COVER SHEET

Responsible Agency: U.S. Department of Energy

Title: Draft Environmental Impact Statement for FutureGen Project (DOE/EIS-0394D)

Location: Mattoon, Illinois; Tuscola, Illinois; Jewett, Texas; and Odessa, Texas

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Abstract:

The Draft Environmental Impact Statement (EIS) for the FutureGen Project provides information about the potential environmental impacts of the U.S. Department of Energy's (DOE's) proposal to provide federal funding to the FutureGen Alliance, Inc. (Alliance) for the FutureGen Project. In a March 2004 Report to Congress, DOE estimated the cost of the project at $950 million in constant 2004 dollars shared at a 74/26 ratio by DOE and the Alliance. Accounting for escalation, based on representative industry indices, the project is currently estimated to cost $1,757,232,310 in as-spent dollars. Including $300,800,000 in expected revenues from the sale of electricity, which would be used to offset operational costs and research and development expenses, the total net project cost is estimated to be $1,456,432,310 in as-spent dollars. DOE will share approximately 74 percent of the net cost (estimated at $1,077,760,230), which includes at least $80 million in projected contributions from foreign governments. The Alliance will share approximately 26 percent of the net cost (estimated at $378,672,080). The cost estimate will be updated as work progresses. The Alliance is a non-profit industrial consortium led by the coal-fueled electric power industry and the coal production industry. The FutureGen Project would include the planning, design, construction, and operation by the Alliance of a coal-fueled electric power and hydrogen gas production plant integrated with carbon dioxide (CO_2) capture and geologic sequestration of the captured gas. The FutureGen Project would employ integrated gasification combined cycle power plant technology that for the first time would be integrated with CO_2 capture and geologic sequestration. Four sites have been identified as reasonable alternatives and are considered in this EIS: (1) Mattoon, Illinois; (2) Tuscola, Illinois; (3) Jewett, Texas; and (4) Odessa, Texas.

DOE determined that the proposed FutureGen Project constitutes a major federal action within the meaning of the National Environmental Policy Act. The *Federal Register* "Notice of Intent to Prepare an Environmental Impact Statement for FutureGen Project" was published on July 28, 2006 (71 FR 42840). DOE held public scoping meetings at Mattoon, Illinois, on August 31, 2006; Tuscola, Illinois, on August 29, 2006; Fairfield, Texas (near Jewett), on August 22, 2006; and Midland, Texas (near Odessa), on August 24, 2006. The Draft EIS provides an evaluation of the environmental consequences that may result from the Proposed Action at each of the four candidate sites, including potential impacts on air quality; climate and meteorology; geology; physiography and soils; groundwater; surface water; wetlands and floodplains; biological resources; cultural resources; land use; aesthetics; transportation and traffic; noise and vibration; utility systems; materials and waste management; human health, safety, and accidents; community services; socioeconomics; and environmental justice. The Draft EIS also provides an analysis of the No-Action Alternative, under which DOE would not provide financial assistance to the FutureGen Project. A preferred alternative has not been identified.

Comment Period:

In preparing the Final EIS, DOE will consider all comments received or postmarked during the 45-day public comment period that will begin when the U.S. Environmental Protection Agency publishes a Notice of Availability of this Draft EIS in the *Federal Register*. DOE will consider late comments to the extent practicable.

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LIST OF ACRONYMS

Acronym	Definition
2000 HCM	2000 Highway Capacity Manual
2D	two dimensional
3D	three dimensional
AASHTO	American Association of State Highway and Transportation Officials
ACAA	American Coal Ash Association
ACHP	Advisory Council on Historic Preservation
ADT	Average Daily Traffic
AEGL	Airborne exposure guideline level
AGR	acid gas removal
AMSL	above mean sea level
ANOI	Advance Notice of Intent
APE	area of potential effects
AQCR	Air Quality Control Region
AQRV	air quality related towers
ASU	air separation unit
BEG	Bureau of Economic Geology
BLM	Bureau of Land Management
BMP	best management practice
Btu	British thermal unit
CAA	Clean Air Act
CAMR	Clean Air Mercury Rule
CCPI	Clean Coal Power Initiative
CCWIS	Crane County Water Injection System
CEED	Center for Energy and Economic Diversification

Acronym	Definition
CEMS	Continuous Emissions Monitoring System
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
CH	County Highway
CHSP	Comprehensive Highway Safety Plan
CNN	Certificate of Convenience and Necessity
COPCS	chemicals of potential concern
CR	County Road
CRMWD	Colorado River Municipal Water District
CRP	Conservation Reserve Program
CSMS	conceptual site models
CWA	Clean Water Act
dB	decibels
dBA	A-weighted sound measurements
DEIS	needs definition
DoD	Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
ECBM	enhanced coalbed methane
EGR	enhanced gas recovery
EGRID	Generation Resource Integrated Database
EIA	Energy Information Administration
EIS	Environmental Impact Statement

Acronym	Definition
EIV	Environmental Information Volume
EMF	electromagnetic fields
EO	Executive Order
EOR	enhanced oil recovery
EPA	U.S. Environmental Protection Agency
ERCOT	Electric Reliability Council of Texas
ESAs	Environmental Site Assessments
FAA	Federal Aviation Administration
FE	Fossil Energy
FEMA	Federal Emergency Management Agency
FG Alliance	FutureGen Alliance
FHWA	Federal Highway Administration
FM	Farm-to-Market Road
FPPA	Farmland Protection Policy Act
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FWS	Fish and Wildlife Service
GAM	groundwater availability model
GHG	greenhouse gas
GIS	Geographic Information System
GLO	General Land Office
GPM	gallons per minute
GWh	gigawatt hours
HAARGIS	Historic Architectural and Archeology Resources Geographic Information System
HAP	hazardous air pollutant
HCS+	Highway Capacity Plus

Acronym	Definition
HIP	Highway Improvement Program
HRSG	heat recovery steam generator
HVTL	high voltage transmission line
hz	hertz
I	Interstate Highway
IAC	Illinois Administrative Code
IAWC	Illinois-American Water Company
ICC	Interstate Commerce Commission
ICDR	Initial Concept Design Report
IDLH	immediately dangerous to life and health
IDNR	Illinois Department of Natural Resources
IDOT	Illinois Department of Transportation
IEPA	Illinois Environmental Protection Agency
IGCC	Integrated Gasification Combined Cycle
IHPA	Illinois Historic Preservation Agency
ILDOA	Illinois Department of Agriculture
IPCC	Intergovernmental Panel on Climate Change
IRIS	Integrated Risk Information System
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Service
IWPA	Interagency Wetland Policy Act of 1989
kV	kilovolt
kV/m	kilovolts per meter
LESA	Land Evaluation and Site Assessment
LFL	lower flammable limit
LiDAR	Light Detection and Ranging

Acronym	Definition
LOS	level of service
LWDs	Lost Work Days
md	millidarcy
MDEA	methyl diethanolamine
mG	milligauss
MGD	million gallons per day
MGSC	Midwest Geological Sequestration Consortium
MISO	Midwest Independent System Operator
MLD	million liters per day
MM&V	monitoring, mitigation, and verification
MMT	million metric tons
MPO	Midland-Odessa Metropolitan Planning Organization
MSDS	Material Safety Data Sheet
MVA	megavolt-ampere
MW	megawatts
MWes	megawatts-electrical
MWh	megawatt-hours
NAAQS	National Ambient Air Quality Standard
NEP	National Energy Policy
NEPA	National Environmental Policy Act
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NETL	National Energy Technology Laboratory
NETRC	North American Electric Reliability Council
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences

Acronym	Definition
NIOSH	National Institute of Occupational Safety and Health
NNL	National Natural Landmark
NOA	Notice of Availability
NOAA	National Oceanic Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NRNL	National Registry of Natural Landmarks
NSPS	New Source Performance Standards
NSR	New Source Review
NWI	National Wetlands Inventory
OPS	Office of Pipeline Safety
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
PCEs	passenger car equivelents
PEL	permissible exposure limit
PFTs	perfluorocarbon tracers
PM	particulate matter
PNNL	Pacific Northwest National Laboratory
ppm	parts per million
ppmv	parts per million volume
PPV	peak particle velocity
PRB	Powder River Basin
PSD	Prevention of Significant Deterioration

Acronym	Definition
psi	pounds per square inch
PUCT	Public Utility Commission of Texas
RCRA	Resource Conservation and Recovery Act
RCT	Railroad Commission of Texas
REL	Reference Exposure Levels
RFP	Request for Proposal
RMS	root-mean-square
ROD	Record of Decision
ROI	region of influence
ROW	right-of-way
SAL	State Archeological Landmark
SCADA	Supervisory Control and Data Acquisition
SCAQMD	California South Coast Air Quality Management District
SCR	selective catalytic reduction
SDTP	Sanitary District treatment plant
SERC	Southeastern Electric Reliability Corporation
SH	State Highway
SHPO	State Historic Preservation Officer
SIPs	State Implementation Plans
SOTA	state-of-the-art
SPCC	spill prevention, control and countermeasure
SPL	sound pressure level
SR	State Route
SRU	sulfur recovery unit
ST	Short Term
STEL	short-term exposure limit

Acronym	Definition
STOMP	Subsurface Transport Over Multiple Phases
STRANET	Strategic Highway Network
SWPPP	Stormwater Pollution Prevention Plan
T&E	threatened and endangered (species)
TAC	Texas Administrative Code
TARL	Texas Archeological Sites Atlas Database
TCP	Traditional Cultural Property
TDCJ	Texas Department of Criminal Justice
TDS	total dissolved solids
TEC	Taylorville Energy Center
TECEQ	Texas Commission on Environmental Quality
THC	Texas Historical Commission
TLO	Texas Legislation Online
TMDL	total maximum daily load
TNP	Texas New Mexico Power Cooperative
TPWD	Texas Parks and Wildlife Department
tpy	tons per year
TR	Township Road
TRCs	Total Recordable Cases
TSD	treatment, storage, or disposal
TTC	Trans Texas Corridor
TWA	time-weighted average
TWCC	Texas Westmoreland Coal Company
TWDB	Texas Water Development Board
TWTL	two-way turn lane
TxDOT	Texas Department of Transportation

Acronym	Definition
UIC	Underground Injection Control
US	US Highway
USACE	United States Army Corps of Engineers
USBLS	U.S. Bureau of Labor Statistics
USC	United States Code
USDA	U.S. Department of Agriculture
USDW	Underground Source of Drinking Water
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
vdB	velocity decibels
VOCs	volatile organic compounds
vpd	vehicles per day
WTP	wastewater treatment plant
WTWSS	West Texas Water Supply System
WWTP	wastewater treatment plant
ZLD	zero liquid discharge

11. DISTRIBUTION LIST

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Ms. Amy Greer Public Education	Natural Resources Defense Council
Mr. David Hawkins Director, Climate Change	Natural Resources Defense Council
Mr. Allen Hershkowitz New York Urban Program	Natural Resources Defense Council
Ms. Jean Flemma Executive Director	Prairie Rivers Network

Non-Governmental Agencies

Mr. James Bergan, Ph.D. Director of Science and Stewardship	The Nature Conservancy of Texas
Mr. Thomas Cassidy Director of Federal Programs	The Nature Conservancy
Ms. Alison Horton Regional Staff Director, Midwest Office	Sierra Club
Ms. Traci Laird Regional Coordinator, Southern Plains Regional Field Office	Sierra Club
Mr. Brandon Young	Sierra Club
Mr. Barry Worthington Executive Director	United States Energy Association
Mr. John Blair President	Valley Watch, Inc.
Mr. Tom Bancroft Vice President of EERD Society	The Wilderness Society

Other Interested Parties: Illinois

Mr. Larry Ashworth

Ms. Tara Barrett

Mr. Edward Behm

Mr. Dan Coleman

Mr. Jeff Collings

G.J. Corley

Mr. Bruce Daily

Mr. Daniel Downs

Mr. Curt Grissom

Mr. Bryan Hewing

Mr. Steve Hilgendorf

Mr. and Ms. Mike and Jaci Manzella

Ms. Stepheny McMahon

Mr. Martin Megeff

Mr. And Ms. William and Marilyn Sue Patterson

Mr. Anthony Pleasant

Mr. and Ms. Roger and Janet Roney

Mr. David Schilling

Ms. Martha Schumann

R. R. Smith

Mr. Jeff Strong

Mr. Geoff Summerville

Mr. Ronald Swager

Mr. Roland Taylor

Ms. Cindy Titus

Other Interested Parties: Texas

Mr. H. Eugene Abbott

Mr. James Busby

Mr. and Ms. John and Cleta Christian

H.C. Clark

Mr. Mario Contreras

Mr. David Donohue

Mr. Terry Farmer

Mr. B. Calvin Hendrick

Mr. Rich Herweck

Mr. Stephen Holditch

Ms. Josefina Hooker

Mr. Tim Hunt

Mr. Jack Khatri

Ms. Gerriiana Koeniger

Mr. Larry Lee

Mr. Robert C. Leibrock

Mr. Michael McCulloch

Mr. Joe Micheletti

Mr. Scott Motycka

Ms. Jackie Nance

Mr. Steve Oliver

Mr. Joe Page

Mr. Babubhai A. Patel

W. L. Pulley

Ms. Kay Rankin

Mr. Dick Rappoler

Mr. Gordon Reigle

Ms. Jana Russell

Ms. Lynnette Schillo

Ms. Dana St. Clair

Mr. Curtis Steger

Mr. Ronald Sutcliffe

Mr. Joel Trovert

Mr. Anthony J. Welker, P.E.

Mr. Darrell Wells

Mr. David White

Mr. Kevin Wilson

Ms. Debbie Wood

Mr. Billy F. Wood

1. PURPOSE AND NEED FOR AGENCY ACTION

1.1 INTRODUCTION

This chapter introduces the Proposed Action and describes the purpose and need for the agency action and the scope of the Environmental Impact Statement (EIS). This chapter also summarizes the National Environmental Policy Act (NEPA) of 1969 process, project objectives, and the public scoping process undertaken for this EIS.

This EIS has been prepared by the U.S. Department of Energy (DOE) in compliance with NEPA of 1969 (42 United States Code [USC] 4321 et seq.) regulations for implementing NEPA as established by the Council of Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] Parts 1500 to 1508), and DOE NEPA procedures (10 CFR Part 1021). This EIS evaluates the potential environmental impacts associated with the Proposed Action at each of the four alternative sites. DOE will use this EIS to decide which, if any, of the alternative sites are acceptable to DOE for hosting the FutureGen Project.

1.2 PROPOSED ACTION

DOE proposes to provide financial assistance for the FutureGen Alliance, Inc. (the Alliance) to plan, design, construct, and operate the FutureGen Project. Members of the Alliance are presented in Section 1.4. DOE has identified four reasonable alternative sites and will determine which sites, if any, are acceptable to DOE to host the FutureGen Project. The four sites currently being considered as reasonable site alternatives for the FutureGen Project are:

- Mattoon, Illinois;
- Tuscola, Illinois;
- Jewett, Texas; and
- Odessa, Texas.

In a March 2004 Report to Congress, DOE estimated the cost of the project at $950 million in constant 2004 dollars shared at a 74/26 ratio by DOE and the Alliance. Accounting for escalation, based on representative industry indices, the project is currently estimated to cost $1,757,232,310 in as-spent dollars. Including $300,800,000 in expected revenues from the sale of electricity, which would be used to offset operational costs and research and development expenses, the total net project cost is estimated to be $1,456,432,310 in as-spent dollars. DOE will share approximately 74 percent of the net cost (estimated at $1,077,760,230), which includes at least $80 million in projected contributions from foreign governments. The Alliance will share approximately 26 percent of the net cost (estimated at $378,672,080). The cost estimate will be updated as work progresses.

The FutureGen Project would be a research facility as well as the cleanest coal-fueled power system in the world for co-producing electricity and hydrogen (H_2). The facility would incorporate cutting-edge research, as well as development of promising new energy-related technologies at a commercial scale, to achieve DOE's goal of validating the technical and economic feasibility of a coal-fueled power plant that achieves low carbon emissions. A key goal of the project would be to sequester at least 90 percent of the plant's carbon dioxide (CO_2) emissions with the future potential to capture and sequester nearly 100 percent. Low carbon emissions would be achieved by integrating CO_2 capture and sequestration operations with the proposed power plant. Performance and economic test results from the FutureGen Project would be shared among participants, industry, the environmental community, and the public. The Proposed Action is discussed in detail in Chapter 2.

