groundwater system surrounding the site.

Some of the results from the earliest background data at the Revloc 1 site (primarily the data up through mid-1988) are erratic, and the data include sampling dates for which the analyses for individual parameters are not in agreement with one another. For example, acidity/sulfate ratios are not what one would expect, and there is not good agreement between specific conductance and TDS levels; DEP identified the issue during review of the permit application. After split sampling between DEP and Ebensburg Power Company, the company changed its sampling procedures and the laboratory doing the analysis. For that reason the data collected for the Revloc 1 site prior to June of 1988 are not considered valid, were not relied upon during review of the permit application, and are not included in this discussion. However, inclusion of that data would not substantially change the conclusions regarding the site.

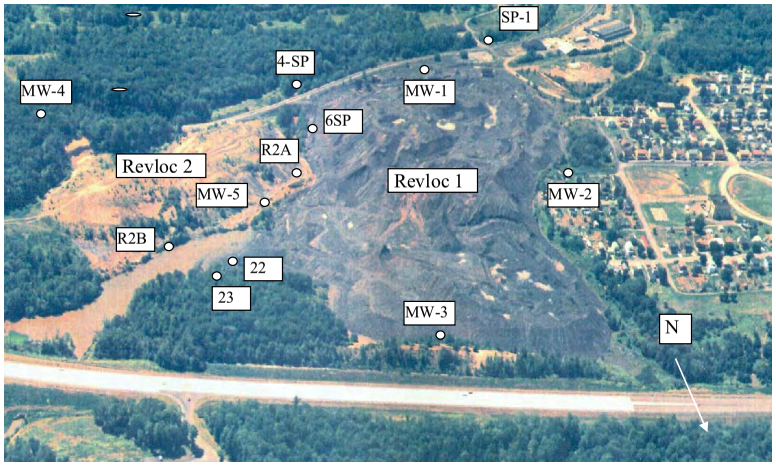


Figure 5.2. Aerial photo circa 1988 showing the Revloc sites and key associated monitoring reports. The photo was obtained from the permit application for Revloc 1.

Water quality results presented in this chapter will sometimes be compared to the maximum contaminant levels (MCL's) for drinking water supplies. This is done because the MCL's are a common benchmark with which many people are familiar. MCL's tend to be conservative to protect human health. Results that exceed an MCL must be considered in terms of cause/effect relationships, the use(s) or lack thereof of the water being tested, the volume of the water if it is a discharge, background conditions that existed prior to the condition being studied, and the overall setting of the project and sample point(s).

Where metals data are discussed in this chapter, they are in terms of total metals; some dissolved metals determinations are available for some parameters, but there are more totals metals data available for review. Where acidity is referred to in this chapter, it is hot acidity.

Data from MW-1, and other monitoring points from the Revloc site discussed herein, are presented in Appendix 5.B. Figure 5.3 displays the historical results for acidity, iron and sulfate, three of the parameters most commonly elevated in mine drainage. The data show that groundwater downgradient of the pile was, not surprisingly, severely degraded by acid mine drainage prior to the Ebensburg Power Company operation. The data show a steady trend of declining concentrations for acidity, iron and sulfate throughout the monitoring period. The decline appears to have begun prior to initiation of Ebensburg Power Company's operations in early 1991. The site had been disturbed by another operation approximately 10 years before Ebensburg Power Company permitted the site; it is possible that some of the earlier declines in

concentrations are due to the natural attenuation of the results of that earlier disturbance of the pile.

Table 5.1 compares the median background values (N=9) for the parameters displayed in Figure 5.3 to the median values nine most recent samples, as of this writing. While water quality in MW-1 continues to show an influence from mine drainage, groundwater quality at the well has markedly improved.

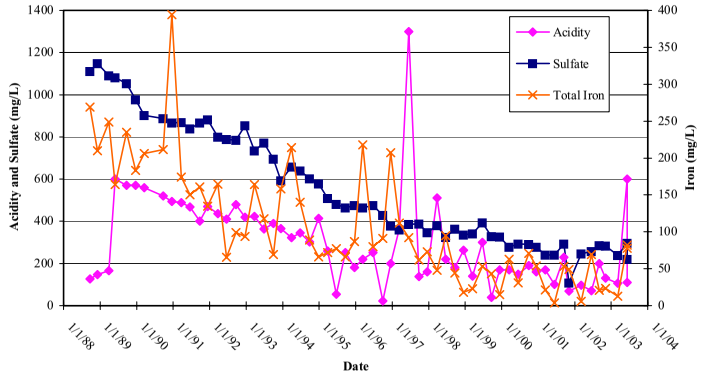


Figure 5.3. Graph of acidity, sulfate and iron at MW-1.

Table 5.1. Comparison of background and recent pollutant concentrations in MW-1.

Revloc 1, MW-1	Acidity (mg/L)	Fe (mg/L)	Mn (mg/L)	Sulfate (mg/L)
Background Median	520	211	18.6	1052
Recent Median	106	23	6.3	257
% Change in Median	-80	-89	-66	-76

The data for MW-1 (Appendix 5.B) show that specific conductance, aluminum, zinc and TDS have declined at MW-1 during the monitoring period, which is consistent with the decline in mine drainage parameters. pH has remained largely unchanged, despite the decrease in acidity and AMD metals. Both calcium and magnesium remain similar to background levels and are relatively low for mine drainage contaminated water; recent samples show Ca concentrations

in the 30 to 40 mg/L range, with Mg concentrations in the 10 to 20 mg/L range. Chloride concentrations may have increased during the monitoring period, but remain below 25 mg/L. Most other metal concentrations remained unchanged during the monitoring period. Chromium, copper, and barium, with an occasional exception, have remained below detection limits, and below the maximum contaminant level (MCL) for drinking water supplies. Cadmium has consistently been below the detection limit, but the limit reported by the laboratory in this case (0.05mg/Ll) is in excess of the MCL. The available data show no trends in lead concentrations; the lab reporting the data has used a relatively high detection limit of 0.1 mg/L.

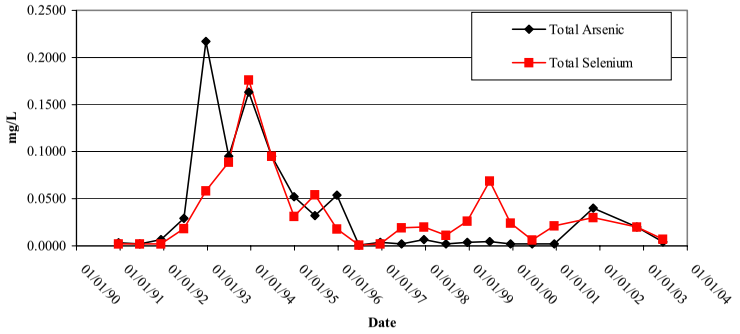


Figure 5.4. Graph of selenium and arsenic concentrations at MW-1.

Arsenic and selenium concentrations in MW-1 increased, beginning in 1992, peaking in 1992 for arsenic and in 1993 for selenium, then returned to background levels by mid-1996 (See Fig. 5.4.) Since 1996, both arsenic and selenium have remained below the MCLs, with the exception of one spike in selenium in 1999. The coal refuse ash is an unlikely source for the elevated arsenic and selenium during the early 1990's for the following reasons: 1) When the increase began, ash had been placed only on the northern end of the site, most distant from MW-1; 2) during the time when selenium and arsenic concentrations were declining from their peak values, then stabilizing, large volumes of ash were being placed directly upgradient of MW-1; 3) the selenium and arsenic data from both MW-2 (clearly upgradient of the site) and MW-3 show similar spikes, although of a lesser magnitude during the same time period as MW-1, suggesting that sampling or laboratory procedures may also have been a factor.

Monitoring well MW-2 is an upgradient well for the Revloc 1 site. The data from it show low TDS water with no mine drainage influence, confirming its upgradient position. The data are generally unchanged with time. The data for MW-2 are provided in Appendix 5.B, but will not be discussed in detail here.

Monitoring well MW-3 is located immediately adjacent to the north-central part of the Revloc 1 site. The available data for MW-3 are included in Appendix 5.B. The permittee reports that MW-3 is a low-volume well from which it is difficult to obtain a clean sample. Water quality in MW-3 has been variable throughout the monitoring period. The initial background samples show some influence from mine drainage, indicating that groundwater at the well was receiving some contamination from the refuse pile. However, for much of the monitoring period the mine drainage influence in the well was slight (sulfate values typically less than 100 mg/L), and at times the well produced very low TDS water (TDS <100 mg/L). Then, beginning in 1998, the acid mine drainage influence in the well increased significantly, only to decline to background levels again during 2003. Even though the location of MW-3 is toward the upgradient end of the pile, because it is located directly adjacent to the pile, it is still at times influenced by contaminated groundwater associated with the pile. The heavy metal concentrations in MW-3 do not show any noticeable trends, with the possible exception of selenium, which may have increased in the 1999 through 2002-time period. Selenium concentrations, however, have remained below the MCL of 0.050 mg/L, and the latest available analysis from a sample collected in June 2003 was below the detection limit of 0.007 mg/L.

The Revloc1 abandoned refuse site was producing six discharges of very poor acid mine drainage leachate, when the site was permitted by Ebensburg Power Company. Data for each of these points, designated 4SP, 4SPA, 4SPB, 6SP, 22SP, and 23SP, are included in Appendix 5.B. The discharges all emanate from the pile in proximity to the South Branch. The most significant of these discharges in terms of both flow volume and pollution load is 4SP, which flows directly into the South Branch from an abandoned railroad grade that forms the southern boundary of the pile. Six samples were collected from discharge 4SP prior to the site being activated by Ebensburg Power Company, however, during the first year of operations, disturbance of the site was limited to the northern end, most distant from 4SP. Therefore, the twelve samples collected from 1991 are included in Table 5.2, which compares the median concentration values of the first 18 samples collected to the most recent 18 samples collected for key acid mine drainage parameters.

Table 5.2. Reduction in flow and concentrations at discharge 4SP.

Discharge 4SP	**Flow (gpm)**	**Acidity (mg/L)**	**Iron (mg/L)**	**Manganese (mg/L)**	**Aluminum (mg/L)**	**Sulfate (mg/L)**
1990-91 Data	31.6	2860	2.23	11.1	435	3820
2002-03 Data	19.2	600	0.80	5.7	17	1221
% Change	-39	-79	-64	-49	-96	-68

Flow and mine drainage pollutant concentrations are both reduced when the earliest data are compared to the most recent data at 4SP. The mine drainage emanating from the Revloc 1 site is characterized by very high acidity and sulfate values, moderate iron concentrations, and very high aluminum concentrations. Some refuse piles leach higher manganese and iron concentrations than does the Revloc 1 site, and the aluminum concentrations at the Revloc 1 site are at the high end of what is typically seen. Figure 5.5 is a graph showing the change in flow and pollution load from 4SP with time. Acid and aluminum loads both have been reduced substantially during the monitoring period. The decline in pollution load is the result of both improved water quality and a decrease in the discharge flow.

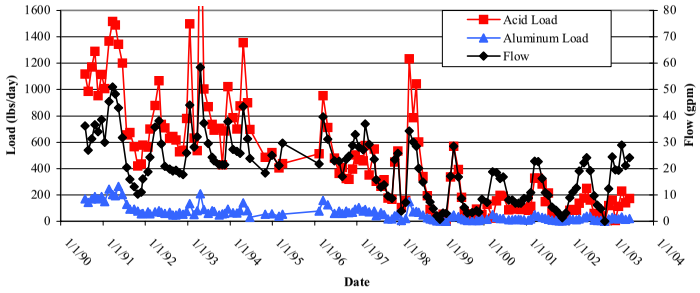


Figure 5.5. Flow, acid load and aluminum load at discharge 4SP.

The monitoring data for discharges 4SPA and 4SPB show similar reductions in both flow and pollutant concentrations and load to those observed at 4SP. In the case of 4SPB, the reductions are due more to a reduction in concentrations than flow. 4SPA and 4SPB are located in the same general area of the site as 4SP.

Discharge 6SP was located along the southeastern portion of the pile; it was eliminated by the operation in 1998, removing its pollution load from the site.

Seeps 22SP and 23SP were the smallest of the discharges emanating from the Revloc 1 site and they occur along the east-central edge of the pile. Water monitoring data for these two points are shown in Appendix 5.B. While concentrations for some parameters have increased at 22SP, pollution loading has decreased due to a reduction in flow. At 23SP both concentrations and loading have increased for some parameters, but the increases are dwarfed by the decreases seen at the larger discharge points. Table 5.3 summarizes the flow and pollution load data for the seeps at the Revloc 1 refuse pile.

When the median values of the first two years of monitoring data are compared to the median values of the last two years of data (Table 5.3), the pollutant load reductions to the South Branch Blacklick Creek from the discharges downgradient of the Revloc site are: 1935 lbs/day of acidity; 283 lbs/day of aluminum; 3675 lbs/day sulfate; lesser amounts of other pollutants. These values show only the decrease in pollutant load in terms of the measurable discharges from the site; additional reductions in pollutant loads in terms of direct groundwater baseflow to the stream are also likely occurring.

Table 5.3. Summary of flow and AMD pollutant load data for the discharges from the Revloc 1 site. Background data were collected in 1990-1991 and recent data were collected in 2002 to mid 2003. N=18 for most of the background and recent data sets. Flows are in gpm and loads are in lbs/day.