1.3 PURPOSE AND NEED FOR AGENCY ACTION

Agency action is needed to support the President's FutureGen Initiative (February 27, 2003), which is based on recommendations in the National Energy Policy (NEP), issued in May 2001 (NEP, 2001). The NEP cites, in broad terms, the need to promote diverse and secure sources of energy and the expected need for coal to play a significant role in providing that energy. The NEP specifically states, "In the long term, the goal of the [clean coal technology] program is to develop low cost, zero-emission power plants with efficiencies close to double that of today's fleet." Action is also needed to support the President's announcement emphasizing the need for the FutureGen Initiative to support other federal initiatives, including the National Climate Change Technology Initiative (June 11, 2001) and the Hydrogen Fuel Initiative (January 28, 2003). These initiatives aim to reduce the Nation's output of greenhouse gas (GHG) emissions to improve the global environment and provide advanced technologies to meet the world's energy needs.

As the Nation's most abundant fossil fuel resource, coal must play an important role in the Nation's efforts to increase its energy independence. However, there is a need to address the associated environmental and climate change challenges related to the continued use of coal. The Intergovernmental Panel on Climate Change (IPCC) has concluded that global atmospheric concentrations of CO_2 have increased markedly since the pre-industrial period, and that the primary source of the increase results from fossil fuel use (IPCC, 2007). The IPCC was established by the United Nations Environmental Programme and the World Meteorological Organization to assess the scientific, technical, and socioeconomic information relevant for the understanding of human induced climate change.

FutureGen Initiative: ***"Today I am pleased to announce that the United States will sponsor a $1 billion, 10-year demonstration project to create the world's first coal-based, zero-emissions electricity and hydrogen power plant. This project will be undertaken with international partners and power and advanced technology providers to dramatically reduce air pollution and capture and store emissions of greenhouse gases. We will work together on this important effort to meet the world's growing energy needs, while protecting the health of our people and our environment."***

President George W. Bush
February 27, 2003

CO_2 accounts for 83 percent of the total U.S. GHG emissions. The CO_2 emissions from the U.S. electric power sector have grown 32 percent since 1990 (compared to 2005), while in comparison, total CO_2 emissions (from all reported sources) have grown by 16.9 percent. Electric power generation now contributes 40 percent of all CO_2 emission in the U.S. In 2005, 82 percent of all electricity production CO_2 emissions resulted from the burning of coal (EIA, 2006).

Fuels used in transportation account for one-third of the Nation's GHG emissions, and an alternative source of transportation fuel, such as coal-derived H_2 fuel, could help reduce GHG emissions. Therefore, methods are needed to more economically and efficiently produce H_2 fuel (e.g., through coal gasification) and to use it for power generation (e.g., through advanced fuel cells).

The FutureGen Project is needed to support these initiatives and recommendations and to foster technology at future low carbon emissions power plants over the next decade to provide the breakthroughs that would dramatically reduce GHG emissions over the longer term. Widespread replication of low carbon emissions technology by the private sector would help meet the needs of our Nation's economy, while reducing risks associated with emissions of GHGs.

1.4 FUTUREGEN PROJECT

> **IGCC** is a coal-fired, integrated gasification combined cycle electric power generation system with capability for both pre- and post-combustion emission controls.
>
> **Geologic Sequestration** is the placement of CO_2 or other GHGs into a geologic formation in such a way that it remains permanently stored.
>
> A **gasifier** produces a combustible gas from coal. The gas fuels a combustion turbine (similar to an aircraft engine) to produce electricity. Heat coming out of the combustion turbine is used to generate steam that powers a steam turbine for additional production of electricity.

The FutureGen Project would provide a platform to test advanced technologies for producing both electricity and H_2 from coal (DOE, 2003). DOE, as well as other parties, may conduct technology research and development activities using this platform. Electricity and H_2 production would be based on the design concept known as the Integrated Gasification Combined Cycle (IGCC) system, which has the potential for increasing energy conversion efficiency while reducing air pollutant emission rates. Geologic sequestration of CO_2 would be a unique component of the project and would help achieve low carbon emissions during normal steady-state operation. CO_2 would be captured and sequestered (i.e., stored) in deep underground saline formations.

The lead organization for the proposed federal action is the National Energy Technology Laboratory (NETL), a multi-purpose laboratory operated by DOE's Office of Fossil Energy. NETL has a mission to solve the environmental, supply, and reliability constraints of producing and using fossil energy resources to promote a stronger economy and a more secure future for America. The DOE goal for this project is to prove the technical feasibility and potential economic viability of co-production of electricity and H_2 fuel from coal, while capturing and sequestering CO_2 and greatly reducing other air emissions.

The Alliance, formed to partner with DOE on the FutureGen Project, is a non-profit consortium of some of the largest coal producers and electricity generators in the world. Member companies are American Electric Power, Anglo American Services Limited, BHP Billiton Energy Coal Inc., China Huaneng Group, CONSOL Energy, E.ON U.S. LLC, Foundation Coal Corporation, Peabody Energy Corporation, PPL Energy Services Group LLC, Rio Tinto Energy America Services, Southern Company Services, and Xstrata Coal. Collectively, these member companies have global operations serving customers across six continents (FG Alliance, 2006). The Alliance, using the siting process described in Chapter 2, Proposed Action and Alternatives, identified the four sites that DOE has determined are the reasonable site alternatives to be considered in this EIS.

1.4.1 FUTUREGEN PROJECT TECHNOLOGY

While IGCC technology is currently used in coal-fueled power plants in both the U.S. and abroad, none of these plants includes a geologic sequestration or H_2 production component. Objectives for the FutureGen Project are presented in Table 1-1 in Section 1.4.2, as derived from DOE's March 2004 Report to Congress (DOE, 2004).

In a typical IGCC power plant, the gasification process combines coal, oxygen (O_2), and steam to produce a H_2-rich combustible gas, called "synthesis gas." The FutureGen Project would be different because, after the gas exits the gasifier, the composition of the synthesis gas would then be "shifted" by the addition of water vapor to produce additional H_2. The product stream would then consist mostly of H_2, steam, and CO_2. After separation of these three gaseous components, the H_2 would be used to generate electricity in a gas combustion turbine. Steam from the process would then be condensed, treated, and recycled into the gasification system or added to the plant's cooling water circuit. CO_2 from the process would be sequestered in deep underground geologic formations that would be monitored to verify the permanence of CO_2 storage.

1.4.2 FUTUREGEN PROJECT OBJECTIVES

The FutureGen Project would be designed to create a capability for full-scale testing of new technologies in support of their commercial deployment. The FutureGen Project may integrate some combination of new technologies for gasification, O_2 production, H_2 production, synthesis gas cleanup, H_2 turbines, CO_2 sequestration, advanced materials, instrumentation, sensors and controls, byproduct use, and water management. Decisions regarding the incorporation of specific technologies in plant design would be made by the Alliance in coordination with DOE. Technologies identified would be consistent with the overall project objectives (see Table 1-1).

Table 1-1. FutureGen Project Objectives

Overall Objectives
• Establish technical and economic feasibility of producing electricity and H_2 from coal with reduced GHG emissions; • Verify sustained, integrated operation of a coal conversion system with geologic sequestration of CO_2; • Verify the effectiveness, safety, and permanence of geologic sequestration of CO_2; • Establish standardized technologies and protocols for geologic CO_2 sequestration monitoring, mitigation, and verification (MM&V); • Confirm the potential of the FutureGen Project concept to achieve economic competitiveness with other approaches through advances in technology by 2020; and • Gain acceptance by the coal and electricity industries, environmental community, international community, and public-at-large for the concept of coal-fueled systems with near-zero emissions through the successful operation of the FutureGen Project.
Facility Performance Objectives
• Capture at least 90 percent of CO_2 and sequester CO_2 at an operational rate of at least 1.1 million tons (1 million metric tons [MMT]) per year in a deep saline formation; • Produce electricity and H_2 consistent with market needs at ratios equivalent to 275 megawatt net output; • Locate plant consistent with adequate coal feedstock availability, proximity to market for products (especially electricity) as part of proving potential economic viability, and proximity to geologic formations for sequestration (e.g., deep saline formations, unmineable coal seams, depleted oil and natural gas reservoirs, and basalt formations); • Achieve environmental requirements; • Provide a design database for subsequent commercial demonstrations or deployments; and • Design a capability for full-flow testing of advanced technologies and advanced technology modules, and design incorporation of loosely integrated units that increase flexibility and enhance operability and reliability.
CO_2 Sequestration, Monitoring, Mitigation, and Verification Objectives
• Accurately quantify storage potential of the geologic formation(s); • Detect and monitor surface and subsurface leakage, if it occurs (with capability to measure CO_2 slightly above atmospheric concentration of 370 parts per million), and demonstrate effectiveness of mitigation; • Provide the scientific basis for carbon accounting and assurance of permanent storage; • Account for co-sequestration of CO_2 and other gases; and • Develop information necessary to estimate costs of future CO_2 management systems.

Source: DOE, 2004.

1.5 NATIONAL ENVIRONMENTAL POLICY ACT

NEPA requires all federal agencies to include, in every recommendation or report on proposals for major federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on (1) the environmental impact of the Proposed Action; (2) any adverse environmental effects that cannot be avoided should the proposal be implemented; (3) alternatives to the Proposed Action; (4) the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and (5) any irreversible and irretrievable commitments of resources that would be involved in the Proposed Action should it be implemented. The Act also requires consultations with federal agencies that have jurisdiction or special expertise with respect to any environmental impact involved. The detailed statement along with the comments and views of consulted governmental agencies, must be made available to the public.

DOE determined that providing financial assistance for the construction and operation of the FutureGen Project would constitute a major federal action that could significantly affect the quality of the natural and human environment. Therefore, DOE has prepared this EIS in compliance with requirements for implementing NEPA as established by the CEQ regulations (40 CFR Parts 1500 to 1508), DOE regulations (10 CFR Part 1021), and DOE procedures for implementing NEPA.

DOE published an Advance Notice of Intent (ANOI) to prepare an EIS in the Federal Register on February 16, 2006 (71 FR 8283). Later, DOE published a Notice of Intent (NOI) in the ***Federal Register*** *o*n July 28, 2006 (71 FR 42840) to initiate public scoping, as described in Section 1.6.1, to begin the NEPA process and the public scoping process to identify the reasonable site alternatives. Both DOE and the Site Proponents consulted with various interested governmental agencies to further define the scope of the EIS. Coordination letters resulting from these consultations are provided in Appendix A.

Following publication in the ***Federal Register*** of a Notice of Availability (NOA) of the Draft EIS by the U.S. Environmental Protection Agency (EPA), there will be at least a 45-day public review and comment period. During this period, public hearings will be held at locations near each of the alternative sites. DOE will consider and respond to comments received on the Draft EIS both individually and collectively and will issue a Final EIS that addresses the comments received. Not less than 30 days after EPA publishes an NOA of the Final EIS, DOE will publish a Record of Decision (ROD) in the ***Federal Register*** that explains the agency's decision on whether to fund the FutureGen Project and, if so, which of the alternative sites would be acceptable to host the FutureGen Project.

1.6 SCOPE OF THE ENVIRONMENTAL IMPACT STATEMENT

1.6.1 NEPA SCOPING PROCESS

This EIS assesses the potential environmental impacts of the Proposed Action at each of four candidate sites within the scope of the FutureGen Project and the No-Action Alternative. The scope of this EIS was determined by DOE after consultation with state and federal agencies and involvement of the public.

Figure 1-1 illustrates the steps during the EIS process. DOE published an ANOI to prepare the EIS in the *Federal Register* on February 16, 2006 (71 FR 8283). Later, DOE published a NOI in the *Federal Register* on July 28, 2006, to identify the reasonable site alternatives and initiate the public scoping process (71 FR 42840).

During the public scoping period, DOE solicited public input to ensure that (1) significant issues would be identified early and properly studied; (2) issues of minimal significance would not consume excessive time and effort; and (3) the EIS would be thorough and balanced. The public scoping period ended on September 13, 2006, after a 47-day comment period.

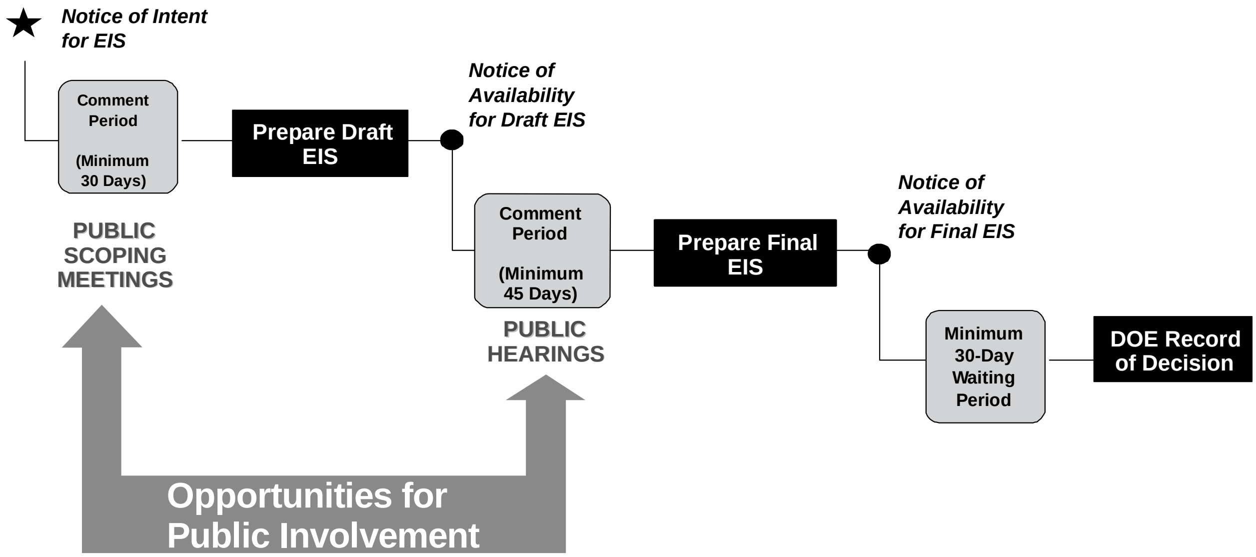


Figure 1-1. Steps in the NEPA Process

DOE published a Notice of Public Scoping Meetings in the *Federal Register* on August 4, 2006 (71 FR 44275). There were four public scoping meetings for the FutureGen Project EIS with one held near each of the alternative sites. The dates and locations of these meetings are shown in Table 1-2. DOE published notices in local newspapers announcing the meeting locations and times during the weeks of August 13, 20, and 27, 2006.

Table 1-2. Public Scoping Meeting Locations and Dates

Public Meeting Location	Date
Mattoon, Illinois Riddle Elementary School, Mattoon, Illinois	August 31, 2006
Tuscola, Illinois Tuscola Community Building, Tuscola, Illinois	August 29, 2006
Jewett (Fairfield), Texas City of Fairfield's Green Barn, Fairfield, Texas	August 22, 2006
Odessa (Midland), Texas Center for Energy and Economic Diversification (CEED) Building, Midland, Texas	August 24, 2006

Each scoping meeting began with an informal open house from 4:00 pm to 7:00 pm during which time attendees were given information packages about the project and were able to view project-related posters. DOE and Alliance representatives were available to answer questions. Alliance representatives were also available at displays illustrating various features of the proposed project. The informal open house was followed by a formal DOE presentation and the formal comment period. Appendix B provides additional information on the NEPA public scoping process.

1.6.2 PUBLIC SCOPING COMMENTS RECEIVED

DOE accommodated several methods for submitting comments on the scope of the EIS. A court reporter was present at each meeting to ensure that all spoken comments during the formal meeting were recorded and transcribed. In addition, anyone who wished to give comments in writing was invited to do so at the public meetings by completing a comment card and submitting it to DOE at the meeting. DOE also offered an e-mail address, a postal address, a facsimile number, and a toll-free telephone number for members of the public to submit their comments. In all, respondents submitted 318 comments via e-mail, mail, facsimile, telephone, or formal oral comment at the public meetings.

The majority of the comments were related to the use of natural resources (e.g., coal, land, and water), the discharge of pollutants to the natural environment (e.g., air and water), and the socioeconomic impacts of the project (e.g., jobs, taxes, and property values). Table 1-3 lists the composite set of issues identified during public scoping for consideration in the EIS. Issues are discussed and analyzed in this EIS in accordance with their relative importance. The most detailed analyses focus on air quality, water resources, noise, and safety, health and accidents.

Table 1-3. Issues Identified During Public Scoping

Purpose and Need
• Demonstration of need for the proposed project. • Consideration of alternatives such as wind or solar power, energy conservation.
Environmental Resources
• Air Quality: Potential impacts from air emissions (including mercury, volatile organic compounds [VOCs], and particulate matter [PM]) during construction and operation of the power plant and impacts to sensitive receptors. Impacts of dust from construction, transportation, and storage of materials. Potential impacts on National Ambient Air Quality Standards (NAAQS). • Geology and Soils: Potential for activation of surface or subsurface faults. Potential for seismic activity from carbon sequestration. • Water Resources: Potential impact to drinking water supplies and freshwater aquifers. Potential impacts to surface water and groundwater flow and to water resources from wastewater discharge or runoff. • Wetlands and Floodplains: Potential impacts to wetlands and floodplains. • Ecological Resources: Potential on-site and off-site impacts to vegetation, terrestrial and aquatic wildlife, threatened and endangered species, and ecologically sensitive habitats. • Cultural Resources: Potential for impacts to Native American cultural resources. • Land Use: Potential impacts to prime farmland and conversion of land use from farming to industrial use. Use of site after plant closure. Property rights to store CO_2 under adjoining property. • Aesthetics: Impacts on viewsheds to residences, including views of transmission lines. • Transportation and Traffic: Potential impacts to local traffic patterns, safety at railroad crossings, and traffic controls. Transportation and roadway infrastructure impacts from rail and truck transport of coal to the plant. Need for upgrades or improvements to local roadway infrastructure. • Noise and Vibration: Noise levels generated from the unloading of coal from railcars and switching the train cars. Impacts to sensitive receptors from increased noise levels. • Materials and Waste Management: Impact of accumulating piles of ash/slag and sulfur generated by the gasification process. Reuse or disposal of byproducts of the coal gasification process. The method and location by which solid and hazardous waste would be disposed, including mercury containing materials and ash/slag. • Human Health, Safety, and Accidents: The potential danger of an explosion at the plant to local community and the community safety measures that would be taken. The potential danger of a terrorist attack. Potential impact of electromagnetic fields on people who live near the proposed transmission lines, substations, and transformers. • Risk Assessment: Development of a monitoring program of the carbon sequestration to detect leaks from the carbon sequestration system and a maintenance program to repair leaks. Potential for a catastrophic release and the actions that would be taken in the event of a release. Potential for carbon sequestration to reverse subsidence. Potential for releases through oil, gas, or water wells to the aquifer system and potential impacts

Table 1-3. Issues Identified During Public Scoping

to these existing wells. Stress limits of the CO_2 injection system and prediction of when CO_2 migration will stop in relation to property boundaries on the surface. Potential for sequestered CO_2 to impact drinking water sources and the risk of movement between aquifers or into the atmosphere.
• Community Services and Socioeconomics: Socioeconomic impacts on local job market, taxes, and impacts to property values, and commercial and residential growth. Use of the power plant after DOE involvement has ended. Impacts to emergency services (e.g., police and fire support).
Cumulative Impacts
• Cumulative Impacts: Potential cumulative impacts that could result from the incremental impacts of the proposed project when added to the other past, present, and reasonably foreseeable future projects.

DOE has addressed all substantive comments in this EIS. However, some comments received are outside the scope of this EIS. For example, several respondents indicated that the EIS should include alternatives such as the utilization of renewable energy resources (e.g., wind and solar power). Because the particular goal of the FutureGen Project is to demonstrate an advanced power generation facility based on fossil fuels, specifically coal, technologies that would not be based on coal use are not within the scope of this EIS. However, DOE oversees numerous programs that are investigating and supporting a wide variety of energy generation technologies, including many based on renewable sources, as well as programs that promote energy conservation. Questions were also raised regarding the environmental and safety impact of coal mining. However, coal is a commercial fuel produced by a regulated industry. There would be no change in nationwide coal production and, therefore, there should be no change in environmental impacts to mining. Hence, DOE considers the environmental impacts of coal mining policies and operations to be outside the scope of this EIS.

1.6.3 AGENCY DECISION-MAKING PROCESS

NEPA requires that agencies evaluate reasonable alternatives to the Proposed Action in an EIS. The purpose and need for the agency action determines the range of reasonable alternatives. In this case, DOE proposes to provide financial assistance to the Alliance for the design, construction, and operation of the first coal-fueled plant to produce electricity and H_2 with geologic sequestration of CO_2. DOE believes the electric utility and coal industries should lead the project because of their experience in implementing power plant projects and because those industries have a significant interest in the success and subsequent commercial deployment of low carbon emissions technology.

In particular, this EIS identifies and analyzes the potential environmental impacts of the FutureGen Project at the four alternative site locations. Should more than one site be approved by DOE in a ROD, the host site would be selected by the Alliance. Once the host site is selected, the Alliance would conduct additional site characterization studies; prepare a site-specific design; and obtain relevant environmental, utility, and operational permits for the project. Appendix C provides a summary of potential federal and state permits and requirements.

Decisions on incorporation of specific technologies would be made by the Alliance consistent with the overall project goal of proving the technical and economic feasibility of carbon capture and geologic sequestration emissions. When identifying technology alternatives, the Alliance started with a list of major components and subsystems of the power plant facility and then created a matrix of potential configurations of equipment. The matrix of potential configurations has been gradually reduced to a general configuration and list of conservative operating parameters (e.g., an upper bound for possible air emissions of various pollutants, other waste streams, and land impacts) that serve as the basis for the analyses in this EIS.

Descriptions of the alternatives and evaluations of potential impacts included in this EIS are intended to assist the federal decision-makers in choosing whether to fund the project and which sites, if any, should be considered further. If DOE elects to provide further financial assistance for the FutureGen Project, the agency may also specify measures to mitigate potential impacts as identified in the NEPA process. In the absence of DOE funding (the No-Action Alternative), the Alliance may still elect to construct and operate the proposed IGCC power plant if it can obtain the additional funding and required permits. However, in the absence of DOE participation, it is unlikely the FutureGen Project would be implemented.

No sooner than 30 days after publication of EPA's NOA of the Final EIS in the *Federal Register*, DOE will announce in a ROD selection of either the No-Action Alternative or the Proposed Action with those sites acceptable to DOE. If DOE decides to implement the Proposed Action, the Alliance will subsequently select a host site from among those sites, if any, that are identified in the ROD as acceptable to DOE.

After selection of the host site, the Alliance would conduct additional site characterization work on the chosen site. This information would support site-specific design work for the FutureGen Project. Both the additional site information and the site-specific design work would be reviewed by DOE and would support the completion of a Supplement Analysis (see 10 CFR 1021.314) by DOE to determine if there are substantial changes in the Proposed Action or significant new circumstances or information relevant to environmental concerns, as discussed in 40 CFR 1502.9(c). Based on the Supplement Analysis, DOE will determine whether a Supplemental EIS should be prepared.

1.6.3.1 Interagency Cooperation

EPA staff participated in the development of the site selection criteria used in the solicitation and evaluation of the site proposals, reviewed and provided input to DOE's plan for conducting a risk assessment of underground storage of CO_2, and reviewed and commented on the preliminary version of this Draft EIS.

1.6.3.2 Relationship Between DOE and the Alliance

On March 23, 2007, DOE and the Alliance signed a Full Scope Cooperative Agreement (the Agreement) to undertake the FutureGen Project. The Agreement defines the terms and conditions for financial assistance, including DOE's oversight role. Under the Agreement, the Alliance would be primarily responsible for implementing the FutureGen Project. DOE would guide the Alliance at a programmatic level to ensure that the FutureGen Project meets DOE's objectives. In addition to programmatic-level guidance, DOE retains certain review and approval rights for major project decisions and oversees the Alliance's compliance with the terms of the Agreement. The FutureGen Project is comprised of six budget periods with continuation of the project into each subsequent budget period contingent upon the approval of a continuation application. The first budget period (Budget Period 0) was completed under a Limited Scope Cooperative Agreement that provided an opportunity to examine the feasibility of the project. The current Budget Period 1 of the Full Scope Cooperative Agreement will cover the remainder of the NEPA process, site selection, detailed characterization of the selected site, and preliminary design work. Figure 1-2 illustrates the Full Scope Cooperative Agreement Timeline.

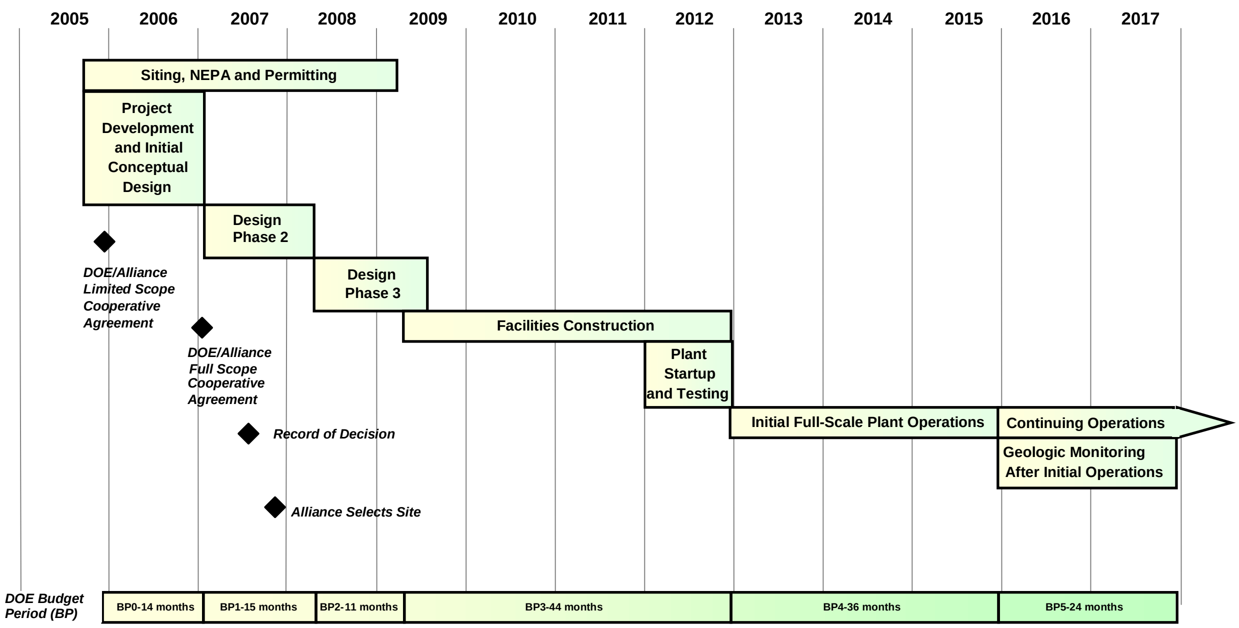


Figure 1-2. FutureGen Project Full Scope Cooperative Agreement Timeline

The FutureGen Project would move between budget periods only after DOE review and approval of continuation applications submitted by the Alliance. Continuation funding would be contingent on (1) availability of funds; (2) satisfactory progress towards meeting the objectives of the previously approved application; (3) compliance with the terms and conditions of the Agreement; and (4) such other terms as the parties agree.

The Alliance would hold legal title to the FutureGen facility subject to DOE's rights under DOE regulations and the Agreement. During the performance of the Full Scope Cooperative Agreement, DOE and the Alliance would develop a mutually acceptable plan for project disposition, which may include continued operation of the facility by the Alliance or some other party in a research or commercial mode.

DOE is responsible for NEPA compliance. For the alternative sites, the Alliance and the Site Proponents (Mattoon and Tuscola, Illinois and Jewett and Odessa, Texas) have provided design information and planning details and facts, which have been independently reviewed by DOE. Information supplied by the Alliance and by the Site Proponents has been reviewed and verified by DOE and used in preparation of this Draft EIS.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter describes in detail the Proposed Action, including alternative sites, the No-Action Alternative, and alternatives eliminated from further consideration. Section 2.2 includes an overview of the FutureGen Project to provide the context for information contained in the alternative site discussions. Additionally, Section 2.5 presents detailed technical information on the proposed FutureGen Project that forms the basis for the analyses in this Environmental Impact Statement (EIS). This information includes detailed descriptions of the proposed power plant, carbon dioxide (CO_2) capture and sequestration (storage) methods, monitoring activities, planned and potential research activities, resources required for the proposed project, and construction and operation plans. Lastly, future design, site characterization, and National Environmental Policy Act (NEPA) of 1969 activities are described.

2.2 DESCRIPTION OF THE PROPOSED ACTION

DOE proposes to provide financial assistance to the Alliance to plan, design, construct, and operate the FutureGen Project. DOE has identified four reasonable alternative sites and will determine which sites, if any, are acceptable to DOE to host the FutureGen Project. The four sites currently being considered as reasonable site alternatives for the FutureGen Project are:

- Mattoon, Illinois;
- Tuscola, Illinois;
- Jewett, Texas; and
- Odessa, Texas.

In a March 2004 Report to Congress, DOE estimated the cost of the project at $950 million in constant 2004 dollars shared at a 74/26 ratio by DOE and the Alliance. Accounting for escalation, based on representative industry indices, the project is currently estimated to cost $1,757,232,310 in as-spent dollars. Including $300,800,000 in expected revenues from the sale of electricity, which would be used to offset operational costs and research and development expenses, the total net project cost is estimated to be $1,456,432,310 in as-spent dollars. DOE will share approximately 74 percent of the net cost (estimated at $1,077,760,230), which includes at least $80 million in projected contributions from foreign governments. The Alliance will share approximately 26 percent of the net cost (estimated at $378,672,080). The cost estimate will be updated as work progresses.

The FutureGen Project would be a research facility as well as the cleanest coal-fueled power system in the world for co-producing electricity and hydrogen (H_2). The facility would incorporate cutting-edge research, as well as the development of promising new energy-related technologies at a commercial scale. Low carbon emissions would be achieved by integrating CO_2 capture and sequestration operations with the proposed power plant (see Figure 2-1). Performance and economic test results from the FutureGen Project would be shared among participants, industry, the environmental community, and the public.

Construction would begin in 2009, with initial startup of the facility anticipated in 2012. DOE-sponsored activities would include construction and 4 years of plant operation, testing, and research (including 1 year of startup) (i.e., research and development) followed by 2 years of additional geologic monitoring for the sequestered CO_2 (see Figure 2-2). After DOE-sponsored activities conclude, the Alliance or its successor would manage and operate the power plant. DOE expects the plant would operate for at least 20 to 30 years, and potentially up to 50 years.

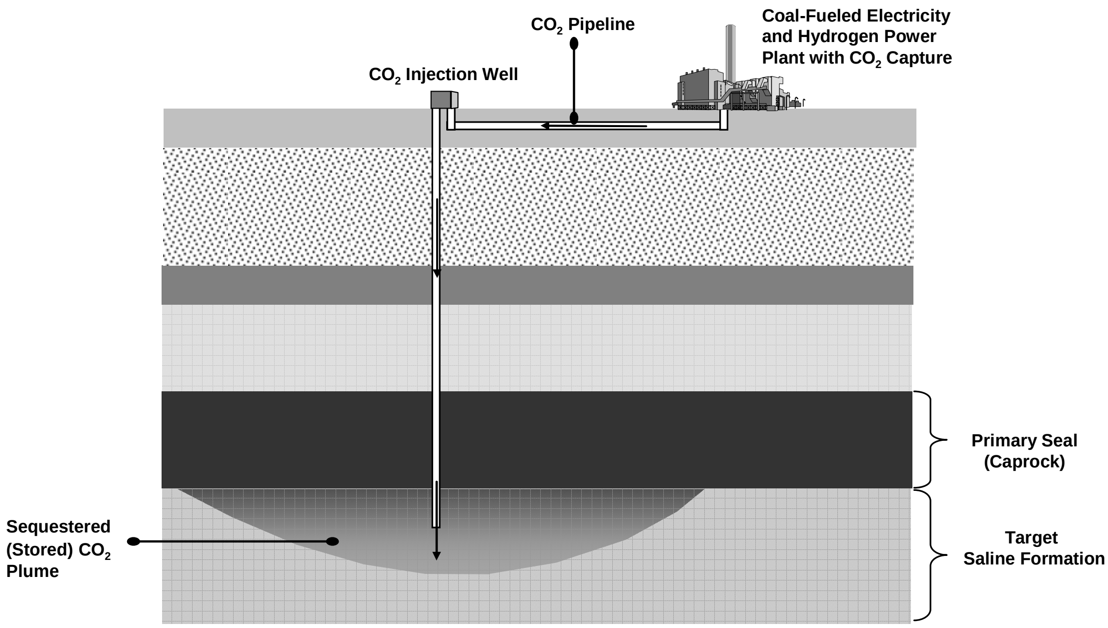


Figure 2-1. FutureGen Project Overview

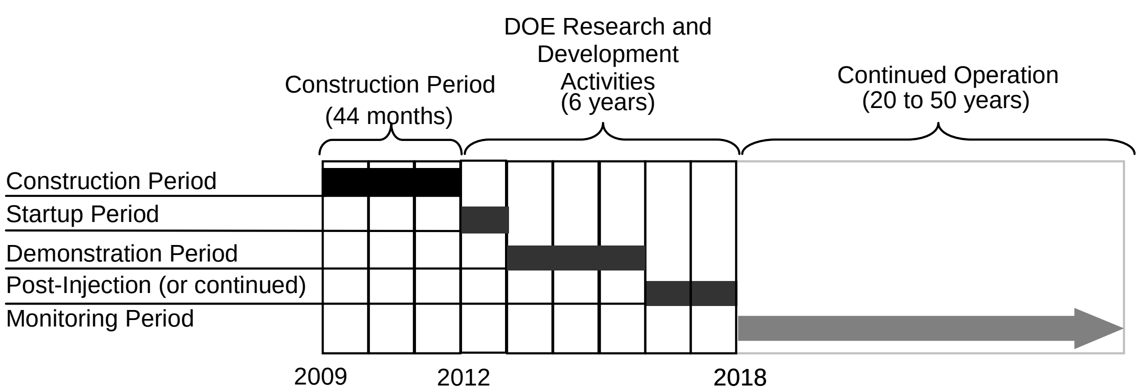


Figure 2-2. Construction, Demonstration, Monitoring, and Operating Schedule

The FutureGen Project would include a coal-fueled electric power and H_2 production plant. The power plant would be a 275-megawatt (MW) output Integrated Gasification Combined Cycle (IGCC) system. CO_2 capture and geologic storage would occur at a rate of at least 1.1 million tons (1 million metric tons [MMT]) of CO_2 per year. Major components needed to support the proposed FutureGen Project include:

- A power plant site and plant infrastructure;
- A sequestration site for CO_2 injection wells related infrastructure, and deep saline formation (i.e., the geologic formation where CO_2 would be stored);
- Utility connections and corridors (e.g., water supply, sanitary wastewater, electric transmission, natural gas pipelines, and CO_2 pipelines); and
- Transportation routes (rail and truck).