	Totals	**4SP**	**4SPA**	**4SPB**	**6SP**	**22SP**	**23SP**
Background Flow	67.8	31.6	13	17	2.7	2.9	0.6
Recent Flow	38.4	19.2	2.6	15.3	0	0.4	0.9
Background Acid Load	2137.7	1060	578	430.9	62.2	6.4	0.2
Recent Acid Load	203.4	116	28	58.3	0	0.7	0.4
Background AL Load	312.5	168.8	83.9	51.9	7.2	0.7	0.01
Recent AL Load	29.9	17.1	5	7.7	0	0.1	0.06
Background Fe Load	3.4	0.89	0.4	2	0.1	0	0.01
Recent Fe Load	0.45	0.15	0	0.3	0	0	0
Background Mn Load	8.61	4.1	2	2	0.3	0.2	0.01
Recent Mn Load	2.24	0.99	0.2	0.9	0	0.1	0.05
Background SO4 Load	5084	1406	724	2854	87	12.4	0.4
Recent SO4 Load	1409	260	51	1091	0	4.1	3.1

5.2.1.4 Monitoring results to date at the Revloc 2 site

The Revloc 2 site, located directly across the South Branch from the Revloc 1 site, has four ash monitoring points associated with it. They are: MW-4, an upgradient well; MW-5 a downgradient well; R2A, a down-gradient discharge; R2B, a downgradient discharge. Monitoring data for all four of these points are included in Appendix 5.B.

The upgradient well is located on the hilltop to the south of the site, and the water quality shows it to be unaffected by mine drainage. The data also show that the water quality at MW-4 has not been affected by the Ebensburg Power operation. MW-4 does show chloride concentrations higher than what may be expected, as high as 175 mg/L. MW-4 is located within 500 feet of an interchange for US Route 219, and road salt may explain the relatively high chloride concentrations in the well.

MW-5 is located between the Revloc 2 site and the South Branch along the north-central edge of the pile. Background data on MW-5 show that it was affected by mine drainage from the pile prior to Ebensburg Power Company's operation. The data also show that water quality in MW-5 has improved, since the well was established to the point where it is now uncontaminated. The change in water quality at MW-5 began before Ebensburg Power Company had substantially affected the Revloc 2 site, so factors other than the re-mining and reclamation, possibly site preparation work and well construction and purging techniques, apparently have contributed to the improvement in the water quality at MW-5. The data for MW-5 show no trends in terms of any toxic metals, while Ca and Mg have decreased.

Discharge R2B is located directly downgradient of an area of the Revloc 2 site that has been mined and partially reclaimed. R2B was low-flow, with extremely poor acid mine drainage

quality prior to Ebensburg Power Company's operations. As re-mining and reclamation of the area upgradient of R2B has progressed, the water quality at the point has improved. Acidity values have fallen from several hundred mg/L, and higher, to 0 in recent samples, while concentrations of metals typically found in mine drainage have also declined. pH has risen, while sulfate values have declined. Calcium, potassium, sodium, and chloride levels have increased. Among the toxic metals, copper, lead, and zinc concentrations appear to have declined, while selenium concentrations appear to have increased. For the years 1998 through 2002, selenium concentrations were elevated when compared to background data.

Discharge R2A is located along the northern edge of the Revloc 2 site, downgradient of an area where re-mining and reclamation are, as of this writing, in progress. The background data from this point show it to be of very poor acid mine drainage quality. While the discharge remains contaminated with mine drainage, the quality has improved in terms of acid mine drainage contamination over the past two years and flows have decreased. For example, the median acidity concentration of the first 12 samples collected was 2600 mg/L while the median acidity concentration of the last 12 samples was 1900 mg/L; the flows also appear to have declined with the median value for the first 12 samples being 12.4 gpm and the median flow of the last 12 samples being 6.1 gpm. Calcium and pH levels may have increased in R2A during the past two years. Magnesium concentrations have been as high as 580 mg/L at R2A. The quality at R2A is representative of very concentrated AMD leachate from the Revloc 2 pile. The concentrations of some heavy metals in R2A are relatively high. For example, arsenic concentrations exceeded the MCL during every sampling event, except for June 10, 2003, and have been as high as 0.67 mg/L. Lead concentrations have typically exceeded the MCL, and chromium, copper, and cadmium have also done so on occasion; the results for each of these heavy metals is variable without any clear trends. The elevated toxic metal concentration in R2A existed prior to Ebensburg Power Company's operation and illustrates that severe bituminous coal AMD, especially from coal refuse piles, can include significant toxic metal concentrations. Zinc concentrations at R2A have increased during the sampling period. Selenium concentrations at R2A have been highly variable, were less than detection limits during the background-sampling period, exceeded the MCL of 0.050 mg/L during much of the monitoring period, but returned to less than the MCL during 2002 and 2003. Table 5.4 presents a summary of the monitoring data on R2A and R2B for AMD parameters.

Sampling Point SP-1 is located on the South Branch below the Revloc 1 and Revloc 2 sites. This point is influenced by the direct discharges and groundwater baseflow from the piles into the stream. Monitoring data for SP-1 are available in Appendix 5.2. Table 5.5 compares the data in terms of median values collected from SP-1 prior to 1992 (N=14) to the 14 most recent samples at the time of this writing.

Table 5.4. Summary of flow and AMD pollutant load data from the Revloc 2 site discharges. Background data were collected from April 1996 through March 1997 (N = 12), and recent data were collected from June 2002 through June 2003 (N = 12). Flows are in gpm and loads are in lbs/day.

Parameter	Total	R2A	R2B
Background Flow	14.6	12.4	2.2
Recent Flow	6.14	6.1	0.04
Background Acid Load	298.2	281	17.2
Recent Acid Load	106	106	0
Background Iron Load	5.3	5	0.3
Recent Iron Load	0.05	0.05	0
Background Mn Load	7.2	6.5	0.7
Recent Mn Load	2.4	2.4	0
Background Al Load	47.7	45.9	1.8
Recent Al Load	16.6	16.6	0
Background SO4 Load	839	777	62
Recent SO4 Load	206	204	2.4

Table 5.5. Comparison of background median flow and mine drainage pollutant concentrations at SP-1, the monitoring point on the South Branch directly down stream of the Revloc 1 and 2 sites.

	Flow (gpm)	pH (su)	Acidity (mg/L)	Iron (mg/L)	Mn (mg/L)	Al (mg/L)	Sulfate (mg/L)
1988-91 Data	3261	4.30	134	1.61	1.03	21.0	191
2000-03 Data	2427	5.55	16	0.50	0.55	1.50	73

Figure 5.6 shows graphically the reductions in aluminum, acidity and sulfate at SP-1, when the background data medians are compared to the most recent data medians.

The data from SP-1 show the improvement to date in terms of mine drainage pollution in the South Branch that has resulted directly from the Ebensburg Power Company operations at the two Revloc sites. Note especially the reduction in aluminum and acidity concentrations along with the increase in pH. During times of low flow, the stream still experiences spikes in pollutant concentrations, but that condition should only improve as re-mining and reclamation continues.

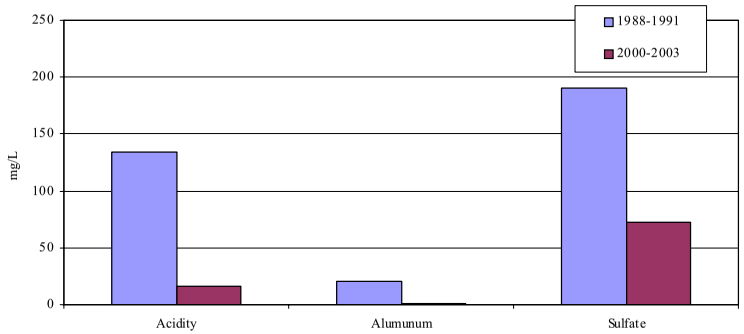


Figure 5.6. Comparison of background and recent median acidity, aluminum and sulfate concentrations at monitoring point SP-1, downstream of the Revloc sites.

While most toxic metal concentrations at the Revloc sites show no change or some decrease, selenium concentrations have increased at some points. Figure 5.7 shows the available selenium concentrations for downgradient ash monitoring points at the Revloc sites. Selenium concentrations at the upgradient points, MW-2 and MW-4 (not included in Fig. 5.7) show no increase during the monitoring period and have been consistently low.

Selenium concentrations at wells MW-1 and MW-3 at the Revloc 1 site have generally been higher than background, and on occasion have exceeded the MCL of 0.05 mg/L, although not since 1999. MW-2 is not shown in Figure 5.7, since selenium concentrations are of a lesser magnitude, but the MW-2 data do show a spike in selenium in 1993-1994 that suggests the elevated selenium shown in MW-1 and MW-3 in that time period may be, in part, related to sampling/laboratory considerations. This conclusion is based on MW-2 being clearly up gradient of the Revloc site and showing no other signs of influence from the pile. The highest selenium values are at R2A and R2B, seeps downgradient of the Revloc 2 site. Both of these points are low volume, and at times intermittent, with the median flow of the last 12 samples from R2B being 0.04 gpm and the median flow of the last 12 samples from R2A being 6.1gpm. Areas upgradient of R2A and R2B were disturbed early in the mining on the Revloc 2 site, in part to accommodate extinguishing the on-site fire. Some areas where ash and refuse reject have been placed above those points remain exposed and unvegetated. It seems likely the elevated selenium in these points is related to the exposed ash/refuse mixture on the surface, which is flushed with each runoff event. Once reclamation of this area is completed, it is reasonable to expect that water quality at the two points will further improve, including a reduction in selenium concentrations. MW-5 is located between R2A and R2B and also appears to be influenced, but to a lesser degree. While selenium concentrations are clearly elevated at R2B and R2A, it is important to view these data in light of the low flows from these points; while concentrations are relatively high, the amounts of selenium discharging at these points are low. Samples collected

by DEP on December 1, 2003 and on February 18, 2004 at SP-1, directly down stream from the Revloc sites, showed a selenium concentration below the detection limit of 0.007 mg/L; copper, chromium, arsenic, mercury, lead, and nickel also were all below detection limits at SP-1 on those dates.

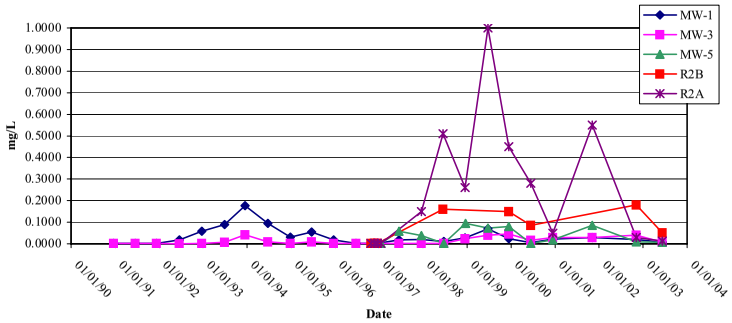


Figure 5.7. Selenium concentrations at downgradient ash monitoring points at the Revloc sites.

5.2.1.5 Conclusions regarding the Revloc site

- Pollution loads have decreased at the 4 largest seeps from the Revloc 1 site (4SP, 4SPA, 4SPB, and 6SP); loading has increased somewhat at the smallest seep (site 23), but the net change has been a clear decrease in pollution loading from the site discharges.

- Groundwater quality at the downgradient well, MW-1, for the Revloc 1 site has improved; water quality at the upgradient well MW-2 remains unchanged; quality at MW-3 also upgradient, but located at the base of the pile has been variable, and presently shows an influence from acid mine drainage.

- Groundwater at the downgradient monitoring well, MW-5, at the Revloc 2 site has improved, but the timing of the changes suggest factors other than re-mining and reclamation are responsible. Quality at the upgradient well, MW-4, remains unchanged.

- Data collected from the two seeps from Revloc 2, R2A and R2B, show that the abandoned coal refuse at the Revloc site leaches worst-case acid mine drainage that also includes metals such as arsenic, lead, and sometimes chromium, cadmium, and copper in excess of the respective MCL's for those parameters. This condition, including the occurrence of some heavy metals well in excess of their respective MCL's, existed prior

to the Ebensburg Power Company operation, and the abandoned coal refuse is the source for those metals.

- Seep R2B has improved substantially in quality and declined in flow as a result of re-mining and reclamation on the Revloc 2 pile. Seep R2A has improved to a lesser degree, but has also decreased in flow as a result of re-mining and reclamation conducted upgradient of it. Reclamation is not completed upgradient of either of these two points. Most heavy metal concentrations appear to have declined at R2B, and remain relatively unchanged to this point at R2A.

- Taken collectively, the Revloc data indicate that selenium is one parameter for which concentrations may have increased as a result of the re-mining and reclamation with ash. Selenium at downgradient wells MW-1 and MW-5 is slightly elevated relative to background concentrations, although selenium has been below the MCL at MW-1 for the past three years and at MW-5 for the past two years. Selenium concentrations at R2B have been elevated relative to background and have consistently exceeded the MCL. Selenium concentrations at R2A have been highly variable, and for the past two years have been less than the MCL. R2A and R2B are both low volume seeps. Two recent downstream samples at SP1 show a selenium concentration of <0.007 mg/l. Selenium concentrations at R2A and R2B will likely decline with final reclamation of the upgradient areas, and monitoring of these points will continue.

- The major mechanism for decrease of mine drainage at Revloc 1 appears to be the removal of the marketable coal refuse and encapsulation of the remaining reject in the compacted FBC ash rather than the neutralization of mine drainage by alkaline leachate from the ash. This conclusion is supported by: 1) pH has remained low, while acidity and sulfate, as well as other mine drainage parameters, have declined at MW-1 and the larger of the pile discharges; 2) the flows of the primary discharge points at both the Revloc 1 and 2 sites have decreased, indicating that, as expected, the permeability of the areas reclaimed is less than that of the abandoned coal refuse.