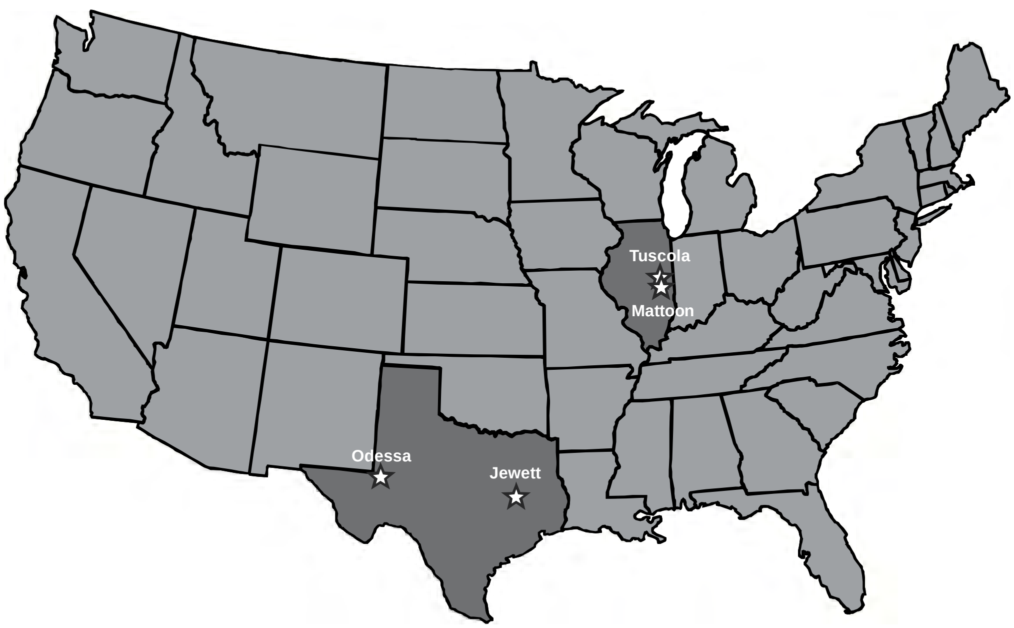
IGCC refers to the combination (integration) of the gasification process with a combined-cycle power plant (i.e., a plant that uses both steam turbine and combustion turbine generators).

2.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not share in the cost for constructing and operating the FutureGen Project. Without DOE funding, the Alliance would not likely undertake the commercial-scale integration of CO_2 capture and geologic sequestration with a coal-fueled power plant in a comparable timeframe. Therefore, the No-Action Alternative is considered a "No-Build" Alternative.

2.4 SITE ALTERNATIVES

There are four alternative site locations under consideration for the FutureGen Project (see Figure 2-3). These candidate sites were identified by the Alliance through a rigorous screening and selection process. DOE reviewed the Alliance's decision-making process and findings to ensure that all reasonable alternatives were considered for analysis in this EIS. Alternatives considered but determined to be unreasonable are discussed in Section 2.4.5.



Source: FG Alliance, 2006a

Figure 2-3. Alternative Site Locations

2.4.1 MATTOON SITE

Proposed Mattoon Power Plant and Sequestration Site

The proposed Mattoon Site consists of approximately 444 acres (180 hectares) of farmland located approximately 1 mile (1.6 kilometers) northwest of the City of Mattoon, in Coles County, Illinois. Key features of the Mattoon Site are listed in Table 2-1. The proposed power plant and sequestration site would be located on the same parcel of land. The proposed site is bordered to the northeast by State Route (SR) 121 and a Canadian National Railroad. Potable water would be supplied by extending existing lines from Mattoon's public water supply system. Process water would be provided from the effluent of the municipal wastewater treatment plants (WWTPs) of the cities of Mattoon and possibly Charleston, Illinois. Sanitary wastewater service would be provided through an extension of Mattoon's public wastewater system. Natural gas would be delivered through a high-pressure line that is within 0.25 mile (0.4 kilometer) of the proposed site. The proposed power plant would connect to the power grid via existing or new high voltage transmission lines. Following Table 2-1, Figures 2-4 and 2-5 illustrate the Mattoon Site and utility corridors, respectively.

Table 2-1. Mattoon Site Features

Feature	Description
Power Plant Site	The proposed Mattoon Power Plant and Sequestration Site consists of approximately 444 acres (180 hectares) located in Mattoon Township, Coles County, Illinois. The proposed site consists of 93 percent farmland and 3 percent public rights-of-way (ROWs), with the remaining percentage being rural residential development and woodlands. The Site Proponent is a group consisting of the State of Illinois (through the Illinois Department of Commerce and Economic Opportunity), the City of Mattoon, Coles County, and Coles Together (an economic development organization). The proposed site is currently privately owned, but the Site Proponent has an option to purchase the site title, which would be conveyed to the Alliance. The northeast boundary of the proposed site is adjacent to SR 121. Rail access is immediately adjacent to the northeast site boundary. The proposed power plant site is located approximately 1 mile (1.6 kilometers) northwest of Mattoon and approximately 150 miles (241.4 kilometers) south of Chicago. This Coles County site is used as farmland, is flat, and is surrounded by a rural area of low-density population.
Sequestration Site Characteristics and Predicted Plume Radius	The sequestration site is located on the same parcel of land as the power plant site. CO_2 injection would occur within the Mt. Simon saline-bearing sandstone at a depth of 1.3 to 1.6 miles (2.1 to 2.6 kilometers). The Mt. Simon formation is overlain by a thick (500- to 700-foot [152- to 213-meter]) regional seal of low permeability siltstones and shales of the Eau Claire formation and is underlain by Precambrian granitic rock.

Table 2-1. Mattoon Site Features

Feature	Description
Sequestration Site Characteristics and Predicted Plume Radius (continued)	The St. Peter sandstone is proposed as an optional target reservoir. It occurs at a depth of 0.9 mile (1.4 kilometers), which is about 0.4 mile (0.6 kilometer) above the Mt. Simon formation. The St. Peter sandstone is estimated to be over 200 feet (61 meters) thick with state-wide lateral continuity. Both the Mt. Simon and St. Peter reservoirs have been successfully used for natural gas storage in other parts of Illinois. To estimate the size of the plume of injected CO_2, the Alliance used numerical modeling to predict the plume radius from the injection well. This modeling estimated that the plume radius at Mattoon could be as large as 1.2 miles (1.9 kilometers) after injecting 1.1 million tons (1 MMT) of CO_2 annually for 50 years. The dispersal and movement of the injected CO_2 would be influenced by the geologic properties of the reservoir, and it is unlikely that the plume would radiate in all directions from the injection point in the form of a perfect circle. However, for reference purposes, this modeled radius corresponds to a circular area equal to 2,789 acres (1,129 hectares). Data from a recent two-dimensional (2D) seismic line across the proposed injection site indicated that the continuity of the seismic reflectors on this seismic line suggests that there is no significant faulting cutting the plane on the seismic line within 1.5 miles (2.4 kilometers) to the west and 1.5 miles (2.4 kilometers) to the east of the Mattoon Sequestration Site (Patrick Engineering, 2006).
Utility Corridors	
Potable Water	Potable water would be supplied to the plant site from the Mattoon public potable water system. A 1-mile (1.6-kilometer) pipeline extension would be constructed within the ROW of County Road (CR) 800N from the proposed power plant site to a 10-inch (25-centimeter) potable water pipeline on 43rd Street south of SR 121.
Process Water	The proposed Mattoon Site would obtain process water from the effluent of the municipal WWTPs of Mattoon and possibly Charleston. For the Mattoon WWTP effluent, a 6.2-mile (10.0-kilometer) pipeline would be constructed, with all but 2 miles (3.2 kilometers) within an existing public ROW located within the city boundary. The Site Proponent has option contracts to buy the necessary easements for these 2 miles (3.2 kilometers) of pipeline. The possible addition of a new 8.1-mile (13.0-kilometer) pipeline from the Charleston WWTP would be within an existing ROW owned by Mattoon and Charleston. The jointly-owned ROW follows the Lincoln Prairie Grass Bike Trail, and existing 138-kilovolt (kV) overhead electric lines run the entire length. An on-site reservoir (on the power plant property) could be constructed to store up to 25 million gallons (94.6 million liters) of process water to satisfy water requirements. A small reservoir of 7 acres (2.8 hectares) would be adequate. If a larger reservoir were constructed (approximately 40 acres [16.2 hectares] in size) with a capacity of 200 million gallons (757 million liters), the Mattoon WWTP effluent would be sufficient by itself to supply the proposed plant's process water.
Sanitary Wastewater	Sanitary wastewater service would be provided to the proposed plant site through an extension of Mattoon's existing public wastewater system. A sanitary sewer lift station would be constructed at the proposed site. A 1.25-mile (2.0-kilometer) wastewater force main would then be constructed in the ROW of SR 121 to an existing sanitary lift station at the intersection of SR 121 and 43rd Street.
Electric Transmission Lines	Option 1: The proposed power plant would connect with an existing 138-kV transmission line located 0.5 mile (0.8 kilometer) from the proposed site. This line runs north-south and is owned by Ameren Corporation. A corridor easement to connect the proposed site to the existing 138-kV line has already been acquired by Mattoon. There are three scenarios to tie into this line under Option 1.

Table 2-1. Mattoon Site Features

Feature	Description
Electric Transmission Lines (continued)	Option 1a: Tie directly into the existing 138-kV line with transfer switching. Option 1b: Install a substation at the interconnection of the new easement with the existing ROW. Option 1c: Run a new transmission line south next to the existing 138-kV line and connect with the existing substation less than 2 miles (3.2 kilometers) away near Route 16. The existing substation would need to be upgraded. Option 2: Under this option, the proposed site would be connected to the nearest 345-kV line at the Neoga South Substation located 16 miles (25.7 kilometers) south of the proposed site. This option would require 16 miles (25.7 kilometers) of new line and ROW to connect the proposed plant with this substation.
Natural Gas	A natural gas mainline is located approximately 0.25 mile (0.4 kilometer) east of the proposed power plant site. This is a high-pressure line, and a new tap and delivery station would be required. The Site Proponent has obtained an option for additional land for the pipeline ROW that would give flexibility in the route to connect to this line.
CO_2 Pipeline	The CO_2 injection well for the FutureGen Project at Mattoon would be located at the proposed power plant site. Therefore, no off-site CO_2 pipeline or corridor would be necessary.
Transportation Corridors	The site is located 7 miles (11.3 kilometers) west of Interstate (I) Highway 57 (I-57), along SR 121. The Canadian National-Peoria Subdivision rail line is immediately adjacent to the northeast site boundary. The Canadian National/Illinois Central mainline connects to the Peoria Subdivision rail line approximately 3.5 miles (5.6 kilometers) from the proposed site. Illinois is located within the East North Central Demand Region for coal, which also includes Ohio, Indiana, Wisconsin, and Michigan. According to the Energy Information Administration (EIA, 2000), the East North Central Demand Region is ideally situated for access to coal, which it receives from each of the major U.S. supply regions. In 1997, the average distance that a coal shipment traveled to reach a destination in this region was about 830 miles (1,336 kilometers) (EIA, 2000). In terms of a straight-line distance, Mattoon is approximately 300 miles (483 kilometers) from the Pittsburgh Coalbed (near south-central Ohio in the northern Appalachian Basin), 900 miles (1,448 kilometers) from the Powder River Basin (PRB) (eastern Wyoming), and 50 miles (80.5 kilometers) from the nearest active coal mine within the Illinois Basin (Vermillion County, Illinois).

Source: FG Alliance, 2006b (unless otherwise noted).

2.4.2 TUSCOLA SITE

Proposed Tuscola Power Plant Site

The proposed Tuscola Site consists of approximately 345 acres (140 hectares) of farmland located approximately 1.5 miles (2.4 kilometers) west of the City of Tuscola, in Douglas County, Illinois. Key features of the Tuscola Site are listed in Table 2-2. Township Road (TR) 86 (750E) borders the western side of the proposed plant site and TR 47 (1050N) runs along its northern border. A CSX Railroad runs along its southern border. Potable water would be supplied through an existing water line along the southern border of the proposed site. Process water would be pumped from a water holding pond fed by the Kaskaskia River and located at the nearby Lyondell-Equistar Chemical Company. Sanitary wastewater would be treated either through a new on-site WWTP or by constructing a new sanitary force-main to the wastewater treatment system at the Lyondell-Equistar plant. The proposed power plant would connect to the power grid via existing or new high voltage transmission lines. Natural gas would be delivered through an existing line that runs through the proposed plant site. The proposed sequestration site is currently farmland situated 11 miles (17.7 kilometers) directly south of the proposed plant site. A new CO_2 pipeline would be constructed within the existing road and utility ROWs, and new ROWs running parallel to existing ROWs if required. Following Table 2-2, Figures 2-6, 2-7, and 2-8 illustrate the Tuscola Power Plant Site, utility corridors, and sequestration site, respectively.

Table 2-2. Tuscola Site Features

Feature	Description
Power Plant Site	The proposed Tuscola Site consists of approximately 345 acres (140 hectares) located in east-central Illinois, 1.5 miles (2.4 kilometers) west of the City of Tuscola within Douglas County. TR 86 (750E) runs along the west border of the proposed plant site and TR 47 (1050N) runs along its northern border. The Site Proponent is a group consisting of the State of Illinois (through the Illinois Department of Commerce and Economic Opportunity), the City of Tuscola, Douglas County, and Tuscola Economic Development, Inc. The proposed site is currently privately owned, but the Site Proponent has an option to purchase the site title, which would be conveyed to the Alliance. The proposed site is located on flat farmland near an industrial complex, which is immediately west of the proposed site. The areas to the immediate north, east, and south are rural with a very low population density.
Sequestration Site Characteristics and Predicted Plume Radius	The proposed sequestration site is located in a rural area, approximately 2 miles (3.2 kilometers) south-southwest of the small town of Arcola in Douglas County in east-central Illinois. The proposed site is located 11 miles (17.7 kilometers) south of the proposed power plant site and is 3 miles (4.8 kilometers) west of I-57. The proposed sequestration site would be located on a land trust, where the trustee is the First National Bank of Arcola. The trustee has been authorized by the beneficiaries of the trust to sell the property. The proposed site is a 10-acre (4-hectare) portion of a larger parcel of 80 acres (32.4 hectares). The proposed sequestration site is located in Arcola Township, Douglas County, approximately 0.25 mile (0.4 kilometer) east of CR 750E along 000N, the Douglas-Coles County line. The site consists primarily of agricultural land with row crops.

Table 2-2. Tuscola Site Features

Feature	Description
Sequestration Site Characteristics and Predicted Plume Radius (continued)	Injection would occur within the Mt. Simon saline-bearing sandstone, at a depth of between 1.3 to 1.5 miles (2.1 to 2.4 kilometers). The Mt. Simon formation is overlain by a thick (500- to 700-foot [152- to 213-meter]) regional seal of low permeability siltstones and shales of the Eau Claire Formation and is underlain by Precambrian granitic rock. The St. Peter sandstone is proposed as an optional target reservoir. It occurs at a depth of 0.9 mile (1.4 kilometers), which is about 0.4 mile (0.6 kilometer) above the Mt. Simon formation. The St. Peter reservoir is estimated to be over 100 feet (30.5 meters) thick with state-wide lateral continuity. Both the Mt. Simon and St. Peter reservoirs have been successfully used for natural gas storage in other parts of Illinois. To estimate the size of the plume of injected CO_2, the Alliance used numerical modeling to predict the plume radius from the injection well. This modeling estimated that the plume radius at the proposed Tuscola injection site could be as large as 1.1 miles (1.8 kilometers) after injecting 1.1 million tons (1 MMT) of CO_2 annually for 50 years. The dispersal and movement of the injected CO_2 would be influenced by the geologic properties of the reservoir, and it is unlikely the plume would radiate in all directions from the injection point in the form of a perfect circle. However, for reference purposes, this modeled radius corresponds to a circular area equal to 2,432 acres (984 hectares). A recent 2D seismic line across the proposed injection site indicated that the continuity of seismic reflectors on this seismic line suggest that there is no significant faulting cutting the plane of the seismic line within 1 mile (1.6 kilometers) to the west and 2.5 miles (4.0 kilometers) to the east of the Tuscola Sequestration Site (Patrick Engineering, 2006).
Utility Corridors	
Potable Water	Potable water would be supplied to the proposed power plant by tapping an existing 8-inch (20.3-centimeter) water line operated by the Illinois American Water Company. This line runs along the southern boundary of the property along the CSX Railroad. Tapping into the existing water line would require less than 1 mile (1.6 kilometers) of new construction.
Process Water	The proposed power plant would receive its process water from an existing 150 million-gallon (568 million-liter) water holding pond at the Lyondell-Equistar Chemical Company located west of the proposed site. This pond contains raw water pumped from the adjacent Kaskaskia River. A 1.5-mile (2.4-kilometer) force main would be constructed to pump water from the pond to the plant, crossing property owned by Lyondell-Equistar Chemical Company and Cabot Corporation, as well as an existing township ROW.
Sanitary Wastewater	Option 1: Under Option 1, an on-site WWTP would be constructed at the proposed plant site. The treated effluent from this facility could then be discharged into an on-site reservoir (if constructed) and then reused as process water. Option 2: Under Option 2, a 0.9-mile (1.4-kilometer) sanitary force-main would be constructed to the existing wastewater treatment system at the Lyondell-Equistar Chemical Company. Once treated, this effluent could potentially be discharged into the existing 150 million-gallon (568 million-liter) reservoir to be reused as process water for the proposed power plant. There is an abandoned 8-inch (20.3-centimeter) potable water pipeline at the property that could potentially be used as a sanitary force-main to the Lyondell-Equistar WWTP. This line would require hydraulic testing before it could be put into service.
Electric Transmission Lines	Option 1: The nearest electric transmission line to the proposed power plant site is a 138-kV line located 0.5 mile (0.8 kilometer) north of the proposed site. This line is owned and operated by Ameren Corporation. The connection to this line would require additional ROW. Under Option 1, the proposed plant would tie into this existing 138-kV line.

Table 2-2. Tuscola Site Features

Feature	Description
Electric Transmission Lines (continued)	Option 2: If the interconnection of the proposed plant to the electric grid required use of a 345-kV line, a new 345-kV line that would parallel or replace the existing 138-kV line would be constructed for approximately 17 miles (27.4 kilometers) and connect to a substation where the line currently joins the 345-kV Sidney-Kansas line. Approximately 3 miles (4.8 kilometers) of new ROW would be required. An interconnection study has been requested and would dictate the ultimate line requirements.
Natural Gas	Natural gas would be delivered to the proposed plant from an existing natural gas mainline that runs through the proposed power plant site. Because the pipeline is a high-pressure line, a new tap and delivery station would be required.
CO_2 Pipeline	A new 11-mile (17.7-kilometer) pipeline would be constructed to transport CO_2 to the proposed sequestration site 10 miles (16.1 kilometers) due south of the proposed plant site. The pipeline would be constructed across existing State of Illinois, Douglas County, and Township ROWs and would occupy new ROWs where needed. The pipeline corridor would run parallel to CR 750E and 700E to the injection location.
Transportation Corridors	There are four railroads nearby: CSX Transportation borders site, Union Pacific (1.5 miles [2.4 kilometers]), Canadian National (1.5 miles [2.4 kilometers]), and Norfolk Southern (approximately 30 miles [48.3 kilometers]). The proposed site is bordered by TR 86 and TR 47. Illinois is located within the East North Central Demand Region for coal, which also includes Ohio, Indiana, Wisconsin, and Michigan. According to the Energy Information Administration (EIA, 2000), the East North Central Demand Region is ideally situated for access to coal, which it receives from each of the major U.S. supply regions. In 1997, the average distance that a coal shipment traveled to reach a destination in this region was about 830 miles (1,336 kilometers) (EIA, 2000). In terms of a straight line distance, Tuscola is approximately 300 miles (483 kilometers) from the Pittsburgh Coalbed (near south-central Ohio in the northern Appalachian Basin), 900 miles (1,448 kilometers) from the PRB (eastern Wyoming), and within 35 miles (56.3 kilometers) of the nearest active coal mines in the Illinois Basin (Vermillion County, Illinois).

Source: FG Alliance, 2006c (unless otherwise noted).

2.4.3 JEWETT SITE

Proposed Jewett Power Plant Site

(NRG Limestone Generating Station in the background)

The proposed Jewett Site is located in east-central Texas on approximately 400 acres (162 hectares) of formerly mined land northwest of the Town of Jewett. Key features of the Jewett Site are listed in Table 2-3. The proposed site is located at the intersection of Leon, Limestone, and Freestone counties, and bordered by U.S. Highway 79 (US 79) and Farm-to-Market Road (FM) 39. The Burlington Northern Santa Fe Railroad runs along the northeastern border of the proposed site. Potable water and process water would be obtained by drilling new wells on site or nearby. Sanitary wastewater would be treated through a new on-site wastewater treatment system. The proposed power plant would connect to the power grid via existing high voltage transmission lines. Natural gas would be delivered through an existing gas pipeline located at the northeastern corner of the proposed plant site. The proposed sequestration injection wells would be located on both private ranchland and state-owned prison land approximately 33 miles (53.1 kilometers) northeast of the proposed power plant site. A new CO_2 pipeline would be installed largely along existing ROWs, but would require some new ROWs. Following Table 2-3, Figures 2-9, 2-10, and 2-11 illustrate the Jewett Power Plant Site, utility corridors, and sequestration site, respectively.

Table 2-3. Jewett Site Features

Feature	Description
Power Plant Site	The proposed Jewett Site is located in east-central Texas on approximately 400 acres (162 hectares) of land northwest of the Town of Jewett. The proposed site is located at the intersection of Leon, Limestone, and Freestone counties on FM 39 near US 79. The area is characterized by very gently rolling reclaimed mine lands immediately adjacent to an operating lignite mine and the nominal 1800-MW NRG Limestone Generating Station (power plant). The Site Proponent is the State of Texas. The proposed power plant site is currently held by one property owner – NRG Texas.
Sequestration Site Characteristics and Predicted Plume Radius	The proposed Jewett Sequestration Site is located in a rural area about 33 miles (53.1 kilometers) northeast of the proposed power plant site. It is located about 16 miles (25.7 kilometers) east of the Town of Fairfield in Freestone County, 65 miles (105 kilometers) north of the Bryan/College Station area, and 60 miles (96.6 kilometers) east of Waco. The land use at the proposed sequestration site is primarily agricultural, with few residences located over the projected plume. Injection would occur on a private ranch (Hill Ranch) and on adjoining state property managed by the Texas Department of Criminal Justice (TDCJ). Two injection wells are proposed for injection into the Woodbine formation. In addition, one more injection well is proposed for injection into the deeper Travis Peak formation at a much lower injection rate than the primary Woodbine wells to take advantage of CO_2 sequestration research opportunities on low permeability reservoirs. The Travis Peak well would not be required in addition to the Woodbine injection wells to accommodate the output of the proposed power plant. One of the Woodbine injection wells and the Travis Peak well would be located on the Hill Ranch property. The other Woodbine injection well would be located on TDCJ property. Under the proposed injection plan, each of the Woodbine wells would be used to inject 45 percent of the total CO_2 output with the remaining 10 percent injected into the Travis Peak well.

Table 2-3. Jewett Site Features

Feature	Description
Sequestration Site Characteristics and Predicted Plume Radius (continued)	Both the Woodbine and Travis Peak formations lie beneath a primary seal, the Eagle Ford Shale, which has a thickness of 400 feet (122 meters). The primary injection zone, the Woodbine sandstone, is directly beneath the Eagle Ford. There are also over 0.4 mile (0.6 kilometer) of low permeability carbonates and shales above the Eagle Ford that create additional protection for shallow drinking water aquifers. The injection depth within the Woodbine formation would be 1 to 1.1 miles (1.6 to 1.8 kilometers). Injection into the Travis Peak formation would occur between 1.7 to 2.1 miles (2.7 to 3.4 kilometers) below the ground surface. To estimate the size of the plume of injected CO_2, the Alliance used numerical modeling to predict the plume radius from the injection wells. This modeling estimated that the plume radius at the proposed Jewett injection site could be as large as 1.7 miles (2.7 kilometers) per Woodbine injection well, 50 years after injecting 2.8 million tons (2.5 MMT) of CO_2 annually for the first 20 years, followed by 30 years of gradual plume spreading. The dispersal and movement of the injected CO_2 would be influenced by the geologic properties of the reservoir, and it is unlikely that the plume would radiate in all directions from the injection point in the form of a perfect circle. However, for reference purposes, this modeled radius corresponds to a circular area equal to 5,484 acres (2,219 hectares). A total of 10,968 acres (4,439 hectares) is estimated for all three wells.
Utility Corridors	
Potable Water	Potable water would be supplied in the same manner as the proposed plant's process water, by installing new wells either on the property or off site. This would require 1 mile (1.6 kilometers) of new construction.
Process Water	Process water would be provided by installing wells on the proposed site or possibly off site into the Carrizo-Wilcox Aquifer. Because the wells would be located on or close to the proposed plant site, only a small length of distribution pipeline, less than 1 mile (1.6 kilometers), would be required to deliver water to the proposed plant.
Sanitary Wastewater	Sanitary wastewater would be treated and disposed of through construction and operation of an on-site sanitary WWTP. Effluent from the WWTP would be treated and disposed of in accordance with local and state regulations or recycled back into the power plant for process water.
Electric Transmission Lines	Option 1: The proposed power plant would connect to a 345-kV transmission line bordering the plant site. Option 2: The proposed power plant would connect to a 138-kV line approximately 2 miles (3.2 kilometers) from the site on a new ROW.
Natural Gas	Natural gas would be delivered through an existing natural gas pipeline located at the northwestern corner of the proposed power plant site. This pipeline is owned and operated by Energy Transfer Corporation.
CO_2 Pipeline	A new CO_2 pipeline would be required to connect the proposed power plant site to the proposed sequestration site. The pipeline would be up to 59 miles (95 kilometers) in length and the ROW would be approximately 20 to 30 feet (6.1 to 9.1 meters) wide. The proposed CO_2 pipeline has been divided into the following common segments, except for segments A-C and B-C, which are alternatives between the proposed plant site and the beginning of segment C: • Segment A-C would begin on the northeastern side of the proposed plant site and follow 2 miles (3.2 kilometers) of existing ROW owned by the Burlington Northern – Santa Fe Railroad. It would continue approximately 3 miles (4.8 kilometers) along a new ROW until it intersects a section of a natural gas pipeline ROW. The corridor would then follow this pipeline another 3 miles (4.8 kilometers) east until it joins a larger trunk of a natural gas pipeline.

Table 2-3. Jewett Site Features

Feature	Description
CO_2 Pipeline (continued)	• Segment B-C would begin along the southern boundary of the proposed plant site and extend southeast approximately 2.5 miles (4.0 kilometers) along FM 39. It then would turn northeast and follow the existing ROW of a natural gas pipeline for another 4 miles (6.4 kilometers) until it joins a ROW for a larger trunk of a natural gas pipeline that extends northwest for approximately 8 miles (12.9 kilometers). • Segment C-D would follow an existing natural gas line ROW northward for approximately 15 miles (24.1 kilometers). • Segment D-E is no longer being evaluated for this project; therefore, it is not addressed in this EIS. • Segment D-F would continue northward along the existing natural gas line ROW for another 9 miles (14.5 kilometers). • Segment F-G would extend in a straight line east along a new ROW approximately 6 miles (9.7 kilometers) to the proposed sequestration wells on the Hill Ranch. • Segment F-H would continue northward along the existing natural gas line corridor for almost 2 miles (3.2 kilometers) where it would cross the Trinity River to the north side. It then would intersect another leg of a natural gas pipeline ROW and continue east for approximately 6 miles (9.7 kilometers). The line would then continue in a generally eastward direction along a county highway (CH) ROW and TDCJ land for approximately another 6 miles (9.7 kilometers) to the proposed injection well site on TDCJ land.
Transportation Corridors	The proposed Jewett Site is bordered by FM 39, which intersects US 79 and State Highway (SH) 164 within 10 miles (16.1 kilometers) of the site boundary. The Burlington Northern – Santa Fe Railroad also runs along the northeastern border of the proposed power plant site. Texas is located in the West South Central Demand Region for coal, which also includes Louisiana, Arkansas, and Oklahoma. According to the Energy Information Administration (EIA, 2000), the West South Central Demand Region receives the majority of its coal resources from the PRB and the Rockies. In 1997, the average distance that a coal shipment traveled to reach a destination in this region was about 1,300 miles (2,092 kilometers) (EIA, 2000). In terms of a straight line distance, Jewett is approximately 950 miles (1,529 kilometers) from the Pittsburgh Coalbed (south-central Ohio in the northern Appalachian Basin), 650 miles (1,046 kilometers) from the Illinois Basin coals (southern Illinois), and 1,000 miles (1,609 kilometers) from the PRB coal supplies (eastern Wyoming). In addition, Texas lignite is available from the on-site Westmoreland Coal Company mine and perhaps other regional mines.

Source: FG Alliance, 2006d (unless otherwise noted).

2.4.4 ODESSA SITE

Proposed Odessa Power Plant Site

The proposed Odessa Site is located on approximately 600 acres (243 hectares) 15 miles (24.1 kilometers) southwest of the City of Odessa in Ector County, Texas. Key features of the Odessa Site are listed in Table 2-4. The proposed site is located just north of I-20 and is north of the Town of Penwell and a Union Pacific Railroad. The land has historically been used for ranching as well as oil and gas activities. Potable water and process water would be obtained by developing new well fields nearby or from several existing water well fields ranging from 24 to 54 miles (38.6 to 86.9 kilometers) from the proposed plant site. Sanitary wastewater would be treated through construction and operation of an on-site treatment system. The proposed power plant would connect to the power grid via existing high voltage transmission lines located approximately 1.8 miles (2.9 kilometers) from the site. Natural gas would be obtained from an existing gas pipeline that traverses the proposed plant site. The proposed sequestration site would be located 58 miles (93.3 kilometers) south of the proposed power plant site on 43,200 acres (17,118 hectares) on University of Texas land. An existing CO_2 pipeline would transport the power plant's CO_2 to the sequestration site, although up to 14 miles (22.5 kilometers) of new CO_2 pipeline would be installed to connect the proposed power plant and the proposed sequestration site to the existing pipeline. Following Table 2-4, Figures 2-12, 2-13, and 2-14 illustrate the Odessa Power Plant Site, utility corridors, and sequestration site, respectively.

Table 2-4. Odessa Site Features

Feature	Description
Power Plant Site	The proposed Odessa Site is located on about 600 acres (243 hectares) approximately 15 miles (24.1 kilometers) southwest of the City of Odessa in Ector County, Texas. The proposed site consists of flat land near I-20 and across the Union Pacific Railroad from the Town of Penwell. The Site Proponent is the State of Texas. Both the proposed site and surrounding land to the east, west, and north are rural areas where land use has been dominated historically by ranching and oil and gas activities (Horizon Environmental Services, 2006). Unimproved roads and structures related to oil and gas well activities are found on and around the proposed site, with most oil production activities historically occurring immediately west of the proposed site. Several pipelines also traverse the proposed site boundaries. The entire property within the proposed power plant site boundary is owned by a single owner.
Sequestration Site Characteristics and Predicted Plume Radius	The proposed sequestration site is located in a semi-arid, sparsely populated area adjacent to I-10 in Pecos County, Texas. The proposed site, owned by the University of Texas, is located 58 miles (93.3 kilometers) south of the proposed power plant near Odessa, Texas, is 3 miles (4.8 kilometers) east of Fort Stockton, and is about 60 miles (96.6 kilometers) south of the Midland-Odessa International Airport. Proposed injection targets for this site are a lower interval of the Delaware Mountain Group sandstones and an upper interval of the Queen formation sandstones. The injection target would be at a depth of between 0.4 mile to 1 mile (0.6 to 1.6 kilometers). These sandstone intervals are separated by an intermediate seal that consists primarily of non-porous and impermeable carbonates of the Goat Seep Limestone. The upper injection horizon is overlain by a 700-foot (213-meter) thick primary seal, the Queen-Seven Rivers formation.