- At point R2B at Revloc 2, pH, calcium and potassium have increased, while acid mine drainage parameters and manganese have decreased, indicating that alkaline leachate from the ash is having some influence on that point. Some of the same influence, although less pronounced, can be seen at R2A. R2A and R2B are subject to direct runoff from partially reclaimed areas where the ash/refuse mixture is exposed at the surface. Reclamation of areas directly upgradient of these seepages is not yet completed, so the final effects of reclamation and ash placement cannot be judged, although the results thus far are encouraging.

- Re-mining and reclamation of the Revloc sites using coal refuse ash has substantially improved the quality of the South Branch Blacklick Creek by reducing the concentration of acid mine drainage parameters in the stream. There are no other sources AMD to the stream up stream of the Revloc sites, and no other mechanism that would account for the pollution reduction in the stream.

5.2.2 Alkaline Addition to Surface Mine Overburden--Laurel Land Development, Inc. McDermott Site

As mentioned in section 5.1, the amount of calcium carbonate in the overburden of a surface mine site has been shown to be the primary factor determining if the site produces acidic or alkaline drainage, more so than the amount of sulfur in the overburden. For this reason, importing alkaline material onto mine sites with alkaline deficient overburden has often been seen as a potential way to make otherwise unmineable sites permitable. However, Pennsylvania's experience with alkaline addition has yielded, at best, mixed results, with several alkaline addition sites having unexpectedly produced substandard water quality, especially during the early years of alkaline addition (Smith and Brady 1998; Brady and Hornberger, 1990). Some of the reasons include difficulty in determining how much alkaline addition is enough, determining the best application methods, and the reality that the cost of importing enough alkaline material frequently exceeds the profitability of the job. Pennsylvania's current approach to alkaline addition on surface mines is described in Technical Guidance Document 563-2112-217 available on DEP's website.

5.2.2.1 Site characterization /setting

The McDermott Mine is located in Jackson Township, Cambria County, PA, just to the north of US Route 22, and just east of the summit of Laurel Ridge. The site has previously been described by Kania (1998) and by Schueck et al., (2001), however, mining was on going during both of those investigations, which, thus were preliminary. In the initial submission and through subsequent permit amendments, mining was proposed on 26.5 acres of Lower Kittanning Coal (LK), 32.1 acres of Middle Kittanning Coal (MK) and 8.6 acres of Upper Kittanning (UK) Coal (Laurel Land Development, SMP# 11950102, 1995). The operator also proposed to remove shale and sandstone (Worthington) from the operation. Little shale was removed, but an unknown tonnage of sandstone was removed, processed, and marketed as aggregate.

In the area of this site, the LK and MK overburden rocks are generally brackish water deposits. Channel sandstone deposits frequently exist within a framework of finer grained sediments such as shales and mudstones. Usually the only significant zone rich in carbonates is the Johnstown limestone horizon (freshwater), which is located at or a few feet below the bottom of the UK coal. The shale units, especially those that directly overlie the LK and MK coals frequently include significant amounts of sulfide minerals. With the lack of carbonates in the overburden and the high-sulfur shales located around the coals, one would expect that LK and MK mining might produce poor quality water, although the role of the Johnstown limestone has to be considered in that conclusion.

Surface and deep mining on the LK and MK seams in the area of the McDermott Mine generally has resulted in acid mine drainage. Because of its persistence, thickness and quality, the LK seam has been extensively deep mined, so is generally available for surface mining under thinner overburden. The MK seam, while usually of good quality, is usually not thick enough for deep mining and often occurs in multiple benches. Surface mining on these seams, therefore, often cannot take place to a high enough overburden to encounter much, if any, of the Johnstown

Limestone. While the overburden quality for these seams can be problematic, the previous mining that has occurred and the resultant unreclaimed spoil, deep mines and discharges present re-mining opportunities at appropriate locations with appropriate mining plans.

The exploratory data on the McDermott site show that over most of the site, the LK coal is directly overlain by a shale unit of 0 to12 feet thick. Above that is sandstone, which in places cuts down to the top of the coal. There is a thin clay layer beneath the MK coal. The MK overburden over most of the site is shale with minor sandstone units in places. The Johnstown limestone is not present on the site, but at the horizon where it would be expected, there is a shale unit that contains significant amounts of carbonate. Unfortunately, the high-carbonate shale exists in an unweathered state only at the highest cover, and only a limited amount of it became part of the mine spoil on this site. The UK coal was encountered only incidentally to the MK mining. The McDermott site is located near the crest of the eastern flank of the Laurel Ridge Anticline, and strata on the site dip shallowly to the northeast.

The McDermott Mine included a proposal to daylight some of the abandoned deep mines, and to reclaim old spoil and an abandoned highwall on the site. The mining plan also proposed alkaline addition in the form of FBC ash from two power plants located in Cambria County, which burn coal refuse to generate electricity (Laurel Land Development, SMP# 11950102, 1995).

Mining previous to the McDermott operation had degraded the headwater areas of the receiving stream, Hinckston Run, a tributary of the Conemaugh River. However, Hinckston Run does improve enough approximately 4 to 5 miles downstream to allow for stocking of brook trout, and some limited trout reproduction.

The permittee performed an acid-base account overburden analysis as part of the pre-permit requirements. Researchers in West Virginia began applying acid-base accounting results to coal mine overburden during the 1970's (Skousen et al., 1990). Interpretation of acid-base account data is complex, partially subjective, evolving, and dependant on the experience level of the interpreter. The approaches to interpreting acid-base account data currently used by Pennsylvania DEP permit reviewers are described in Brady et al., (1994), Perry and Brady (1995), and Perry (1998).

Acid-base accounting is intended to measure the potential of the disturbed rock to generate both acidity and alkalinity. The maximum potential acidity (MPA) is determined stoichiometrically from percent sulfur in the rock. The rock's ability to neutralize acid is measured in the laboratory and is termed neutralization potential (NP). NP and MPA are reported in terms of tons $CaCO_3$ per 1000 tons of material (or parts per thousand, ppt). Sites are frequently characterized in terms of net NP (NNP=NP-MPA). Site-wide NNP is one of the more effective ways to evaluate acid-base account data (Perry and Brady, 1995; Skousen et al., 2002). These terms can be used to characterize a single rock horizon, a drill hole, an entire mine site, or parts thereof. Pennsylvania experience has shown that strata with NPs < 30 ppt $CaCO_3$, or NPs without a fizz (does not effervesce with 25% HCl) are typically not significant alkalinity producers. Likewise, strata with percent sulfur less than 0.5 are not generally significant producers of acidity. An approach sometimes taken is to evaluate the ABA data by including

only those strata greater than these "thresholds" in the calculations (Brady and Hornberger, 1990). This is the approach that was taken here. Overburden data summaries referenced in this chapter were derived using a computer spreadsheet program (Smith and Brady, 1990).

Based on the mining plan submitted in the permit application, DEP interpreted the data to show an average site-wide $CaCO_3$ deficiency (i.e., a prevalence of potential acid producing material over potential alkaline producing material) of approximately –320 tons/acre and a net neutralization potential (NNP) of -3.07 tons calcium carbonate equivalence per 1000 tons of overburden. Sites with an NNP of less than zero have a high probability of producing acid water. (There are exceptions, such as low-cover sites in settings otherwise unlikely to create AMD (Perry and Brady, 1995).) For this study, the overburden data for the site were re-evaluated in light of how the site was actually mined; for example, more LK coal was mined, and thus more LK overburden was disturbed on the site than proposed. The recalculation shows a site-wide deficiency of –418 tons/acre and a NNP of –2.98 tons/1000 tons. The NNP (tons/1000 tons) is essentially unchanged by the recalculation, despite the increase in the tons per acre deficiency, because the total tons of overburden disturbed also increased with the recalculation. The recalculated site overburden data are summarized in the first row of Table 5.6.

Initially, the proposed ash (from the Interpower-Ahlcon plant at Colver, PA) had a neutralization potential (NP) of about 200 tons/1000 tons (ppt). The proposed ash addition rate was 2160 tons per acre averaged over the site, which equates to approximately to 500 tons of calcium carbonate addition per acre. During a later permit revision (December of 1997) the ash addition rate was increased to 3200 tons per acre. Also, the source of the ash was changed to the Cambria Reclamation Plant in Ebensburg (average NP 174 tons/1000 tons). The operator further increased the rate of ash application as mining progressed, due, in part, to emerging water quality problems on site. The ash was to be added to the pit floor, mixed with the spoil, and added to special-handled material at different rates for each coal seam being mined. In some areas ash was added to the surface prior to spreading topsoil. Records show that 28,775 tons of Colver power plant ash were used on the site, and 288,155 tons of Cambria Reclamation ash were applied. The total tons of ash added to the site were 316,930. Weight averaging the two different ashes results in the conclusion that the ash put on the site had the calcium carbonate equivalence of approximately 56,000 tons of pure calcium carbonate. The operator removed coal from approximately 48 surface acres, so ash was applied at approximately 6,600 tons per acre, which is theoretically equivalent to about 1,165 tons per acre of pure limestone. The material was not evenly distributed over the site, however. Areas mined early in the operation received substantially less ash than areas mined later in the operation, and the operator placed a large amount of ash in the west-central part of the site after final coal removal. The second row of table 5.6 summarizes the site overburden with the alkaline ash addition factored in.

Table 5.6. Summary of overburden analysis data for the Laurel Land Development McDermott site.

McDermott Site OBA	MPA (tons)	NP (tons)	Available NP (tons/acre)	NNP (tons/1000 tons)	NP/MPA Ratio
Raw Overburden	31679	11574	-419	-2.98	0.37
With Alkaline Addition	31679	67497	746	5.31	2.13

5.2.2.2 Mine operations

The McDermott permit was issued in January of 1996 and activated in April of that year. The site was mined primarily with a combination of a dragline and dozers. As is sometimes the case with dragline operations, spoil material was exposed to weathering in an un-graded state for extended periods. Mining began in the north-central part of the mine site, advanced first to the north, and then to the south. The higher cover portions of the job in the west-central part of the site were mined last. Toward the end of the operation, reclamation slowed considerably, and the operator eventually abandoned the site, leaving it partially unreclaimed, the state in which it currently remains.

5.2.2.3 Monitoring results to date at the McDermott Site

Soon after mining began, so did water quality problems. Mining had started in the north-central part of the permit application along the Lower Kittanning cropline. The nearest downgradient monitoring points to that location are a well, MW-2 and a spring, MD-12. Water monitoring data for the McDermott site monitoring points are presented in Appendix 5.C. Monitoring point locations relative to the McDermott site are shown in Figure 5.8.

Figure 5.9 displays the results for some standard mine drainage parameters at MD-12. While the data are highly variable, sulfate, acidity, iron, and manganese clearly increased soon after mining began upgradient of the point. Other parameters such as calcium, magnesium, and chloride increased also. Among the heavy metals, zinc and nickel (typically associated with AMD) increased somewhat. Copper spiked during late 1996 through 1999, but has been near background levels for the past four years, and remained well below the MCL at all times. Lead concentrations showed a similar spike, and frequently exceeded the MCL of 0.015 mg/L from 1997 into early 1999, but have since declined to below the MCL. (Lead concentrations at the monitoring points for the McDermott site will be discussed in more detail later in this chapter.)

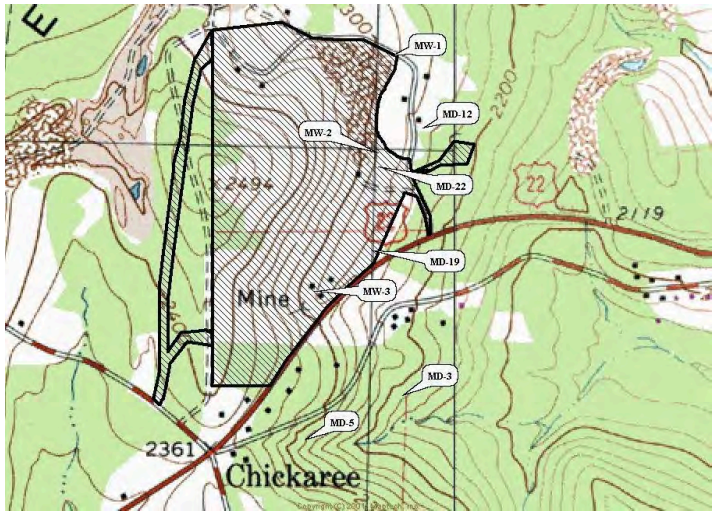


Figure 5.8. Map showing the locations of the McDermott Mine monitoring points.

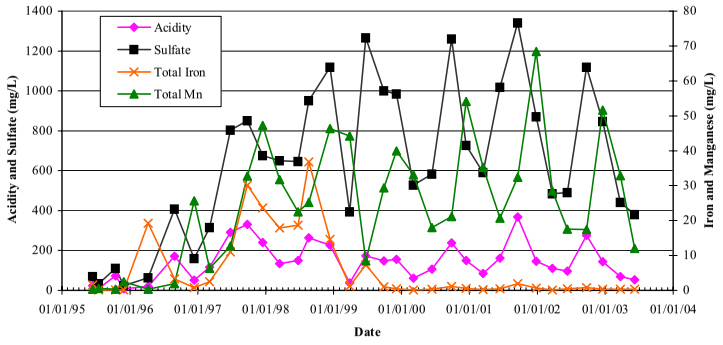


Figure 5.9. Mine drainage parameters at spring MD-12.