Table 2-4. Odessa Site Features

Feature	Description
Sequestration Site Characteristics and Predicted Plume Radius (continued)	To estimate the size of the plume of injected CO_2, the Alliance used numerical modeling to predict the plume radius from the proposed injection wells. This modeling estimated that the plume radius at the proposed Odessa injection site could be as large as 1 mile (1.6 kilometers) per well after injecting 1.1 million tons (1 MMT) of CO_2 annually for 50 years. The dispersal and movement of the injected CO_2 would be influenced by the geologic properties of the reservoir and it is unlikely the plume would radiate in all directions from the injection point in the form of a perfect circle. However, for reference purposes, this modeled radius corresponds to a circular area equal to 2,136 acres (864 hectares). A minimum of three wells would be required to support a constant 1.1 million tons (1 MMT) per year injection rate. A minimum of eight wells would be needed to support a 2.8 million tons (2.5 MMT) per year injection rate. Assuming a total of 55 million tons (50 MMT) of CO_2 is injected, the total plume area would be 6,980 acres (2,825 hectares) assuming eight wells would be required to inject 2.8 million tons (2.5 MMT) per year for the first 20 years of a 50-year time period. A slightly smaller area (6,073 acres [2,458 hectares]) would be required if only three wells were needed to inject 1.1 million tons (1 MMT) per year for each year in a 50-year time period.
Utility Corridors	
Potable Water	Potable water would potentially be obtained through the same sources identified for process water.
Process Water	Process water could be acquired by developing new well fields or from several existing well fields that draw water from the Ogallala, Pecos Valley, Edwards-Trinity Plateau, Dockum, or Capitan Reef aquifers. Six existing well fields have been identified that could deliver water to the site, ranging from 24 to 54 miles (38.6 to 86.9 kilometers) from the proposed power plant site (straight-line distance). Any of these six potential sources would require pipeline construction along new ROWs.
Sanitary Wastewater	Sanitary wastewater would be treated and disposed of through construction and operation of a new on-site sanitary WWTP. Effluent from the WWTP would be treated and disposed of in accordance with local and state regulations or recycled back into the proposed power plant for use as process water.
Electric Transmission Lines	The proposed power plant would connect with one of two 138-kV transmission lines, one approximately 0.7 mile (1.1 kilometers) on new ROW and the second approximately 1.8 miles (2.9 kilometers) on existing ROW from the proposed site. In either case, the interconnection would only require the construction of a substation and a short transmission line to tie into these lines. The southern corridor would follow an existing ROW along FM 1601, which borders the proposed site, while a new ROW would be required for the northern route option.
Natural Gas	The proposed power plant would tap an existing natural gas pipeline that traverses the proposed plant site and that is owned and operated by ATMOS Energy.
CO_2 Pipeline	The proposed injection wells would be located on 42,300 acres (17,118 hectares) of University of Texas lands, 58 miles (93.3 kilometers) south of the proposed Odessa Power Plant Site. CO_2 would be transported in (and co-mingled in) an existing regional 16-inch (40.6-centimeter) diameter CO_2 pipeline just east of the plant site operated by Kinder Morgan CO_2 Company. Two miles (3.2 kilometers) of new CO_2 pipeline would connect the proposed power plant site to the existing pipeline, and approximately 7 to 14 miles (11.3 to 22.5 kilometers) of new pipeline would connect the existing CO_2 pipeline to the proposed injection sites. Because multiple injection wells would be used, intra-well piping would be required to connect the wells to the pipeline.

Table 2-4. Odessa Site Features

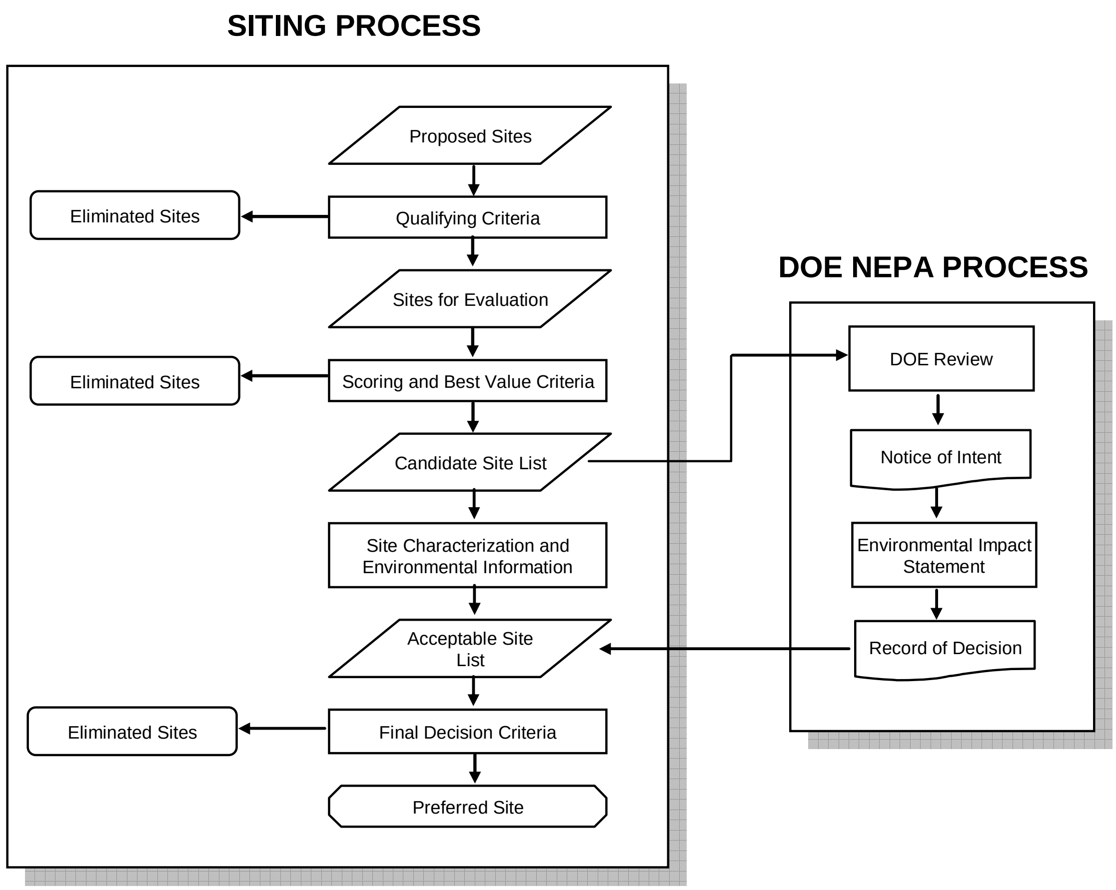
Feature	Description
Transportation Corridors	The southern border of the proposed plant site is less than 0.5 mile (0.8 kilometer) from I-20, with an improved roadway that borders the property. A Union Pacific Railroad line runs along the southern border of the site. Deliveries to or from the proposed site could be accomplished by either rail or truck. Texas is located in the West South Central Demand Region for coal, which also includes Louisiana, Arkansas, and Oklahoma. According to the Energy Information Administration (EIA, 2000), the West South Central Demand Region receives the majority of its coal resources from the PRB and the Rockies. In 1997, the average distance that a coal shipment traveled to reach a destination in this region was about 1,300 miles (2,092 kilometers) (EIA, 2000). In terms of a straight-line distance, Odessa is approximately 1,250 miles (2,012 kilometers) from the Pittsburgh Coalbed (south-central Ohio in the northern Appalachian Basin), 900 miles (1,448 kilometers) from the Illinois Basin (southern Illinois), and 800 miles (1,287 kilometers) from the PRB (eastern Wyoming). While no sources of coal or lignite are available near the proposed plant site, Texas does have several coal mines in the eastern and southern portions of the state. The closest operating Texas coal mine is the Eagle Pass Mine, approximately 250 miles (402 kilometers) to the southwest of Odessa.

Source: FG Alliance, 2006e (unless otherwise noted).

2.4.5 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

2.4.5.1 Site Selection Process

On December 2, 2005, the Alliance entered into a Limited Scope Cooperative Agreement with DOE for the Alliance to begin the site selection process and prepare a conceptual design for the proposed FutureGen Project. The Alliance developed siting criteria, issued a Request for Proposals (RFP), evaluated proposals received, and visited each proposed site. DOE reviewed Alliance activities at each step in the process to ensure fairness, openness, and technical accuracy. DOE also reviewed the process at each step to ensure that all reasonable alternative sites would be evaluated by DOE in the NEPA process. Figure 2-15 shows an overview of the siting process, which is discussed in detail below.



Source: Adapted from FG Alliance, 2006a

Figure 2-15. Alliance Siting Process

2.4.5.2 Siting Criteria

Beginning in December 2005, the Alliance Siting Team developed criteria to select sites that could be considered for the FutureGen Project. This Siting Team consisted of scientists, engineers, and others who are either employees of the Alliance member companies, consultants to the Alliance, members of Technical Committees, or employees of Battelle Memorial Institute, the primary support contractor for the Alliance. The Technical Committees are advisory groups of experts, such as distinguished industry consultants, members of academia, employees of national laboratories, and representatives of industry-related organizations. The criteria, which were reviewed and approved by DOE, focused on the goals and objectives for the FutureGen Project, including the need to expeditiously demonstrate a viable CO_2 capture and geologic storage process that would address an issue of national and international importance. In particular, the Siting Team drafted criteria to identify and avoid potential technical, engineering, and environmental challenges that could affect the schedule and success of the FutureGen Project.

Three types of criteria were established:

- Qualifying criteria – Criteria that each site would have to meet before being considered further - failure to meet any criterion resulted in disqualification;
- Scoring criteria – Criteria that would allow sites to be ranked based on the extent to which they possessed desirable features; and
- Best value criteria – Criteria that were not capable of being quantitatively scored, but that represented factors the Alliance would consider when choosing a site that could best fulfill the Project's mission.

The Alliance developed criteria for both the power plant (surface) and geologic storage (subsurface) components and later revised these criteria based on comments from subject-matter experts. The Alliance also sought, received, and considered input from outside stakeholders, including regulatory agencies and environmental groups, through selected interviews and comments received during the formal public comment period. DOE reviewed the rationale and participated in meetings to discuss each criterion before the Alliance published the draft RFP for public comment. The criteria are found in the FutureGen Alliance ***Request for Proposals for the FutureGen Facility Host Site*** (http://www.futuregenalliance.org/news/futuregen_siting_final_rfp_3-07-2006.pdf) (FG Alliance, 2006a) and in the ***Results of Site Offeror Proposal Evaluation*** report dated July 21, 2006 (FG Alliance, 2006a).

2.4.5.3 Request for Proposal

The qualifying, scoring, and best value criteria were included in a draft RFP that the Alliance posted to its website (FG Alliance, 2006f) on February 14, 2006, for public review and comment. The Alliance accepted comments regarding the draft RFP until February 28, 2006. Responses to the comments received were posted to the website. The final RFP, revised in accordance with comments received and other considerations, was posted to the Alliance website on March 7, 2006. The Alliance accepted clarifying questions regarding the final RFP until March 16, 2006. Responses to questions received were posted to the website and, in response to the clarifying questions, minor amendments to the final RFP were posted to the website on March 20 and 24, 2006. The final RFP stated that the deadline for proposal submittals was May 4, 2006.

2.4.5.4 Site Proposals Received

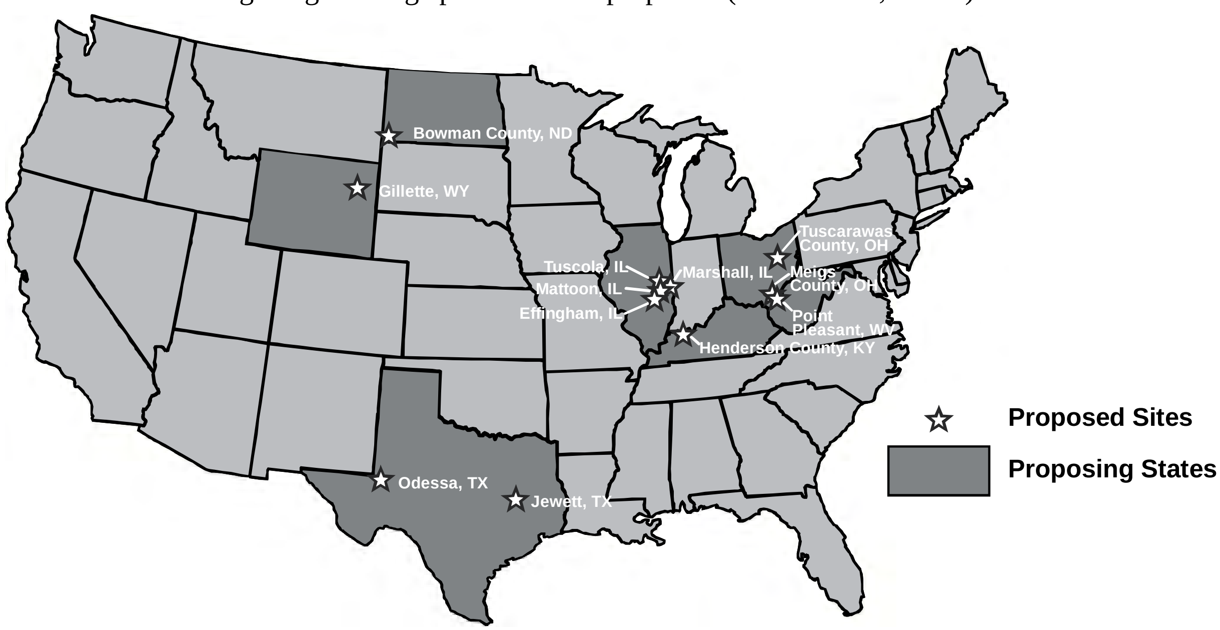
The Alliance received 12 proposals from seven states (see Figure 2-16). The proposals included[1]:

- Illinois – Effingham Site
- Illinois – Marshall Site
- Illinois – Mattoon Site
- Illinois – Tuscola Site
- Kentucky – Henderson County Site
- North Dakota – Bowman County Site
- Ohio – Meigs County Site
- Ohio – Tuscarawas County Site
- Texas – Jewett Site
- Texas – Odessa Site
- West Virginia – Point Pleasant Site
- Wyoming – Gillette Site

After an initial review of the 12 proposals, the Alliance visited each site to verify that the proposals fairly represented the condition at the site.

2.4.5.5 Proposal Evaluation

The Alliance Siting Team created two Proposal Evaluation Teams. One team evaluated the proposals based on criteria related to the power plant site, and the other team evaluated the proposals based on criteria related to geologic storage. Both Evaluation Teams included outside experts. Three outside experts from Sargent & Lundy, L.L.C. assisted with the evaluation of the power plant site proposals. Two outside experts from Lawrence Berkeley National Laboratory and Montana State University assisted with the evaluation of the geologic storage portion of the proposals (FG Alliance, 2006a).



Source: FG Alliance, 2006a

Figure 2-16. Map of Offered Sites

[1] Some site offerors submitted proposals under different titles than shown above. For example, the Jewett Site was submitted for consideration under the title "Heart of Brazos" because it is located within the jurisdiction of both the Heart of Texas and the Brazos Valley Councils of Government. In addition, the Illinois sites (Mattoon and Tuscola) included the landowner's last name as part of the site name (i.e., Mattoon-Dole and Tuscola-Pflum). For consistency within this EIS, all alternative site locations will be referred to according to the name of the closest city.

2.4.5.6 Qualifying Criteria Review

The Evaluation Teams carefully examined each proposal to assess compliance with qualifying criteria. During this review, the Alliance generated clarifying questions for each of the site offerors. The questions were submitted to individual offerors on May 18, 2006, by e-mail. All offerors submitted their responses by the deadline of May 24, 2006 (the original deadline of May 23 was extended by one day at the request of one offeror). After review of the responses to questions, as well as the original proposals, the Evaluation Teams determined that four sites did not satisfy all of the qualifying criteria. The Alliance Board of Directors reviewed this conclusion during conference calls on May 24 and May 30, 2006. After thorough discussions, the Board concurred with the Evaluation Team's conclusions and voted to exclude the four sites from further consideration in the proposal evaluation process.

The four sites that did not meet all of the qualifying criteria were:

- North Dakota – Bowman County Site
- Ohio – Meigs County Site
- West Virginia – Point Pleasant Site
- Wyoming – Gillette Site

Some sites did not qualify based on more than one criterion. The reasons for excluding these four sites were:

- One site was located within 60 miles (96.6 kilometers) of the boundary of a Mandatory Class I Visibility Area. Minimizing or avoiding environmental impacts is a major mission of the FutureGen Project. The 60-mile (96.6-kilometer) distance was selected based on "Prevention of Significant Deterioration" requirements that discourages siting a source of air pollutant emissions within 60 miles (96.6 kilometers) of a Class I visibility area, and the 60-mile (96.6-kilometer) buffer is based on standard industry practice.
- Two sites proposed CO_2 injection wells that would be less than 10 miles (16.1 kilometers) from public access areas (defined as a state park or national park or preserve, national monument, national seashore, national lakeshore, national wildlife refuge, designated wilderness area, designated wild and scenic river, or study area for any of the preceding designations) or sensitive features such as large dams, water reservoirs, hazardous materials storage facilities, and Class I injection wells. Based on the professional judgment of technical experts, the Alliance concluded that a 55-million-ton (50 MMT) CO_2 plume would have a very low probability of migrating 10 miles (16 kilometers) or more from the bottom hole of an injection well. Because this would be a first-of-a-kind demonstration project, 10 miles (16 kilometers) was selected as a conservative safe distance.
- One site had a public access road and a railroad traversing it and thus did not meet the minimum 200 contiguous-acres (81 contiguous-hectares) site requirement. The Alliance based this minimum acreage requirement on the area required for typical power plants, while taking into account the FutureGen Project's need for additional space for multiple coal piles, research facilities, and carbon capture facilities.
- The proposed sequestration reservoir for one site met the definition of an underground source of drinking water because it was specified as having fewer than 0.08 pound/gallon (10,000 milligrams/liter) total dissolved solids. This criterion was designed to protect current and future sources of drinking water.

2.4.5.7 Scoring Criteria Review

For the remaining eight sites that met all qualifying criteria (qualifying sites), each team member individually scored each proposal using the scoring criteria, scales and weights established in advance of the receipt of the proposals. Each Evaluation Team then conferred and identified areas of difference for further discussion and resolution.

During the period of June 6 through 8, 2006, all Evaluation Team members, including the outside technical experts, met in Richland, Washington, for an internal workshop with members of the Alliance Technical Committee observing the meeting. During this meeting, the Evaluation Team developed and submitted a set of clarifying questions for one site offeror (Illinois-Marshall), and a response was received by the June 12, 2006, deadline set by the Alliance.

The scores for each site were tabulated and a final score was derived for each scoring criterion for each site. Ranked lists of sites for both the power plant and the geologic storage area were generated and combined to develop a ranked list of qualified sites. The summaries for this scoring process are found in the FutureGen Alliance report *Results of Site Offeror Proposal Evaluation* dated July 21, 2006 (FG Alliance, 2006a).

Site visits were conducted in late May 2006. A Site Visit Team made inquiries in the following areas regarding each proposed site during the site visit:

- Coal supply environment/delivery mode flexibility
- Road access
- Distance to rail/barge delivery
- Access to natural gas pipeline
- Cultural resources
- Air dispersion
- Grid proximity
- ROW
- Voltage
- Proximity to public access areas
- Proximity to Tribal lands
- Proximity to proposed target formation(s)
- Physical access to area above geologic storage (e.g., roads)
- Presence of mines, landfills, wells above geologic storage area
- Sensitive receptors over geologic storage area
- Background CO_2 sources

The Site Visit Team presented the results of the site visits to the Proposal Evaluation Teams and members of the Alliance Technical Committee during the Richland internal workshop. The site visits confirmed the information in the proposals, identified some additional information, and were used to inform the Alliance's consideration of the proposals.

2.4.5.8 Best Value Criteria Review

The RFP asked site offerors to submit a narrative discussion regarding several best value criteria. These criteria relate to:

- Land cost
- Availability/quality of existing plant and target formation characterization data
- Land ownership
- Residences or sensitive receptors above target formation
- CO_2 title and indemnification
- Market for H_2
- Waste recycling and disposal
- Clean Air Act compliance
- Expedited permitting
- Transmission interconnection
- Background CO_2 data
- Power sales
- Other considerations

The responses provided by the site offerors to the best value criteria were summarized and compared. The Alliance Board of Directors reviewed this material and used it, along with the scoring results, to develop the Candidate Site List.

2.4.5.9 Candidate Site List

The Alliance concluded that it was imperative for the success of the FutureGen Project that candidate sites offer: (1) an acceptable location for siting a power plant; (2) at least one acceptable geologic storage formation; and (3) minimal risks of schedule delays or project failure. Based on this assessment, the Alliance determined that four of the eight qualified sites met these three requirements. The reasons for screening out the other four qualified sites are discussed below.

Of the eight sites that met all of the qualifying criteria, three scored substantially lower than the others, taking into account the results of both the power plant site and the injection site scoring criteria. Overall, these three sites achieved relatively low scores in the following areas and were excluded from further consideration:

- Proximity to sensitive areas;
- Distance to transmission lines and to transportation for material and fuel delivery;
- Penetrations of secondary seals for the target formation;
- Target formation properties, especially the extent of the plume area and the number of wells needed to meet the injection target;
- Ability to meet monitoring, mitigation, and verification (MM&V) requirements (see Section 2.5.2.2); and
- Additional regulatory requirements that would be imposed.

The Alliance also determined that one of the remaining five top-scoring sites posed substantial problems for construction given its relatively small size and the configuration of the site. Experts in power plant siting concluded that it would be difficult to construct a rail loop for coal delivery at the proposed site. This site was also located close to residential areas, which raised land use compatibility concerns. The net effect of the best value criteria was to weaken the standing of this site after the initial scoring and it was subsequently eliminated from the Candidate Site List (FG Alliance, 2006a).

At the end of the process, the Alliance removed the following qualified sites from consideration based on the application of the scoring and best value criteria under the Alliance's evaluation system:

- Illinois – Effingham
- Illinois – Marshall
- Kentucky – Henderson
- Ohio – Tuscarawas

The remaining four sites made the Candidate Site List. These four sites met all of the qualification criteria and scored highly in the opinion of the Evaluation Team. Furthermore, considering all of the information submitted, including information submitted for the best value criteria and the findings of the Site Visit Team, the Alliance found that these sites offer: (1) an acceptable location for siting a power plant; (2) at least one acceptable geologic storage formation; and (3) minimal risks of schedule delays or project failure. Therefore, the Alliance concluded that 4 of the original 12 sites proposed could be acceptable to host the proposed FutureGen Project and that the sites appear reasonable from a technical, environmental, and economic perspective. Best value criteria would be applied again to information provided by the site offerors during the final selection of a host site, should DOE approve the Proposed Action and more than one alternative site.

At the conclusion of the review of proposals, the Alliance provided DOE with a report (FG Alliance, 2006a) that describes the screening process, the results of the screening process, and identifies the sites that the Alliance concludes are candidates.

DOE reviewed the Alliance's report on the selection process (FG Alliance, 2006a) for fairness, technical accuracy, and compliance with the established approach. DOE concluded that the process met these requirements and determined that the Alliance's Candidate Site List, including the four sites described in Section 2.4, is the appropriate list of reasonable alternative sites for detailed analysis in this EIS.

The reasonable alternative sites are (in no order of preference):

- Mattoon, Illinois
- Tuscola, Illinois
- Jewett, Texas
- Odessa, Texas

2.4.6 TECHNOLOGY OPTIONS ELIMINATED FROM FURTHER CONSIDERATION

Pursuant to the President's FutureGen Initiative, DOE determined that all project alternatives must use coal as fuel, produce electricity, produce H_2, meet very low target emission rates, and capture and store emissions of greenhouse gases (GHGs). Therefore, DOE determined that reasonable alternatives would not include:

- Super-critical pulverized coal power plant technology – By using a single-step complete combustion process (unlike IGCC), these plants cannot produce significant quantities of H_2 without suffering an unreasonably large efficiency penalty when using the produced electricity to generate H_2 (e.g., by electrolysis).
- Integrated gasification fuel cell power plant technology – Project risk levels are too high given that fuel cells are not sufficiently developed at the size required for this project.
- Nuclear power plant technology – These plants do not use coal, which is a low-cost and abundant fuel resource. This option also does not allow an opportunity to demonstrate the capture and storage of GHG emissions.
- Renewable resource technologies (which do not use coal and do not allow an opportunity to demonstrate the capture and storage of GHG emissions including wind power, wave power, geothermal energy, solar energy, and biomass combustion). Other DOE programs and projects aim to further the development of renewable resource technologies as part of DOE's diverse portfolio of energy research, development, and demonstration efforts.
- Energy efficiency improvement technologies (e.g., through conservation and improvements in demand-side efficiencywhich do not generate H_2 or electricity from coal. However, increasing energy efficiency does complement the goals of the FutureGen Project to help reduce emissions of CO_2 and other GHGs from coal-fueled energy production.

Many of the technologies eliminated from consideration are addressed by other programs and projects in DOE's diverse portfolio of energy research, development, and demonstration efforts. These technologies, along with increasing energy efficiency, complement the goals of the FutureGen Project to help reduce emissions of CO_2 and other GHGs from coal-fueled energy production.

Geologic sequestration was identified as a reasonable alternative for meeting the requirement of reduced GHG emission. Other sequestration alternatives considered, but eliminated, include:

- Deep ocean sequestration – Deep ocean sequestration is the deliberate injection of captured CO_2 into the ocean at great depths where it could potentially be isolated from the atmosphere for centuries (IPCC, 2005). This technology currently exists; however, the knowledge base is inadequate to determine what biological, physical, or chemical impacts might occur from interactions with the marine ecosystem.

- Terrestrial sequestration – Terrestrial sequestration is the process of atmospheric CO_2 absorption by trees, plants, and crops through photosynthesis and storage as carbon compounds in biomass (tree trunks, branches, foliage, and roots) and soils. While terrestrial sequestration may be an attractive and useful sequestration option, the uncertain long-term accountability and permanence of CO_2 storage and the inability to directly store the CO_2 captured from power plants makes this option unlikely to be implemented in the electrical power industry (NETL, 2007).
- Mineral sequestration – Mineral sequestration is the process of reacting CO_2 with metal oxide-bearing materials (typically minerals like forsterite or serpentine) to form insoluble stable carbonates, with calcium and magnesium being the most commonly used metals (IPCC, 2005). The main challenge for mineral sequestration is developing a commercial process for reaction of the naturally occurring minerals with CO_2 to form carbonates. Even though the reaction is thermodynamically favored, it is extremely slow in nature, and therefore, its economic viability is uncertain (Herzog, 2002).

DOE also considered, but eliminated the alternative of attaching CO_2 capture devices and sequestration facilities to an existing or planned commercial power plant. Such an approach could meet the FutureGen Project's objectives without the cost of planning, designing, and building a new power plant. However, this alternative was eliminated for the following reasons:

- Existing or planned non-IGCC power plants – Almost all non-IGCC power plants are not sufficiently pressurized to reduce the efficiency penalty associated with capture and compression of CO_2. In addition, these plants cannot produce appreciable quantities of H_2 without suffering an unreasonably large efficiency penalty when using the produced electricity to generate H_2 (e.g., by electrolysis).
- Existing or planned IGCC power plants – Owners of these plants have not volunteered their existing or planned IGCC power plants for the FutureGen Project. Existing plants would not be able to accommodate equipment for pre-combustion capture of CO_2 from synthesis gas without extensive modification, and would not have the necessary features that create a research platform to meet the FutureGen Project's research, development, and demonstration objectives.

Owners of existing and planned power plants, including IGCC plants, would not accept the financial and operational risks associated with adding CO_2 capture devices and experimental geologic sequestration to their plants. Commercial ventures generally cannot accept the intensive testing and interruptions of power generation that would be associated with the research and development activities of the FutureGen Project. Commercial operators are bound by power purchase agreements that are unforgiving of delivery failures, and the power market does not offer much flexibility in negotiating the terms and conditions in these agreements. While the idea of "attaching" the FutureGen Project to an existing or planned IGCC power plant is technically feasible, it is unreasonable from a business perspective.

On April 21, 2003, DOE published a Request for Information in the ***Federal Register*** (68 FR 19521) openly inviting expressions of interest from organizations capable of implementing the FutureGen Project. Only one qualifying group (the Alliance) submitted an expression of interest. No existing or planned power plant operators offered to modify their plants to achieve the FutureGen Project goals.

To meet the FutureGen Project objectives, DOE requires advancements in the facility's design, experimentation in a near-laboratory setting (including experimentation in a test platform), and operational technology development (at a full-scale and at a reduced scale in available side streams and slip streams). These advancements would be more appropriate for a research platform, such as the FutureGen Project, rather than an existing commercial power plant.

2.5 THE FUTUREGEN PROJECT

This section describes specific FutureGen technologies and activities. The FutureGen Project is in the early stages of design and, although the major features of the project are known, many engineering and planning details are still in the developmental stage. The Alliance developed reference design information and bounding conditions for use in this EIS. Where appropriate, design uncertainties and bounding conditions used are indicated in this EIS. As the conceptual design work progresses, the Alliance would make decisions on the incorporation of specific technologies consistent with the overall project goals. Future activities that would be undertaken are described in Section 2.6.

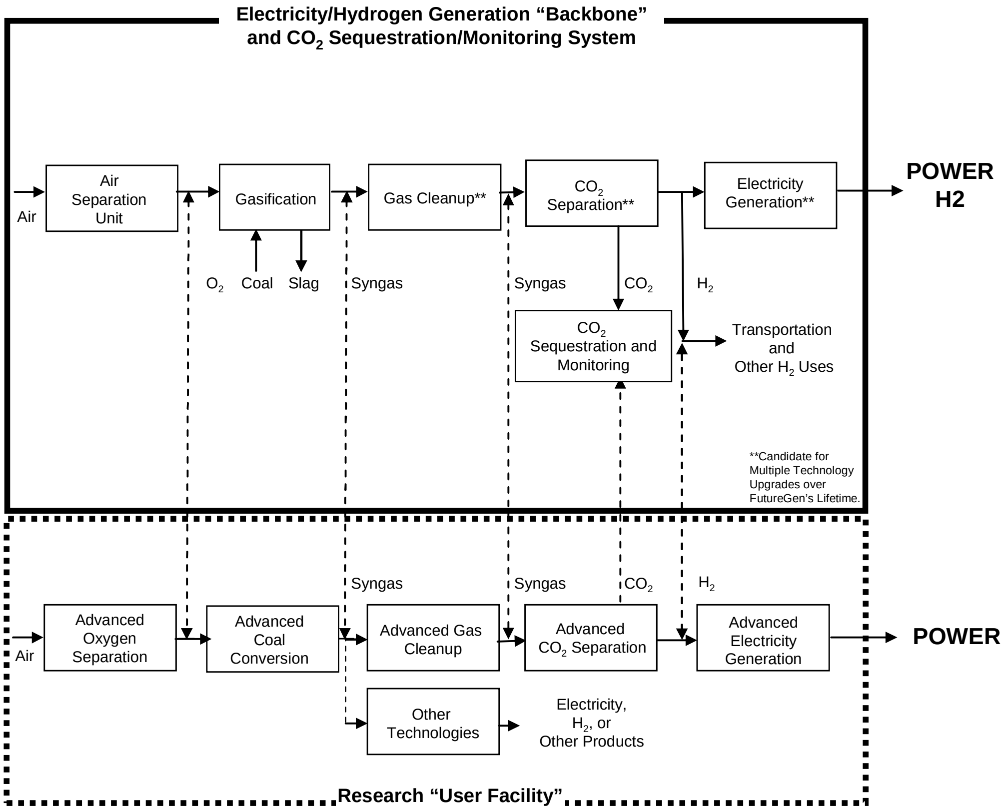
2.5.1 POWER PLANT AND RESEARCH FACILITY

The FutureGen Power Plant would be a 275-MW output IGCC system. The major components of this system are illustrated in Figure 2-17 and an example plant layout is provided in Figure 2-18.

The following sections provide general descriptions of each feature including coal handling equipment, gasifier, syngas cooling, syngas conditioning, combined cycle power system, flare, cooling towers, and the zero liquid discharge (ZLD) system. Because the facility is in the early stages of design, the specific types, makes, and models of equipment have not been determined.

Planned research, development, and demonstration activities (see Figure 2-19) would use all elements of the facility, including the backbone power generation train, an optional side-stream power train (see discussion on Case 3B later in this section), a sub-scale test platform (or test bay), and the CO_2 sequestration facility located outside the power plant. In addition to research and development on power plant technologies, the FutureGen Project could serve as the premier platform for testing and deploying new technologies related to CO_2 storage, retention, and monitoring, and for developing a critical understanding of reservoir structure, chemistry, and performance.