Appendix P

Monitoring well MW-2 is one of three monitoring wells placed downgradient of the McDermott site to monitor the results of the re-mining and ash placement effort. Each of these wells is drilled down slope of the LK cropline into the Kittanning sandstone formation. Monitoring well MW-2 showed similar results to those at MD-12. Shortly after mining began, mine drainage parameters began to increase (Fig. 5.10). Calcium, magnesium and chloride increased. Copper increased, although it remained well below the MCL of 1.3 mg/L. Nickel and zinc increased somewhat. As was the case with MD-12, lead concentrations also increased at MW-2, peaking in 1997 at around 0.08 mg/L and declining since.

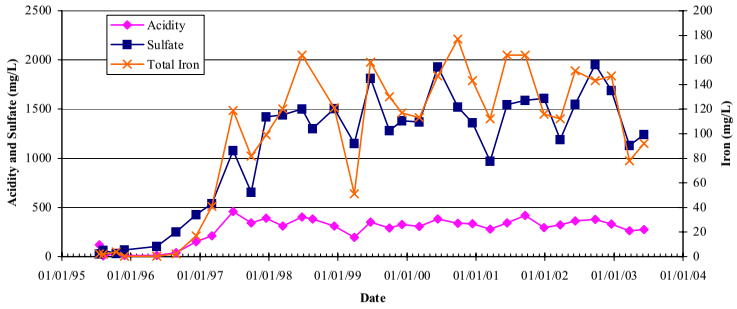


Figure 5.10. Acidity, sulfate and iron at MW-2.

Monitoring well MW-1 is located along the northeastern corner of the McDermott site and is located downgradient of area mined on the McDermott Mine. MW-1 is also located directly downgradient of an area of abandoned mine lands that had been mined prior to the McDermott site. The McDermott Mine reclaimed the abandoned highwall that had been left by the pre-law operation. The monitoring data show that MW-1 was affected by mine drainage by the abandoned mine lands prior to the initiation of the McDermott operation. The data also show that mining on the McDermott site further affected the water quality at MW-1. Figure 5.11 shows the monitoring results for MW-1 for acidity, iron and sulfate.

The McDermott Mine affected areas upgradient of MW-1 early in the operation, during 1996, and the influence on the well in terms of increasing sulfate can be seen as early as the beginning of 1997. Note in figure 5.11 that sulfate increased, while acidity did not. This could be explained either by attributing the increased sulfate to the coal ash, or by an increase in acid mine drainage production, which is being neutralized by the ash.

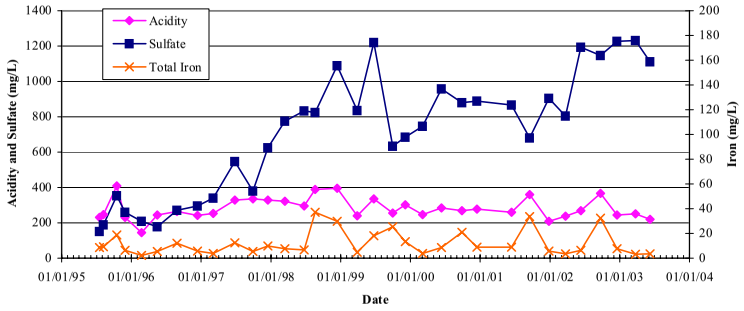


Figure 5.11. Acidity, sulfate and iron at MW-1.

Figure 5.12 shows the sampling results at MW-1 for calcium, magnesium, aluminum, and manganese. The McDermott operation clearly caused an increase in manganese in MW-2, with concentrations increasing about 4 times from near 5 mg/L to near 20 mg/L. The increase in manganese confirms an increase in acid mine drainage production as a result of the disturbance of the site overburden. The increase in manganese concentrations, without an increase in acidity, suggests that the additional mine drainage being produced is being neutralized by the ash. The increase in sulfates could be due to either an increase in pyrite oxidation, dissolution of the ash, which in laboratory tests leaches elevated sulfates, or, most likely a combination of both.

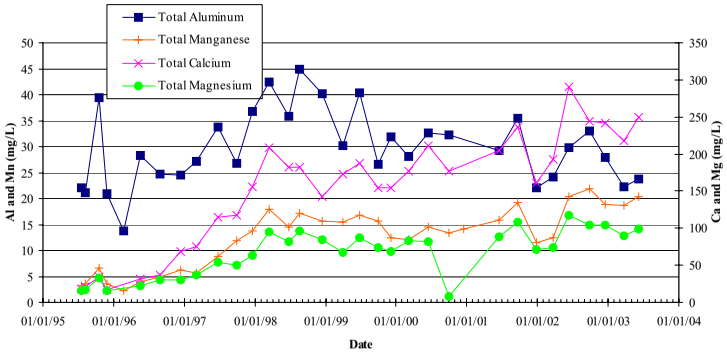


Figure 5.12. Calcium, magnesium, aluminum, and manganese at MW-1.

Calcium and magnesium levels also have increased in MW-2. Aluminum concentrations were elevated prior to the McDermott operation and remain unchanged. Nickel and zinc concentrations at MW-2, although not particularly high have increased somewhat, also suggesting an increase in mine drainage, which is then being neutralized. pH has remained constant in the low 3's. Lead concentrations did not show an increase in MW-1 as they did in MW-2 and MD-12, however, they were relatively elevated in MW-2 in the background and frequently exceeded the MCL throughout the monitoring period, including before the McDermott Mine affected the area.

Monitoring well MW-3 is located along the southeastern edge of the McDermott site. Mining and ash placement did not advance to areas upgradient of MW-3 until mid-1998. Shortly thereafter, acid mine drainage began to show up in the well (Fig. 5.13). Hot acidity, iron, and sulfate all increased substantially. Much of the acidity increase in MW-3 is apparently mineral acidity; pH at MW-3 has not declined and has remained in the low 5's.

Calcium, magnesium, manganese, chloride, specific conductance, and TDS have all increased in MW-3. Among the other metals, nickel and zinc have increased. Copper, chromium, arsenic, and cadmium show no discernible increase. Lead concentrations have been highly variable, but also show no trends and consistently have been below the MCL.

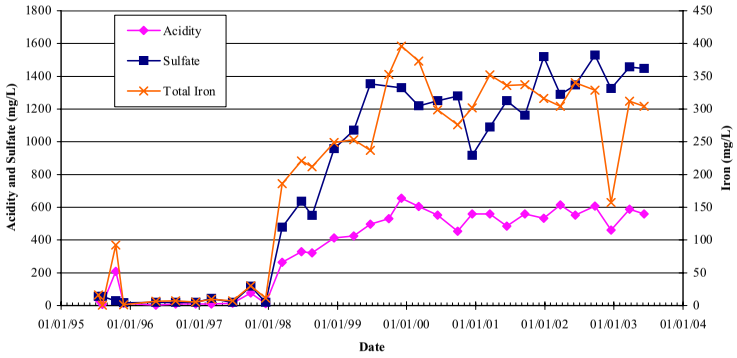


Figure 5.13. Acidity, sulfate and iron at MW-3.

The lead results from the various monitoring points at the McDermott site warrant some discussion, because lead concentrations increased at both MW-2 and MD-12 after mining took place on areas of the site upgradient of those two points. Figure 5.14 shows the lead concentrations with time at various key monitoring points on the McDermott site. Lead concentrations at the monitoring points not included in Figure 5.14 were not remarkable in that

they generally were typical of background conditions and showed no discernible change during the monitoring period. Among the three site monitoring wells, the highest lead concentrations prior to the McDermott operation were found in MW-1, the one well that was affected by mine drainage prior to the McDermott operation. (MW-1 was located directly downgradient of a small abandoned surface mine, and its background water quality showed an influence from mine drainage pre-McDermott (Fig. 5.11)). Lead concentrations in MW-1 frequently exceed the MCL (0.015 mg/L), and are unchanged by the additional mining and ash placement conducted directly upgradient of the well by the McDermott operation.

Among the other various sample points where lead concentrations were measured prior to the McDermott operation, lead concentrations were also relatively high in MD-2, a small seep from a deep mine entry, also located on the northern section of the McDermott site. MD-2 was mined out soon after operations began, thus the short monitoring period for that point. The background data collected prior to the McDermott operation show no other points with elevated lead, including deep mine discharges MD-3, MD-5 and MD-1. MD-1 was located near the center of the McDermott site, and MD-3 and MD-5 are located to the southeast of the site. After Laurel Land Development re-mined the McDermott site, lead concentrations increased in MD-12 and MW-2, located on the northern end of the site, but did not increase in MW-3, MD-3, and MD-5, despite the latter three points being clearly degraded by mine drainage generated by the McDermott operation. All areas of the site, north and south, had FBC ash used in reclamation, and because the southern part of the job was mined after the northern part, the ash application rates were generally greater on the southern area. Given all these facts, the source of increased lead in MD-12 and MW-2 appears to be in the coal overburden on the northern end of the site rather than the coal ash.

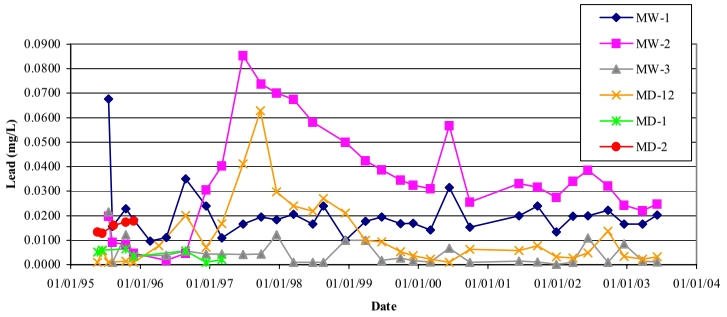


Figure 5.14. Lead concentrations at various monitoring points on the McDermott Mine site.

MD-22 is the discharge from a pit floor drain that the operator installed on the south central section of the site; the pit floor drain was installed as part of an abatement plan in response to the water quality problems that the site monitoring showed were occurring. Water quality for MD-22 is available in Appendix 5.C. The pit floor drain was excavated into the pit floor and filled with limestone. It was intended to collect water flowing across the pit floor, treat it by neutralizing acidity and imparting alkalinity, and discharge it at a location that additional treatment could be applied, if needed. The pit floor drain was partially successful in that it produces a discharge with less acidity than the water seen in the monitoring wells. The discharge from the drain is net alkaline during lower flow periods. As would be expected, the drain discharges water with very high conductivity, sulfate, TDS, calcium, and magnesium. Iron, manganese, aluminum, nickel and zinc, metals typically found in mine drainage, are elevated in MD-22. The sodium and chloride concentrations in the drain discharge are above levels typically seen in mine drainage from shallow flow systems, and may be influenced by the ash. (The chloride levels are consistently well below the recommended level for drinking water supplies, and the sodium levels are much less than would be found in water treated with a conventional water softener.) Metals in MD-22 are relatively low and consistently below the MCL's for those parameters. The metal concentrations are likely affected by the fact that MD-22 is partially treated by the limestone in the trench. However, even during sampling events when the discharge from MD-22 is net acid with a low pH, the heavy metals are low.

In addition to the monitoring points discussed in detail in this chapter, a downgradient spring (MD-19) and two other downgradient abandoned deep mine discharges (MD-3 and MD-5) were further degraded by the McDermott operation. The degradation is in terms of mine drainage parameters, and there is no significant increase in any heavy metal, including lead, or other parameter attributable to the ash placement on the site. Data for MD-3, MD-5 and MD-19 are available in Appendix 5.C.

The McDermott site is located downgradient of an area previously mined by Ace Drilling Coal Company in the late 1970's. Laurel Land Development has asserted that poor water quality on its site is solely due to the Ace Drilling operation, however, several lines of evidence contradict that conclusion, including 1) mine drainage is pervasive across all affected areas of the McDermott site; 2) mining on Ace Drilling occurred about 20 years prior to that on McDermott, yet points downgradient of the McDermott site sequentially worsened only after overburden was disturbed on the McDermott site; 3) mine drainage at points downgradient of McDermott appeared rapidly after overburden disturbance on McDermott.

5.2.2.4 Conclusions regarding the McDermott site

- Re-mining and partial reclamation of the McDermott site caused an increase in acid mine drainage degradation in most downgradient monitoring points; points that were AMD-impacted prior to the McDermott operation worsened (MW-1, MD-3, MD-12, and MD-5), and points that showed no influence from AMD prior to the operation (MW-2, MW-3 and MD-19) became AMD-contaminated shortly after mining occurred upgradient of them.

- Both DEP and the permittee were aware prior to the operation that the site overburden analysis identified the potential for AMD production, thus the applicant formulated the alkaline addition plan to address this concern.
- In terms of total tons of ash and total calcium carbonate equivalence, the amount of alkaline ash imported to the site met and exceeded that originally proposed. A re-evaluation of the overburden analysis results showed that, although the original mining plan was not completely followed, that fact did not significantly worsen the site NNP deficiency, as compared to the pre-mining prediction.
- Some operational practices likely exacerbated AMD production from the site: 1) reclamation of affected area was not always timely; 2) ash delivery was intermittent, leading to the need to stockpile ash, which was then subject to pozzolanic hardening prior to its use; 3) the site was ultimately abandoned by the operator leaving an unreclaimed area open to accelerated weathering and high infiltration rates. However, monitoring data show that AMD formation began almost immediately with overburden disturbance on the site, and AMD production would likely have occurred even had good mining practices been followed.
- An ash addition rate of 6600 tons per acre (calcium carbonate equivalence of 1165 tons per acre) did not prevent AMD formation on this site. The alkaline addition rate achieved a site-wide NNP of 5.31 tons/thousand tons, however, the ash application rate was not uniform across the site.
- For at least some monitoring points, the data suggest that ash is neutralizing some AMD, but not enough to cause the site to produce net-alkaline water, and AMD production was clearly not prevented.
- A review of the water quality data for this site shows no evidence of contamination from ash utilization. Sodium and chloride concentrations are elevated at some points relative to levels typically found in acid mine drainage from shallow flow systems, indicating that ash may be the source of those parameters, however, the levels are not high enough to be considered contamination. Ash is probably contributing to the elevated calcium levels seen at some points. Lead levels increased at two monitoring points as a result of the operation, but the pattern of its occurrence, and an evaluation of background data, point to the overburden on the northern end of the site as the source. It is possible that the ash is contributing to sulfate concentrations, but that is difficult to separate from the AMD influence.
- Results at this site were similar to those at sites where alkaline addition in the form of waste lime was added to sites in the face of clearly poor overburden quality, and the result was production of additional AMD.

5.3.3 Reclamation of A Bituminous Coal Bond Forfeiture Site—Abel-Dreshman Site

Pennsylvania's significant abandoned mine reclamation obligation has been widely documented. The total cost of reclaiming the state's abandoned mine lands has been estimated as high as $15 billion. The vast majority of that legacy of polluting discharges is attributable to older sites that were either mined before or shortly after the advent of modern permitting requirements that were brought into effect in 1978-1982. In an evaluation of post-mining water quality associated with the surface mine permits issued by Pennsylvania DEP between 1977 and 1996, Smith (1999) found that predictive capabilities improved markedly with time. Less than

1% of the permits issued between 1987 and 1996 resulted in a discharge requiring treatment, while the failure rate for sites from 1977 through 1986 was 10-20%. Very few surface mining permits issued today in Pennsylvania results in water quality problems. The McDermott site described in section 5.2.2 is an example of one that did.

The Abel-Dreshman site is an example of a site that was permitted just prior to modern understanding of acid mine drainage and its prevention, and the Abel-Dreshman site also produced pollution and was left partially reclaimed by the original permittee. Coal ash was not placed on the Abel-Dreshman site, when it was mined, but was subsequently used as an alkaline addition agent, when the site was reclaimed. The Abel-Dreshman site was previously reported on by Schueck et al., (2001), however, additional water quality data are now available, which are included in this chapter. (See Appendix 5.D for the raw water sampling data from the Abel-Dreshman site.)

5.3.3.1 Site characterization/ setting

DEP issued the Abel-Dreshman Surface Mining Permit # 10800101 to Chernicky Coal Company on June 17, 1980. The permit authorizes mining of 55.5 acres of Middle Kittanning Coal (MK). The prevalent rock type on this site is sandstone, which was deposited in a brackish water environment. The site is located on Seaton Creek in the Ohio River drainage basin.

The Abel-Dreshman site was permitted at a time when overburden analysis was rarely used, and no overburden analysis was performed for the initial site application. However, in 1984, after Chernicky Coal Company had mined and abandoned a significant portion of the site, another company proposed to take over the site to finish the mining and reclamation. Because the mining done to that point on the site had created water quality problems, DEP required overburden analysis as part of that attempt to transfer the site. Two holes were drilled, both on the Abel tract, since the Dreshman tract had little recoverable coal remaining on it.

DEP did not authorize the additional proposed mining, because the overburden analysis showed a strong potential to generate additional mine drainage pollution if mining continued. The data show a clear deficiency of NP (neutralizing material in terms of calcium carbonate equivalence) on the site, as shown by the negative NNP in terms of both tons/1000 tons and tons/acre. The information provided in Table 5.7 under the heading "Tons $CaCO_3$/needed to provide:" shows for each drill hole how much calcium carbonate would need to be added to each acre represented by that drill hole to meet certain benchmark values shown to have significance by Brady et al., (1994) and Perry and Brady (1995).

On a mass-average basis, the two overburden holes on the site, OB-1 and OB-2, included 56% sandstone and 91.1% sandstone, respectively. In a study of Allegheny Formation rocks in West Virginia, diPretoro and Rauch (1986) reported a propensity for sites with high percentages of sandstone in their overburden to produce acid mine drainage.

Table 5.7. Summary of the overburden analysis data for the Abel-Dreshman site.

Drill Hole #	Highwall Cover Height	Net Neutralization Potential			Tons $CaCO_3$/acre needed to provide:		% SS
		tons/1000 tons	tons/acre		6 ton/1000 ton excess	12 ton/1000 ton excess	
		Thresholds			Thresholds		
		without	with	without	with	without	
OB-1	56	-2.33	-227	-215	780	1320	56.5
OB-2	46	-9.27	-612	-740	1090	1696	91.1

5.3.3.2 Mine operations

Chernicky Coal Company took the first cut on the Abel-Dreshman site in July 1980, and mining continued intermittently until June 1982. Approximately 65 of the 74.5 bonded acres were affected. The site was mined as two operations, with one pit on the Abel parcel and one pit on the Dreshman parcel. Routine sampling by the DEP inspector on July 29, 1982 revealed the first signs of AMD contamination on the site at a sediment pond and at a spoil discharge (Table 5.8).

Table 5.8. Sample results of July 29, 1982 showing the quality of AMD occurring on that day. Flow is in gpm, pH is in standard units, and all other parameters are in mg/L.

Description	Flow	pH	Alk.	Hot Acidity	Total Fe	Total Mn	Total Al	SO_4	Net Alk.
Sediment Pond		3.3	0	359	5.5	91.7	25.3	1300	-359
Spoil Discharge	5	5.4	17	105	33.1	43.6	0.81	900	-88

Samples collected by DEP during 1982 and 1983 further documented that the site was producing AMD. Due to a variety of problems with the site, DEP initiated bond forfeiture proceedings in March 1983. The initial operator had abandoned two pits on the site, one of which flooded with groundwater. On March 1984 the Department measured the impoundment's dimensions at 150 ft. L x 60 ft. W x 40 ft. and measured the other pit at 75 ft. L x 50 ft. W x 40 ft.

On February 3, 1997, DEP entered into a landowner reclamation agreement through which Amerikohl Mining Company, Inc. would complete the reclamation on the abandoned site. The reclamation was performed from September 1997 until September 1998. Amerikohl did no additional mining on the site, so there was no additional disturbance of acid-producing overburden. The reclamation plan included the mixing of 200,000 tons of Scrubgrass Generating Project CFB ash to the mine spoil as an alkaline addition agent in an attempt to offset the deficiency in the mine spoil that had been documented by the site overburden analysis. The Scrubgrass facility is located in Scrubgrass Twp., Venango County. As part of the plan, the entire site was to be reclaimed to the standard typically required in Pennsylvania, known as

approximate original contour or AOC. Records show that only 83,600 tons of ash were actually mixed with the site overburden. According to NP tests performed on the ash, it had approximately 600 tons per 1000 tons of $CaCO_3$ equivalent. This number is quite high for CFB ash, but apparently, because the plant was still being adjusted at that point, lime utilization was rather inefficient. Approximately 1235 tons of ash were added to each of the 50 affected acres equating to 1003 tons of 100% $CaCO_3$ equivalent. This amount would provide a little more than a 6 tons/1000 ton excess NP (calculated with thresholds) across the site (Table 5.7).

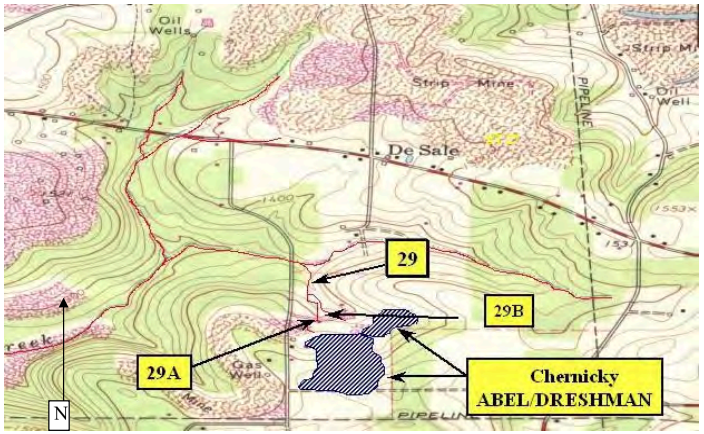


Figure 5.15. Map of the Abel-Dreshman site and monitoring points.

The Abel-Dreshman site consists of two parcels, and placement of the ash was slightly different on the two areas. The ash generator added water at the plant to condition the ash for dust control, sufficient to bring the ash up to a moisture content of about 21%. Bottom dump trucks transported the ash to the site. A bulldozer then promptly mixed the ash and spoil while pushing both into the pit. The floor of the existing pits was covered with a layer of the ash, approximately 2 to 3 feet thick. (The flooded pit was pumped prior to ash placement.) On the Abel parcel much of the ash was spread in layers due to non-availability of equipment and breakdowns, where it was thoroughly mixed with the spoil on the Dreshman site. Amerikohl placed and compacted a layer of ash one to two feet thick on both parcels before placement of the final topsoil material.

5.3.3.3 Monitoring results from the Abel-Dreshman site.

The Department chose three downgradient springs as monitoring points for the Abel-Dreshman project. The springs are identified as sample points 29, 29A, and 29B. Point 29A is downgradient of the Dreshman tract, 29B is downgradient of the Abel tract, and 29 is located just below the confluence of the flows represented by 29A and 29B.

Table 5.9 summarizes water monitoring results for certain mine drainage parameters at point 29A. Comparing the period prior to ash addition and backfilling (prior to September 1997 – 1998) to the periods during and following the application of ash (after September 1998) shows a marked decrease in metals concentrations at monitoring point 29A. The data also show a significant increase in pH and net alkalinity. (Negative acidity values in this case were reported by the laboratory as 0 acidity, so where net alkalinity is referenced herein, it is alkalinity minus any acidity reported.) Sulfate concentrations are unchanged.

Table 5.10 shows summary mine drainage parameter results for point 29B, broken into the same subsets as were the data for 29A. In the case of 29B there was little change in pH, but net alkalinity did improve substantially, as did manganese.

Table 5.9. Summary of mine drainage parameter results at point 29A, comparing the periods, before, during and after ash application and reclamation.

MP-29A	Pre-Ash Application	During-Ash Application	Post-Ash Application
# of samples (n)	9	9	11
Median pH (su)	3.5	3.7)	6.1)
Average Net Alkalinity (mg/L)	-185.3	-207.	-35.2
Std. Deviation Net Alkalinity	56.9)	50.6	80.7
Average Total Iron (mg/L)	2.1	15.1	0.8
Std. Deviation Total Iron	1.5	13.7	1.2
Average Total Manganese (mg/L)	44.6	76.3	32.7
Std. Deviation Total Manganese	25.5	19.7	23.1
Average Total Aluminum (mg/L)	3.5	3.1	1.3
Std. Deviation Total Aluminum	1.0	2.1	1.5
Average Total Sulfate (mg/L)	835.6	942.7	817.2
Std. Deviation Total Sulfate	377.5	292.6	202.0

Table 5.11 includes summary data for point 29, which represents water quality of the combined flows of 29A and 29B. Net alkalinity and pH increased, while iron, manganese and aluminum decreased, when the pre-ash water quality data are compared to the post ash data. Sulfate concentrations have also decreased.

The pH at point 29A may have declined somewhat over the past two to three years (Fig. 5.16), while the pH values at 29B and 29 have been stable, and may still be increasing slightly.

Table 5.10. Summary of mine drainage parameter results at point 29B, comparing the periods, before, during and after ash application and reclamation.

MP-29B	Pre-Ash Application	During-Ash Application	Post-Ash Application
# of samples (n)	9	9	11
Median pH (su)	4.5	4.7	4.7
Average Net Alkalinity (mg/L)	-36.3	-18.7	-5.0
Std. Deviation Net Alkalinity	17.1	16.2	8.0
Average Total Iron (mg/L)	1.1	0.1	0.2
Std. Deviation Total Iron	1.7	0.1	0.3
Average Total Manganese (mg/L)	27.7	7.0	5.9
Std. Deviation Total Manganese	37.0	3.3	2.5
Average Total Aluminum (mg/L)	2.5	1.8	1.4
Std. Deviation Total Aluminum	0.6	0.8	0.7
Average Total Sulfate (mg/L)	335.1	190.6	213.1
Std. Deviation Total Sulfate	289.7	63.7	69.5

Table 5.11. Summary of mine drainage parameter results at point 29, comparing the periods, before, during and after ash application and reclamation.

MP-29	Pre-Ash Application	During-Ash Application	Post-Ash Application
# of samples (n)	9	9	11
Median pH (su)	3.6	3.8	4.8
Average Net Alkalinity (mg/L)	-117.8	-104.3	-2.8
Std. Deviation Net Alkalinity	39.5	58.1	11.8
Average Total Iron (mg/L)	1.5	6.4	0.2
Std. Deviation Total Iron	0.6	11.2	0.2
Average Total Manganese (mg/L)	43.3	38.3	9.5
Std. Deviation Total Manganese	18.2	18.8	4.1
Average Total Aluminum (mg/L)	2.9	2.7	0.9
Std. Deviation Total Aluminum	0.5	2.1	0.5
Average Total Sulfate (mg/L)	634.7	624.8	295.6
Std. Deviation Total Sulfate (mg/L)	237.1	258.7	75.2

Net alkalinity at all three points appears to have declined slightly over the past three years (Fig. 5.17), but still remains above pre-ash placement and reclamation values. Possible reasons for a decline in net alkalinity at the monitoring points could be a decline in available NP in the backfill with time, or it could be due to climatic effects (e.g., rainfall). The higher net alkalinities tend to occur during the wetter seasons of the year, and over much of Pennsylvania, 2001 and 2002 were relatively dry. Continued monitoring will reveal if net alkalinity stabilizes or continues to decline.

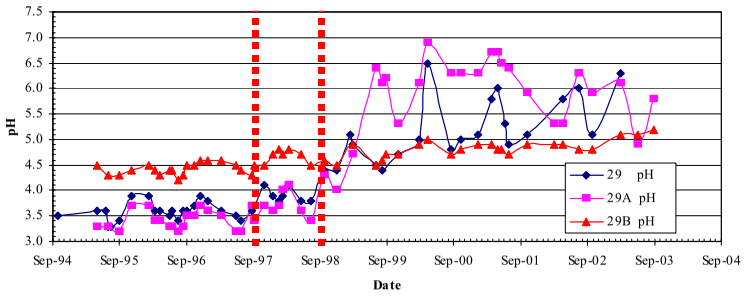


Figure 5.16. Graph of pH with time at points 29, 29A and 29B. The two vertical lines bracket the period during which ash placement and reclamation took place.

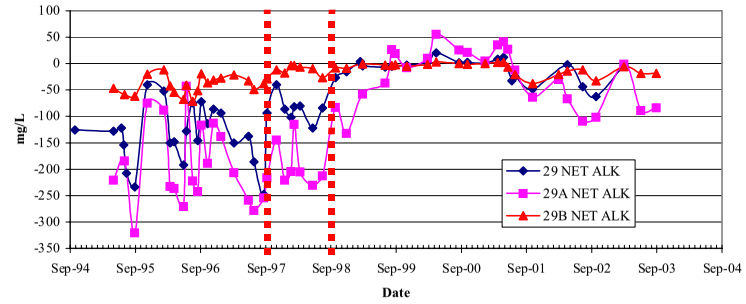


Figure 5.17. Graph of net alkalinity with time at points 29, 29A and 29B. The two vertical lines bracket the period during which ash placement and reclamation took place.

The primary AMD metals (iron, manganese, and aluminum) declined at points 29, 29A and 29B after the site was reclaimed with the addition of ash. Figure 5.18 displays the available

data for aluminum at the three points. Aluminum concentrations at all three points appear to be stable since 1999. The removal of aluminum from down stream areas is particularly significant, due to aluminum's toxicity to aquatic life. The data for iron and manganese, while not presented in graphic form here, show similar patterns to that seen for aluminum.

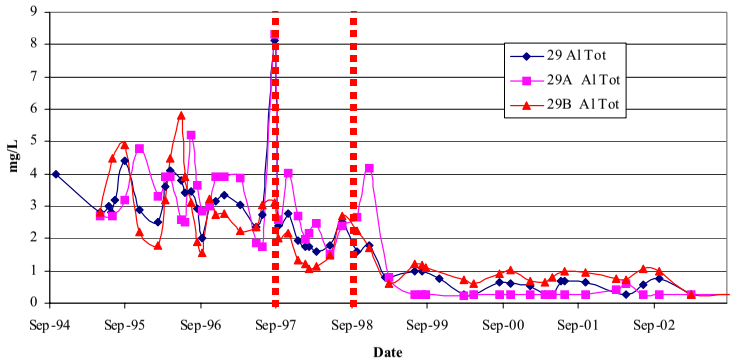


Figure 5.18. Graph of aluminum concentrations with time at points 29, 29A and 29B. The two vertical lines bracket the period during which ash placement and reclamation took place.

Monitoring was conducted at 29, 29A, and 29B for additional parameters beyond the traditional AMD parameters (Appendix 5.D) Most of these additional results are unremarkable. Sodium concentrations appear to have increased at point 29A, which also showed the largest increases in pH and net alkalinity when compared to the other two monitoring points discussed here. Sodium concentrations also increased at the Revloc and McDermott sites at some points downgradient of the ash placement areas, but in no case were the numbers particularly high. The concentrations of toxic metals including selenium, mercury, copper, chromium, cadmium and arsenic are consistently below detection limits throughout the monitoring period at all three points. Lead concentrations have occasionally been at detectable limits, but are generally low, and show no increase after reclamation of the site with ash.

5.3.3.4 Conclusions regarding the Abel-Dreshman site

- Overburden analysis data for this site show that the site overburden had significant potential to generate acid mine drainage and little potential to generate alkalinity.
- Reclamation of the site with coal ash resulted in increases in pH and net alkalinity and decreases in AMD metals in monitoring points downgradient of the site.

- The ash used on the site appears to be generating alkalinity in that the overburden did not have the capability to do so. Reclaiming the site by backfilling it and adding a layer of compacted ash to the surface may also have contributed to water quality improvements.
- Net alkalinity has declined at the monitoring points over the past two to three years, but water quality appears to be otherwise stable, and remains substantially improved as compared to pre-ash placement.
- There is no indication of increases in heavy metals or other pollutants at downgradient monitoring points as a result of the use of ash on the site.
- Downgradient water quality is likely much better than it would have been had the site simply been reclaimed without the use of ash.

5.3 CONCLUSIONS

Abandoned coal refuse piles are a significant environmental liability in the Bituminous Coal Region of Pennsylvania, and traditional AML approaches toward reclaiming the piles do little to abate the associated water quality problems. Not only do these piles produce a leachate of highly concentrated AMD character, they also can leach elevated levels of toxic metals, such as arsenic, copper, and lead. The use of FBC ash in the re-mining and reclamation of two large refuse piles at Revloc, PA has resulted in a large reduction in pollution load from site discharges and in a substantial improvement in downstream quality on the South Branch Blacklick Creek. Both flows and concentrations of pollutants have declined at the largest discharge points. Re-mining and reclamation are on going at these sites, and further water quality improvements are expected. Monitoring data show no significant negative impacts to downgradient water quality from the use of FBC ash on the sites. Selenium concentrations have increased somewhat, however, the two points with the most-elevated selenium are low-volume seeps downgradient of an area where final reclamation has yet to be achieved. Burning of waste coal to generate electricity is now a common practice in PA. Not only does this practice turn environmental liabilities into an energy source, the by-product in the form of FBC ash is particularly suited to aid in the full reclamation of waste coal piles.

At the Laurel Land Development, Inc. McDermott site, the use of FBC ash as an alkaline addition agent was unsuccessful in preventing mine drainage formation. Water quality data indicate that the large quantity of ash placed in the backfill may be neutralizing some AMD, but has not prevented the formation of AMD, and has not generated net alkaline water. Several downgradient monitoring points have been degraded with AMD at the McDermott site. While operational complications, such as an intermittent ash supply, stockpiling of ash before incorporation into the backfill, and delayed and incomplete site reclamation may have contributed to the site problems, they likely are not the sole cause of the problems. Using alkaline addition in the form of ground limestone to prevent AMD on mine sites where predictive indicators strongly point toward AMD production has historically not been highly successful in PA. The production of AMD on the McDermott site, despite a relatively high rate of alkaline ash addition, suggests that it may be even more difficult to overcome an overburden deficiency with FBC ash than it is with limestone. FBC ash probably can be best utilized on active mine sites as a sealing or encapsulating material to limit the contact of water with high-sulfur pit floors and pit cleanings, or as a best management practice, where alkaline addition is not necessarily needed to prevent AMD production, but where it may be helpful in abating pre-

existing AMD problems. Water quality data at the McDermott site show that, while the ash did not prevent AMD formation, it also did not cause pollution in terms of increased non-AMD metals in downgradient monitoring points.

At the Abel-Dreshman site, the use of FBC ash in the reclamation of an abandoned surface mine resulted in an improvement in downgradient water quality. The use of ash appears to have increased the net alkalinity of downgradient monitoring points, increased the pH, and decreased metal concentrations. Net alkalinity appears to have declined recently, but remains above pre-ash placement levels. Overburden analysis on the Abel-Dreshman site indicates that the overburden is unlikely to generate any alkalinity on its own. The Abel-Dreshman ash project was purely a reclamation project, and no additional overburden was disturbed. That is one fundamental difference between Abel-Dreshman and McDermott. On the McDermott site, the area of fresh overburden disturbance was large relative to the area of re-mining and abandoned mine reclamation. Also, the NP of the ash used at Abel-Dreshman was much higher than the NP of the ash used at McDermott. Downgradient water monitoring at Abel-Dreshman shows that the use of ash in site reclamation caused no metal contamination.

Appendix P

Beneficial Use of FBC Coal Ash for Mine Reclamation in the Anthracite Region at the Wheelabrator Frackville and Mount Carmel Co-Gen Sites

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ABSTRACT

The Wheelabrator Frackville and Mount Carmel Co-Gen sites are located in the Anthracite Region of Pennsylvania, utilize anthracite culm, silt and refuse as fuel and reclaim abandoned and active mine lands with the coal ash they produce. Since the plants have been operating, they have reclaimed over 300 acres of abandoned mine lands, and have also eliminated a large number of safety hazards via that reclamation work. Site monitoring has also revealed no degradation associated with the coal ash placement, and some groundwater and surface water improvements will be evident once the projects and all site related reclamation is completed.

INTRODUCTION

The remining and reclamation of abandoned mine lands in Pennsylvania increased significantly with the construction of waste coal fired power plants in recent years. The coal ash produced by these power plants has resulted in a significant growth in the use of coal ash for mine reclamation in the anthracite and bituminous regions of Pennsylvania. The nine anthracite region waste coal power plants account for over 39 million tons of coal ash beneficially used for abandoned mine reclamation via the remining of waste coal piles and the filling and reclamation of abandoned mine land pits. The majority of the reclamation associated with these plants is through the utilization of coal ash as fill material and the resultant reclamation of the abandoned mine land features. The reclamation associated with these sites has, in most cases, also improved the groundwater and/or surface water in the vicinity of the projects. All of this reclamation has been conducted at no cost to the Commonwealth and represents a significant monetary savings for Pennsylvania's Abandoned Mine Land Reclamation Program.

The Wheelabrator Frackville and Mount Carmel Co-Gen sites represent two sites where significant remining and reclamation of abandoned mine lands has and is occurring via the operation of the power plants, and the beneficial use of the coal ash produced by the plants. This paper will give a short description of each site, and the resultant effects of the remining and reclamation of the sites through the beneficial use of coal ash.

Wheelabrator Culm Services, Inc. – (Wheelabrator Frackville Co-Gen)

This 580 acre surface mining permit site, (SMP No. 54880202) was issued for coal refuse reprocessing with coal ash utilization in October 1991, and is located in Mahanoy Township,

Schuylkill County, as shown on Figure 1. Known as the Morea/New Boston Operation after the historic colliery names, the operation is situated entirely on previously mined areas. The land surface consisted of abandoned anthracite culm banks, multiple open strip-mined pits, and overall disturbed surface-water drainage. It is located in the southeastern portion of the Western Middle Anthracite Field.

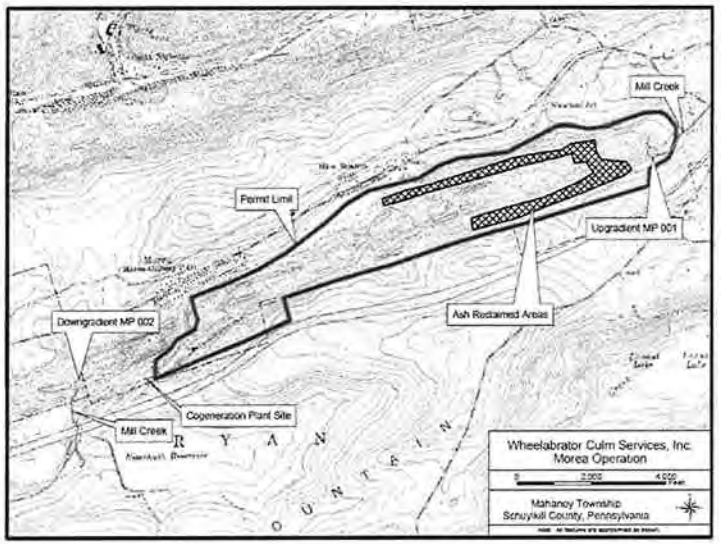


Figure 1. Site map of Wheelabrator – Morea mine site.

The minepool and groundwater flow system of the Morea and New Boston Collieries is somewhat isolated from the remainder of the Western Middle Field. These two collieries are located in a narrow basin on top of Broad Mountain. This case study site was selected because it is a good example of extensive abandoned mine reclamation with coal ash from a FBC plant, the ash reclamation project has significant potential for surface water and groundwater improvement (when completed), and the groundwater monitoring scenario is relatively simple.

Most of the permit area was taken over from the previous operator, Lehigh Valley Anthracite. The Wheelabrator Frackville Energy Co., Inc. constructed the circulating fluidized bed boiler plant (FBC) in 1988 on-site, near their primary fuel source – (anthracite culm) and potential ash placement areas. Coal refuse and coal silt from other local permitted areas is conveyed to the plant. Fly and bottom ash are then hauled from the plant by truck to the active ash placement area. The operation is conducted in phases of refuse recovery and ash utilization. Over 11 years, the operator has had nine phases approved for ash placement, various support activities and

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refuse reprocessing. At the end of 2004, the operator reported over six and a half million tons of anthracite coal refuse burned in the plant, and over four million cubic yards of ash utilized for reclamation on-site, with 123 acres of abandoned mine lands reclaimed.

The primary use of the coal ash produced by the plant was to fill the abandoned open pits on site. Several 10 to 20 acre pits were filled with ash. On-site spoil and abandoned coal refuse material is used to line the pits prior to ash placement, with the best material saved for final cover. Photographs of the abandoned surface mine pits reclaimed with coal ash are shown in Figure 2a. Extensive wildlife habitat plantings have been established on the reclaimed areas shown in Figure 2b. In addition, the coarse bottom ash from this plant is approved for use as anti-skid material for on-site access and haul roads. This material is stored separately and used during inclement weather.



Figure 2a. Ash placement in pits



Figure 2b. Wildlife plantings

Initially, 8 feet of fill (spoil and refuse material) was needed to line the pits. All ash conveyed to the active placement area was dumped into the working area and then spread and compacted in lifts of 2-4 feet within 24-48 hours of placement. The ash is conditioned at the plant with adequate moisture for compaction, which is achieved simply by the process of repeated passes of the haul trucks and dozers during spreading. Each daily cell is 150 by 200 feet. A final cover of 4 feet is placed on top, utilizing the adjacent spoil material, with the top one foot being the best available from the site. Daily and intermediate cover is used, as needed, to control dust before the final cover. Since the plant utilizes treated minepool water for cooling purposes, the sludge from the water treatment process is blended with the ash in a 1 to 467 ratio, and placed in the ash use areas.

The site was extensively affected by pre-Act mining. There is no point-source discharge or direct drainage to a stream – water percolates directly through the surface material or drains to the pits and ultimately is conveyed to the minepool underneath. Upgradient diversions are used to prevent runoff onto the site. There is essentially no natural soil present.

Of the nine mining and coal ash placement phases shown on the permit maps, three phases (1, 2 and 3) are substantially completed, and some reclamation work has been completed on two other phases (4 and 5), which are shown in the cross-hatched symbol on Figure 1. When this entire remining project is completed, significant surface-water and groundwater benefits should occur,

in addition to the extensive reclamation of abandoned mine lands. With every acre of abandoned surface mine pits that are reclaimed to approximate original contour on this site, there is a reduction in water infiltrating directly into the underlying minepool, and an accompanying increase in surface water runoff. The tributary to Mill Creek in the eastern end of the SMP presently flows to the subsurface through abandoned mine workings within the permit area, but this stream should be restored to the surface and emanate from the permit as a perennial stream before completion of the project. The elimination of stream loss (or dramatic reduction in stream bed leakage) and the reduction in direct infiltration to the abandoned underground mines through coal ash backfilling of abandoned surface pits is expected to significantly reduce the flow of the Morea Colliery discharge (downgradient monitoring point MP 002), shown on Figure 1. The reduction in flow of abandoned mine discharges by remining operations is one of the most common and significant benefits according to Hawkins (1995), Brady et al. (2001) and Smith et al. (2004). It is anticipated that the extensive placement of alkaline coal ash at the Wheelabrator site will improve the water quality of the Morea Colliery discharge. However, if the concentration of some water quality parameters does not change significantly, the overall pollution load of the discharge should decrease significantly due to the reduction in flow.

As part of the permit conditions, the permittee is required to conduct groundwater and ash monitoring. For this site, the minepool conditions are such that sampling points are easily identified. Mill Creek runs on the surface before it reaches the Wheelabrator site and then goes underground into the minepool complex. A point was picked on Mill Creek as an upgradient monitoring site, shown on Figure 1. The minepool overflows downgradient from the site which represents the emergence of Mill Creek to the surface. It is worse in quality due to acid mine drainage pollution of the minepool. This is the designated downgradient monitoring point that theoretically would reflect any changes in water quality due to the mining and ash placement activities. The DEP has monitoring data on these points from 1986 to the present. The major problem in comparing upgradient monitoring point 001 with downgradient monitoring point 002 is that they represent two different hydrologic regimes that are only interconnected because the stream (001) flows subsurface into the minepool, emanating at the minepool discharge (002). The concentrations of acidity, sulfates, manganese and other analytes have been consistently higher in the downgradient point since the start of monitoring (except for a few rare occasions), not due to degradation caused by Wheelabrator mining and reclamation activities, but due to the fundamental difference in analyte concentrations between the minepool and the stream. Thus, interpretations may be made from the presence of any trends within the data from either point. For example, it appears that the pre-mining acidity at the downgradient monitoring point was usually about 90 to 100 mg/L, whereas during ash placement it has typically been about 50 to 80 mg/L as shown in Figure 3a. However, alkalinity has not increased and is still negligible, because the acidity in the minepool is still overwhelming any alkalinity attributable to the coal ash placement.

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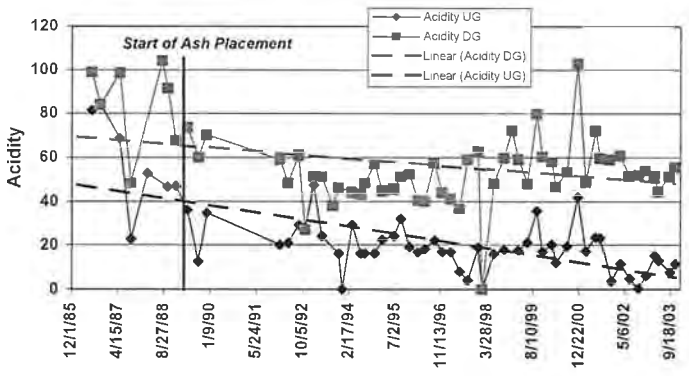


Figure 3a. Acidity in minepool and stream at Wheelabrator site

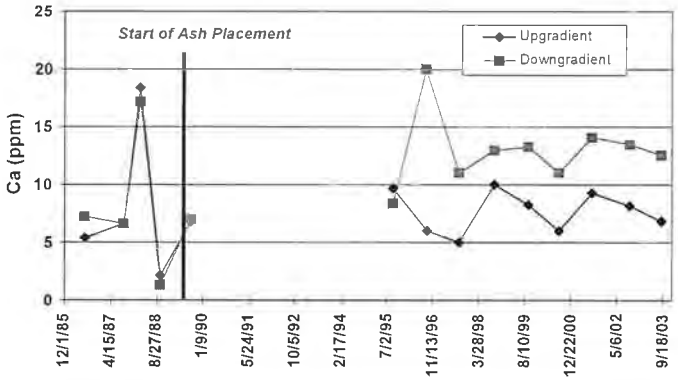


Figure 3b. Calcium concentration in minepool and stream at Wheelabrator site

There has been no significant change in the overall water quality in an upgradient to downgradient comparison, but some trends of particular constituents are noticeable. The

upgradient pH is consistently between 4 and 5 whereas the downgradient is consistently between 3 and 4. For both points, specific conductance trends slightly upward and acidity trends slightly downward. Figure 3b shows that calcium concentrations in the upgradient stream monitoring point and the downgradient minepool discharge were nearly identical prior to 1990, while the data since 1995 show the calcium concentrations in the minepool discharge are consistently higher than the upgradient sample site. This difference, however subtle, may be due to dissolution of the calcium hydroxide in the coal ash.

Overall, the Wheelabrator mine site and cogeneration plant operations have resulted in the use of refuse material to produce energy while not only reclaiming the banks of waste material, but also providing stable fill, as ash, to decrease the safety and environmental hazard of open, abandoned pits. Formerly unusable land is being restored to a graded, vegetated condition for future use as shown in the photos in Figure 2a and 2b. It is not anticipated that the ash placement will result in an overall degradation of water quality. Over the long-term, further pollution resulting from flow to the minepool will be reduced as more natural overland drainage patterns are restored and Mill Creek is eventually returned to a surface stream across the site.

Susquehanna Coal Company – (Mt. Carmel Co-Gen Site)

During a night in December 1989, a woman was walking in a wooded area near Route 54 between the city of Mt. Carmel and the village of Marion Heights in PA when she fell into a 100 foot deep abandoned surface mine pit and was killed. That fatality elevated the backfilling priority of that abandoned mine land feature to the Priority 1 class on the OSM list of backfilling projects, in order to abate the mine hazard and prevent future fatalities. In April 1987, Susquehanna Coal Co. applied for a surface mining permit (SMP #49870202) to mine and process abandoned culm banks from the Natalie and Richards collieries to be used as fuel in the fluidized bed combustion boiler of the Foster Wheeler Mt. Carmel, Inc., cogeneration plant being constructed on-site (Fig. 4). That SMP was issued on August 24, 1987 and included approval to place fly ash and bottom ash from the cogeneration plant in the abandoned pit and adjacent areas. By 1995, all of the abandoned pits (except for an access area near the ash conveyor) were reclaimed to approximate original contour at no cost to the state or federal government (Fig. 5.1b).

The Susquehanna Coal Co. site is located in Mount Carmel and Coal Townships in Northumberland County. The SMP boundary of the 788 acre site is shown on Figure 4. The SMP overlies four abandoned underground mines. These mines are, from east to west, the Richards Water Level, Natalie, Hickory Ridge and Hickory Swamp Collieries. The area of the Richards Colliery within the SMP is very minor, and near to the cogeneration plant site adjacent to Route 54; thus Borehole No. (BH) 48 shown on Figure 4 serves as an upgradient monitoring well. Most of the permit area, including the ash placement areas, is overlying the Natalie and Hickory Ridge Collieries. These four abandoned underground mines and several additional adjacent collieries are all hydrologically interconnected through breeched, leaking barrier pillars, with the Scott overflow shown on Figure 4 being the major mine discharge point. The Scott discharge emanates from the Scott Colliery located south of the permit area. These collieries are within the western portion of the Western Middle Anthracite Field.

Geologically, the site is located within the Western Middle Synclinorium, which is depicted by Arndt (1971). Of the many anticlines and synclines within this synclinorium, the axis of the Hickory Swamp Syncline passes directly through the permit area and is parallel to the long

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dimension of the SMP boundary shown on Figure 4. Hence, the abandoned surface mine pits and the extensive abandoned coal refuse piles within the permit area shown on Figure 5a, sat within this relatively narrow trough-like geologic structure, and were underdrained through abandoned underground mine voids to the Scott Overflow. Millions of tons of these coal refuse deposits were mined, transported to the cogeneration plant by a conveyor system and combusted with limestone in the circulating fluidized bed boiler. The resultant alkaline coal ash has been returned to an abandoned surface mine pit by a conveyor system (with trucks currently used to transport ash to western portions of the SMP that are out of reach of the conveyor). The coal ash deposits on the site range from greater than 50 feet thickness in the area of prior deep abandoned pits, to relatively thin veneers of coal ash used to regrade and reclaim other abandoned mine land features (Fig. 5.1 a, 1b & 1c). Any water infiltrating through these reclaimed coal ash areas or active coal ash placement areas will flow within the synclinal trough, and thence through cross-connecting mine voids to the Scott Overflow shown on Figure 4. Apparently, this groundwater flow system functions effectively as an underdrain for the site.

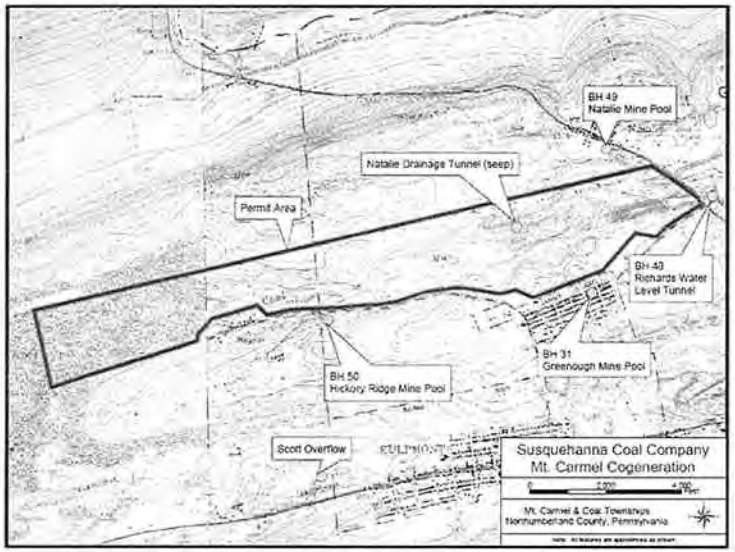


Figure 4. Site map of Susquehanna Coal – Mt Carmel Cogeneration site.



Figure 5a. Abandoned pits and refuse piles at start of ash placement.



5b. 10 years of ash placement and reclamation of pit.



5c. Coal ash deposit greater than 50 feet thick near conveyor.



5d. Scott Overflow monitoring point.

The Mount Carmel cogeneration plant consumed a total of 9,106,000 tons of coal refuse from 1990 through 2004, and produced 6,099,975 tons of alkaline coal ash for mine reclamation on-site during that 15 year period. The average yearly culm consumption was 607,067 tons, and the average annual coal ash production was 406,665 tons. A total of 209 acres of abandoned mine lands were reclaimed with coal ash within the SMP for an average of 16.1 acres reclaimed per year. Additional reclamation has also occurred through the remining of coal refuse banks in and around the plant area. These operations are permitted to supply fuel for the cogeneration plant and include an additional 50 acres of abandoned mine land reclamation directly associated with this cogeneration plant operation.

Groundwater monitoring data for five of the monitoring points shown on Figure 4 are compiled in Table 1. These data are representative samples of quarterly and annual groundwater monitoring by the permittee from 1989 through 2003. BH 48 in the Richards Colliery has characteristics of acid mine drainage with acidity from 18.0 to 131.0 mg/L (median 67.6 mg/L); sulfate from 34.0 to 283.0 mg/L (median 141.0 mg/L); and iron 0.41 to 380.0 mg/L (median 12.30 mg/L). These ranges and medians were computed from the 55 samples in the permit file.

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This upgradient monitoring well was intended to be a companion to the other upgradient well, BH 49 within the Natalie Colliery, but the water quality of these two wells is very different The highest acidity in BH 49 is 40 0 mg/L but most of the samples were alkaline with alkalinity from 15 0 to 93 6 mg/L (median 47 0 mg/L) The iron in BH 49 ranges from 14 20 to 296 0 mg/L (median 58 0 mg/L), but the sulfate ranges from 1 51 to 362 0 mg/L with a median of 6 0 mg/L Most of the sulfate values for BH 49 were less than 10 0 mg/L, thus this monitoring well does not exhibit acidic or neutralized mine drainage characteristics, and may not be intercepting the actual Natalie minepool These two boreholes were used as downgradient monitoring wells for the Mount Carmel Township landfill located immediately east of the permit area There is the possibility that the alkalinity in BH 49 is attributable to landfill leachate or sewage However, significant influence from landfill leachate can probably be ruled out, based upon 18 groundwater analyses that were conducted for Chemical Oxygen Demand (COD) In these analyses, the COD for BH 48 ranged from 7 70 to 43 20 mg/L, while the COD for BH 49 ranged from 0 to 69 0 mg/L According to a 1986 EPA study, which sampled leachate from municipal waste landfills throughout the United States, the median COD was 2,800 mg/L and the maximum was 50,450 mg/L

BH 31 in the Greenough minepool and BH 50 in the Hickory Ridge Colliery are both of questionable value as long-term groundwater monitoring points for the Susquehanna Coal Co site This monitoring well has a chemical signature that resembles neutralized acid mine drainage, but there are no distinct trends of water quality improvement nor degradation Further, from its location, BH 31 cannot be considered an upgradient well, but it is unlikely to be a reliable downgradient monitoring well

The location of BH 50 within the Hickory Ridge Colliery should make it a suitable downgradient monitoring well, at the southern edge of the permit area (Fig 4 16) and north of the Scott Overflow discharge. However, its chemical signature does not resemble mine drainage, and the well has little value in groundwater quality interpretation related to the surface mine and ash placement site The sulfates in BH 50 are less than 10 0 mg/L in 47 of 55 samples in the data set The median alkalinity is 45 mg/L and most of the samples fluctuate about that concentration from 1988 to 2003; thus, there is no apparent trend of increasing or decreasing alkalinity concentrations Also, there were only 2 samples with detectable acidity concentrations This water is not representative of acidic or neutralized minepool water quality, and clearly does not represent groundwater influenced by the area of coal ash placement Thus the water quality data from BH 50 and BH 31 were deemed to be unworthy of further consideration

Table 1. Groundwater monitoring data of the Susquehanna site in (mg/L) (0.00 values = below detection limit)

SAMPLED	pH	SPECIF. COND.	ALK	ACID	Fe	Mn	SO4	TDS	TSS	Al	As	Cd	Ca	Cr	Pb
B.H. #31 Greenough															
7/9/90	4.85	450	11.2	26.9	64.0	2.3	71	341	53						
3/10/92	6.60	380	79.0	0.0	22.9	1.5	26	215	24						
9/19/95	6.10	327	105.0	0.0	27.0	1.7	81	158	26	0.00	0.000	0.000	30.2	0.000	0.000
8/27/96	6.10	590	46.8	0.0	18.9	2.0	81	316	14	*0.70*	*0.005*	*0.010*	32.1	*0.040*	*0.100*
9/29/00	6.04	548	60.0	*1.0*	24.4	2.0	90	303	3	1.00	*0.005*	*0.010*	31.6	*0.040*	*0.100*
8/6/01	4.12	445	3.6	24.0	10.3	2.3	80	290	20	1.30	*0.005*	*0.010*	3.4	*0.040*	*0.100*
11/6/01	5.48	430	39.9	*1.0*	16.5	1.8	72	254	10						
B.H. #48 Richards Water Level															
5/29/90	3.65	700	0.0	61.6	60.0	4.5	133	452	229	5.20	0.000	0.000		0.000	0.000
6/13/94	3.70	557	0.0	67.6	8.6	4.7	278	524	25						
3/6/95	3.60	656	0.0	79.2	25.0	4.2	283	532	36						
9/26/95	3.60	684	0.0	81.0	28.0	5.1	179	559	45	7.20	0.000	0.000	20.7	0.000	0.000
12/3/98	3.67	1350	0.0	70.0	2.4	4.3	141	589	5						
9/23/99	3.61	1120	0.0	66.5	12.3	5.2	225	586	4	8.40	*0.005*	*0.010*	20.8	*0.040*	*0.100*
6/13/00	3.48	488	*1.0*	131.0	380.0	3.9	120	764	900						
B.H. #49 Natalie															
8/9/92	5.90	105	38.0	40.0	51.0	0.8	2	73	78						
9/30/93	6.20	98	45.0	0.0	44.0	0.9	362	58	86	0.00	0.000	0.000		0.000	0.000
12/22/96	6.11	246	47.0	2.5	53.4	1.0	152	114	40						
9/25/97	6.37	93	63.0	0.0	296.0	1.1	6	82	332	3.50	0.000	0.000	7.4	0.000	0.000
8/27/99	6.19	275	93.6	0.0	159.0	1.2	2	166	274	1.20	*0.005*	*0.010*	9.7	*0.040*	*0.100*
3/2/01	5.75	200	36.0	*1.0*	58.0	1.0	3	84	120						
B.H. #50 Hickory Ridge															
7/9/90	6.60	75	43.0	0.0	26.3	0.4	2	37	88	0.00	0.000	0.000		0.000	0.000
8/3/90	2.49	1200	0.0	464.0	21.0	0.3	5	105	15						
3/22/94	6.50	569	83.0	0.0	20.0	0.4	0	372	36						
12/14/94	5.87	472	43.0	22.0	31.0	4.0	341	435	1	0.00	0.000	0.000	47.2	0.000	0.000
12/17/99	6.00	127	45.0	0.0	34.2	0.3	0	50	54						
8/7/02	6.50	96	14.4	*1.0*	10.0	0.5	3	94	6	*0.70*	*0.005*	*0.010*	10.4	*0.040*	*0.100*
3/12/03	6.58	1060	56.0	*1.0*	7.4	0.6	25	756	18						
8/7/03	6.78	133	20.1	*0.4*	21.3	1.4	2	67	51						
Scott overflow															
10/16/89	6.52	660	38.0	54.8	31.2	4.6	371	200	4						
2/2/90	6.50	650	38.0	35.1	26.5	4.3	248	20	12						
10/3/90	6.05	658	32.3	30.4	23.5	3.8	170	548	0						
4/9/91	5.67	700	38.0	82.0	28.0	3.8	260	450	2						

The Scott Overflow is considered the most reliable downgradient groundwater monitoring point for the Susquehanna Coal Co permit site It exhibits a discernable trend of groundwater quality improvement, which is most likely attributed to the beneficial use of coal ash in mine reclamation, plus the removal of large volumes of coal refuse for combustion in the FBC power plant USGS sample data of the Scott discharge from 1975 (Growitz, et al , 1985) and 1991 (Wood, 1996) show that the flow of the discharge was measured at 15 cfs (6733 gpm) on April 17, 1975 and a flow of 4 8 cfs (2154 gpm) on November 1, 1991 The acidity in the 1975 sample was 165 mg/L and 161 mg/L in 1991 The alkalinity concentration of the 1975 sample was 16 mg/L, and the

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1991 sample was 38 mg/L. Representative samples from the permittee's self-monitoring data are in Table 4 5. Of the 60 permittee's monitoring samples of the Scott Overflow in the DEP permit file, the median acidity is 26.15 mg/L and the median alkalinity is 43 0 mg/L. Acidity exceeds alkalinity in 12 out of 60 samples in this data set, but 7 of these are in 1989 and 1990, when ash placement on the site was in its infancy (Fig. 4 18a), and the last time that acidity exceeded alkalinity was the sample of December 15, 1994. The median alkalinity for the samples prior to 1991 is 32 3 mg/L as compared to the median alkalinity of 44 mg/L for all samples from 1991 to 2003. The corresponding median acidity values are 35 1 mg/L for pre 1991 samples, and 21 3 mg/L for the past 12 years. This trend of acidity reduction is shown on Figure 6a for the Scott Overflow discharge as compared to the relatively consistent acidity in upgradient monitoring well BH 48. The corresponding trend of increasing alkalinity concentration in the Scott Overflow discharge is shown in Figure 6b. The least- squares trend line fitted to the alkalinity data for the Scott Overflow indicates an increase through time, however, the plotted monitoring data are not equally spaced through time – so the slope of the line may not be an accurate representation of the actual time trend. There also has been a subtle trend of decreasing sulfate concentration in the Scott discharge since 1995 as shown on Figure 6c. This indicates that the acidity production at the Mt. Carmel cogeneration plant site may be decreasing due to the removal of the coal refuse and the concomitant addition of alkaline coal ash to reclaim abandoned pits on the site.

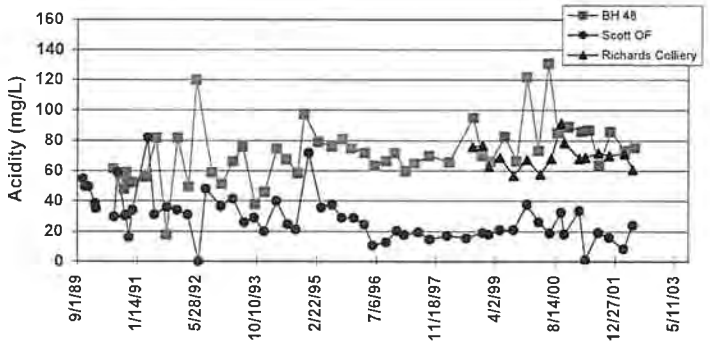


Figure 6a. Acidity in upgradient monitoring points and downgradient Scott Overflow at the Susquehanna site

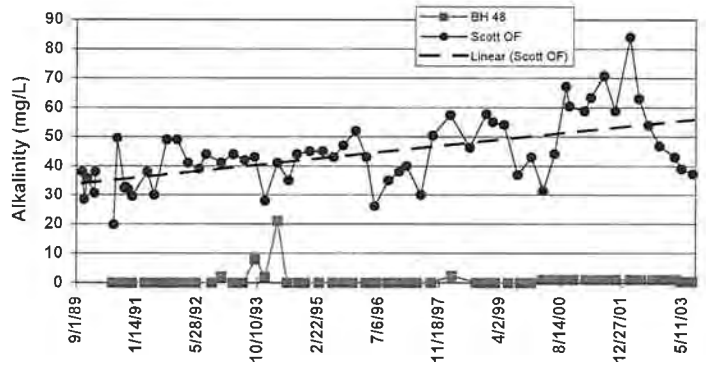


Figure 6b. Alkalinity increase in downgradient Scott Overflow

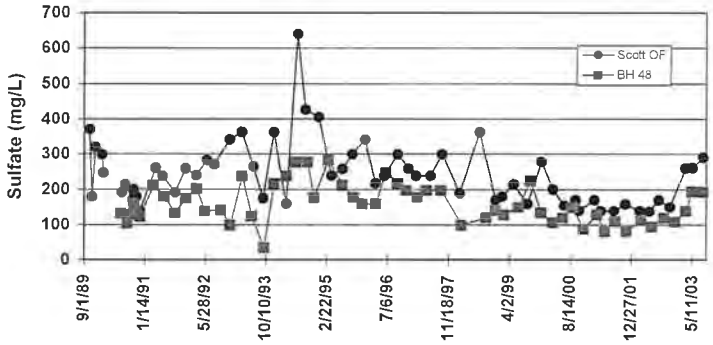


Figure 6c. Sulfate in monitoring points at the Susquehanna Coal site.

CONCLUSIONS

1. A very significant amount of abandoned mine reclamation in the four anthracite coal fields has been completed through the beneficial use of coal ash on remining sites. This extensive reclamation is significant, not only on individual sites associated with FBC power plants (e g the before and after photos in Fig. 5a and b, but also in the total acreage reclaimed at no cost to the government or taxpayers.

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2. The evaluation of more than 15 years worth of groundwater monitoring data for the case study sites presented in this paper, and other permitted sites throughout the anthracite region, has not resulted in any significant findings of environmental damage or groundwater pollution cases, as measured at key downgradient minepool monitoring points. Several sites discussed in this paper showed no significant change in groundwater/minepool water quality, despite extensive ash placement and land reclamation – although these sites significantly reduced infiltration to the minepool, and thus should represent a reduction in the flow and thereby the pollution load of acidity, iron and other metals in these high volume minepool discharges. At least one site discussed in this paper produced a significant increase in alkalinity concentrations, or reduction in acidity, iron or other analytes that is attributable to the beneficial use of coal ash on these sites

3. The range of mine site characteristics, coal ash placement configurations and groundwater/minepool monitoring scenarios presented in this paper demonstrates that a "one size fits all" approach to the permitting and compliance monitoring of the sites is not practical or effective. Site specific application of engineering principles and evaluation of geologic factors is essential, particularly: (a) the soil-mechanics engineering of ash placement, (b) the mining engineering of the active surface mine and abandoned underground mines, (c) the geologic structure of the site and surrounding area (e.g. synclinorium), and (d) the hydrogeology of the site and underlying minepool system. Permit applicants, their consultants and regulatory agency scientists and engineers must collaborate to promote effective ash placement technology and to develop practical and realistic groundwater monitoring plans.

4. The groundwater monitoring data for various coal ash placement sites and a hydrologic budget review demonstrates that the "high and dry" concept of placing relatively dry (optimum moisture content) coal ash into a relatively dry mine environment is working well. It is feasible to develop a matrix approach that would match the range of physical and chemical properties of FBC and PC coal ash classes to various ash placement alternatives, in order to optimize cementitous behavior of specific ash types, or maximize alkalinity production in groundwater – and solve a variety of abandoned mine land and mine drainage problems.

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