The "backbone" refers to the equipment train necessary to fulfill the major objective of the FutureGen Project (i.e., commercial-scale, power generation with a minimum of 1.1 million tons [1 MMT] of CO_2 captured and stored per year). The facility's test platform and optional side-stream power train would enable full-scale module testing as well as sub-scale testing of new components and systems using syngas, H_2, or other chemicals produced by the facility. While design and construction of the facilities required to allow such testing to occur are part of the Proposed Action, the use of the test platform would be funded outside the scope of the FutureGen Cooperative Agreement.



Source: Adapted from FG Alliance, 2007.

Figure 2-19. FutureGen Power Plant Overview

Prototype testing of advanced technologies would be considered in the following areas:

- Fuel Processing Power Plant – Electric power production, H_2 production and carbon capture
  - Coal feed – Tests of high pressure, continuous dry coal feed systems have the potential to reduce equipment cost and improve plant efficiency. Current dry feed systems use lock hoppers, which result in multiple vessels and cyclic operation to achieve continuous feed.
  - Oxygen supply (air separation) – Use of ceramic membrane technology for separating oxygen (O_2) from air offers the opportunity to reduce capital cost and reduce auxiliary power consumption relative to conventional cryogenic air separation technology.
  - Syngas preconditioning – The syngas composition is shifted to maximize the CO_2 concentration for removal. Advanced technologies are proposed that would allow for shifting the syngas composition and separating the CO_2 in the same unit operation, thus simplifying the process.
  - Syngas cleaning – Particulate, sulfur, halides, alkali, ammonia (NH_3), mercury (Hg), and other trace metal compounds are removed in the syngas cleaning sub-system. Cleaning can be achieved today with processes operating at low temperature. Advanced technologies are being developed to allow this cleaning to occur at an elevated temperature to retain the water content in the syngas. This results in increased plant efficiency. Lower capital cost also could be possible with these advanced technologies.
  - CO_2 removal/separation – There are many advanced concepts being developed that have the potential to reduce the cost of removing CO_2 from the shifted syngas stream. The CO_2 can be removed by separating CO_2 or H_2. Advanced technologies include membranes (e.g., ceramic, polymer, metal), solid sorbent materials, and solvents. Technology that operates at elevated

temperatures can be combined with the advanced syngas cleaning technology to realize benefits in overall plant efficiency.
    - Power systems – The electric power is currently generated through the use of gas turbines and steam turbines. Advanced gas turbine technology would allow for increased plant efficiency using H_2 rich fuel and would also be designed to achieve reduced nitrogen oxide (NO_x) emissions. Fuel cells (e.g., solid oxide fuel cells) are being developed that have the potential to increase plant efficiency by incorporating this technology with the turbine technology.
    - Water management – Advances in this area include advanced cooling technology, water recovery, and non-traditional water use for cooling. Examples of benefits include recovery and reuse of heat to improve plant efficiency; use of lower quality water and allowing the wastewater to be concentrated for zero water discharge; recovery of water lost in wet cooling tower plumes for reuse in the plant; and water management concepts to minimize the use of water.
- Carbon Sequestration
    - Power plant/sequestration integration – The proposed FutureGen Project would allow for operating an integrated plant with power production, H_2 production, carbon capture, and CO_2 sequestration. Advances in process operation and control would be tested and would provide opportunities for advanced sub-system technology.
    - Monitoring and mitigation – The monitoring system is important to verify the injected CO_2 has been sequestered, to track the fate of CO_2 over time, to provide data to confirm predictive models, and to detect leakage of CO_2. Technology is available to perform these tasks. Advanced technologies will provide opportunities to advance the automation of monitoring and to reduce the cost
    - Reservoir modeling and science – The FutureGen Project would collect extensive data on the fate of CO_2 and the environment containing the CO_2. These data would enable advances in reservoir modeling and our understanding of the science associated with sequestration phenomena.
    - Sequestration of hydrogen sulfide (H_2S) gas with CO_2 co-sequestration – The ability to co-sequester CO_2 and H_2S provides an opportunity to achieve greater improvements in plant efficiency and reduced capital cost. This facility allows for understanding the potential for this option through analysis and modeling that would determine design and operation requirements to meet project requirements and testing based on these analyses.

The FutureGen Project would also function as a platform for testing and deploying new concepts related to CO_2 storage, monitoring, and leak mitigation. The FutureGen Project would provide an opportunity to develop a critical understanding of reservoir structure, chemistry and performance. A preliminary monitoring scheme and descriptions of these monitoring techniques are discussed in Section 2.5.2.2. The research strategy would be designed to advance the science and engineering of geologic sequestration in the following areas:

- Processes of fluid flow and fluid momentum, conservation of mass, and energy fluxes in complex, heterogeneous porous rock and fractured rock, including large-scale connectivity and flow characteristics;
- Coupled thermal-hydraulic-mechanical-chemical processes and feedbacks;
- Transmission of stresses and impacts of stresses on CO_2 transport and containment;
- Projection of system response over large areas through remote sensing and monitoring, data integration, and reservoir modeling;
- Automated controls linking the power plant to the CO_2 storage reservoir to ensure safe and economical operations;
- Strategies to improve injection or CO_2 trapping; and
- Sequestration of CO_2 with other gases, such as H_2S with CO_2.

Coal Handling Equipment

Coal handling equipment unloads, conveys, prepares, and stores coal delivered to a power plant. The equipment used for an IGCC plant is largely the same as that used at a conventional coal-fueled power plant. The coal is crushed or pulverized before feeding into the gasification system. Some systems dry feed the coal through lock hoppers, while others feed the fuel in a coal-water slurry (Rosenberg et al., 2005). The coal feed method for the FutureGen Project would depend upon the type of gasifier selected by the Alliance (see Table 2-5).

Coal would be transported to the facility by rail (see Section 2.5.5.1). The unloading would be done by a "rapid rail" type unloading system utilizing bottom dump railcars that travel continuously at a slow speed and unload the coal into two receiving hoppers below the rail. Coal would then be withdrawn from each hopper by a single belt feeder. The coal would then be discharged from the belt feeder onto a belt conveyor that includes a belt scale and an "as-received" sample system. The coal would then be conveyed to a transfer tower where it would be directed either to a main storage pile or onto an emergency storage pile (FG Alliance, 2007). A detailed discussion of unloading and loading activities are discussed in Volume II for each site in Sections 4.14, 5.14, 6.14, and 7.14. Coal would be stored on site in two piles, each providing a 15-day supply, or as one long coal pile of similar size. The coal piles would be either covered or uncovered, depending on operational, environmental, and economic considerations. If covered, the conceptual design allows for the possibility of a Quonset hut-type building for on-site coal storage. Approximate dimensions would be 600 feet (182.9 meters) long by 50 feet (15.2 meters) wide by 75 feet (22.9 meters) high.

Gasifier

The gasification process would combine coal, O_2, and steam to produce a H_2-rich synthesis gas or "syngas." After exiting the gasifier, the composition of the syngas, predominantly H_2 and carbon monoxide (CO), would be "shifted" to produce additional H_2. The product stream would consist mostly of H_2, steam, and CO_2. After separation of these three gas components, the H_2 would be used to generate electricity in a gas turbine or fuel cell. A slip stream of H_2 would also be available for use in on-site research and development activities. Steam from the process would be condensed, treated, and recycled into the gasifier or added to the plant's process water circuit. The separated (i.e., captured) CO_2 would be permanently sequestered.

Gasifiers of the types envisioned for the FutureGen Project operate at high temperatures (2,000 to 3,000°F (1,093°C to 1,649°C) and elevated pressures (400 to 1,000 psi [2,758 to 6,895 kPa]) in the presence of O_2 gas and steam. While performance estimates developed under the conceptual design incorporate technologies that are considered commercial in nature, the actual selection of technologies would occur as a result of an open solicitation. Vendors would be encouraged to propose the most advanced design that fits the requirements and mission of the FutureGen Project.

Table 2-5. Power Plant Technology Cases under Evaluation for the FutureGen Project

Process or Component	Case 1	Case 2	Case 3	
			Unit A[1]	Unit B
Combustion Turbine	Frame 7FB	Frame 7FB	Frame 7FB	SGT6-3000
Gasifier Technology	Entrained Flow with Water Quench	Entrained Flow with Water Quench	Entrained Flow with Water Quench	Transport
Oxidant	95 mole percent Oxygen	95 mole percent Oxygen	95 mole percent Oxygen	TBD mole percent Oxygen

Table 2-5. Power Plant Technology Cases under Evaluation for the FutureGen Project

Process or Component	Case 1	Case 2	Case 3	
			Unit A[1]	Unit B
ASU	Cryogenic	Cryogenic	Cryogenic	Ion Transport Membrane
Coal	Pittsburgh Illinois PRB	Pittsburgh Illinois PRB	Pittsburgh Illinois PRB	Pittsburgh Illinois PRB
Coal Feed	Slurry	Dry	Slurry	Dry
H_2S Separation	Physical Solvent 1st Stage	Physical Solvent 1st Stage	Physical Solvent 1st Stage	Chemical Solvent
Sulfur Removal (minimum)	99 percent	99 percent	99 percent	99 percent
Sulfur Recovery	Claus Plant/ Elemental Sulfur	Claus Plant/ Elemental Sulfur	Claus Plant/ Elemental Sulfur	Claus Plant/ Elemental Sulfur
CO_2 Separation	Physical Solvent 2nd Stage	Physical Solvent 2nd Stage	Physical Solvent 2nd Stage	Physical Solvent 2nd Stage
CO_2 Capture (minimum)	1 million tpy (0.9 million mtpy), 90 percent	1 million tpy (0.9 million mtpy), 90 percent	1 million tpy (0.9 million mtpy), 90 percent	1 million tpy (0.9 million mtpy), 90 percent
CO_2 Sequestration	Plant Gate, 2200 psig(15,168 kPa)	Plant Gate, 2200 psig (15,168 kPa)	Plant Gate, 2200 psig (15,168 kPa)	Plant Gate, 2200 psig (15,168 kPa)
H_2 Production	835 lb/h (378.7 kg/h) at 100 percent purity	835 lb/h (378.7 kg/h) at 100 percent purity	835 lb/h (378.7 kg/h) at 100 percent purity	None

[1] Case 3A differs from Case 1 in that its gasifier and coal handling systems were sized for maximum coal feed rates. The larger feed rates would provide enough syngas production to fully load the combustion turbine regardless of the type of coal used.
ASU = air separation unit; TBD = To be determined; tpy = tons per year; mtpy = metric tons per year; psig = pounds per square inch gauge measurement;
kPa = kilopascal; lb/h = pounds per hour; kg/h = kilograms per hour.
Source: FG Alliance, 2007.

Due to advantages in gas cleanup economics as well as combustion turbine requirements, it is expected that the FutureGen Project would be a high-pressure O_2-blown facility. O_2-blown gasification requires supplying a stream of compressed O_2 gas (rather than air) to the gasification reactor. Commercially available O_2 plants, commonly called an air separation unit, operate at very low temperatures (cryogenic). Cryogenic O_2 production is an established commercial process that is used extensively worldwide (Rosenberg et al., 2005). Recent advances in membrane air separation have shown promise, and the Ion Transfer Membrane O_2 system is one advanced technology that has shown merit for inclusion in some capacity at the FutureGen Project.

Slag and **ash** are residues produced by the combustion of coal. Slag is heat-fused material that accumulates on the sides and bottom of a gasifier and is removed periodically. Ash includes solids produced from the bottom of the gasifier (bottom ash) and solids entrained with the syngas (fly ash). The slag or ash would be recycled for beneficial use or disposed of according to environmental regulations.

The FutureGen Project would generate up to 96,865 tons (87,875 metric tons) of slag and ash per year, of which 47,565 tons (43,151 metric tons) would be ash. Slag and ash are residues produced by the combustion of coal. Whether slag is formed depends on the type of gasifier. Gasifiers that operate at temperatures exceeding coal fusion temperature are termed "slagging." The FutureGen Project is considering both slagging and non-slagging gasifier options. If a local market exists, the slag or ash would be transported off site to a recycling facility or manufacturer that could recycle it into a beneficial product. Alternatively, the slag or ash could be disposed of off site at a commercial landfill or at an on-site landfill, if one is constructed. The quantity of slag or ash would increase by 49 percent if Case 3B were implemented although this option is considered unlikely.

Syngas Cooling

Coal gasification systems operate at high temperatures and produce raw, hot syngas. Typically, the syngas is cooled from around 2,000°F (1,093°C) to below 1,000°F (538°C), and the heat is recovered. Cooling is accomplished using a waste heat boiler or a direct quench process that injects either water or cool, recycled syngas into the raw syngas. When a waste heat boiler is used, steam produced in the boiler is typically routed to the heat recovery steam generator (HRSG) to augment steam turbine power generation (Rosenberg et al., 2005).

Syngas Conditioning

The syngas conditioning process involves removing particulate matter, converting CO in syngas to CO_2 (shifting), and capturing sulfur, and nitrogen, and other chemical compounds from the syngas before it is input to the combustion turbine. Particulate removal is accomplished using either barrier filters or by water scrubbers located downstream of the cooling devices. The particulate matter, including char and fly ash, is typically recycled back to the gasifier. When filters are used, they are cleaned by periodically back-pulsing them with fuel gas to remove trapped material.

CO is shifted by adding steam and flowing the mixture through a selective catalytic reduction process, converting the CO to CO_2 and producing H_2. Any carbonyl sulfide (COS) in the syngas would be converted to H_2S and captured downstream. Once filtered and cooled, the syngas is treated in two-stages of cleanup (called acid gas removal [AGR]); the first stage separates H_2S and mercury (Hg) and the second stage separates the CO_2 and produces a concentrated stream of H_2. The H_2S would be diverted to the sulfur recovery unit (SRU). Hg would likely be removed using activated carbon beds.

Current commercial AGR processes are chemical solvent-based processes or physical solvent-based processes. Chemical solvent-based processes use aqueous solutions of amines such as methyl diethanolamine (MDEA) and physical solvent-based processes (such as Selexol™) use dimethyl ethers of polyethylene glycol, or Rectisol™, which uses refrigerated methanol. Polyethylene glycol and methanol are chemically inert and can be regenerated (recycled) through depressurization in a “flash tank” (a unit that separates liquid and gas phases) although additional processing is necessary to remove the H_2S absorbed by the solvent. Polyethylene glycol and methanol are chemically inert. Under all technology cases (see Table 2-5) except 3B, a physical solvent would be used. Case 3B would use an amine solution.

Sulfur recovery processes recover sulfur in the form of either sulfuric acid or elemental sulfur. The most common removal system for sulfur recovery is the Claus process, which produces marketable elemental sulfur from the H_2S in the syngas (Rosenberg et al., 2005). The preliminary concept for the FutureGen Project assumes use of a Claus process.

> The **Claus process** recovers elemental sulfur from gaseous H_2S. It is a multi-step thermal and catalytic process where the final step involves oxidation of H_2S. The main reaction equation is:
> $2H_2S + O_2 \rightarrow 2S + 2H_2O$

Combined Cycle Power System

After cleanup, the concentrated H_2 stream flows to the combined cycle power system. In a combined cycle system, the first cycle involves the combustion of the primary fuel, H_2, in the case of the FutureGen

Project, in a combustion turbine. The combustion turbine powers an electric generator. It also may compress air for the ASU or gasifier. Hot exhaust gases are captured and directed to an HRSG, which produces steam. For the second cycle, the steam drives a steam turbine to produce additional electricity. The two electricity generation systems, one with a combustion turbine and the other with a steam turbine, constitute the combined cycle power system and generate more electricity than the older conventional systems that only use a steam turbine.

Flare

The FutureGen Project would be equipped with a flare to combust syngas during normal startups resulting in unplanned restart emissions and during plant upsets (also called unplanned outages). The flare would have a single stack and a single flame. The stack height would be up to 250 feet (76.2 meters) high, and the flare would be designed for a minimum 99 percent destruction efficiency of CO and H_2S.

Plant upset is a serious malfunction of any part of the IGCC process train and usually results in a sudden shutdown of the combined-cycle unit's gas turbine and other plant components.

Cooling Towers

The FutureGen Project would likely include a hybrid cooling system to reduce water usage, consisting of a mechanical draft cooling tower combined with a convective heat removal system. Most of the water appropriated for the power plant would be consumed by evaporative cooling. The amount of water required would be influenced by many factors including: ambient weather conditions; the cycles of concentration in the cooling towers; and the quality of the make-up water source. In general, if the source water is relatively low in total dissolved solids, the cycles of concentration in the cooling towers can be increased, resulting in less water consumption.

Zero Liquid Discharge System

ZLD system is a process involving the separation of solids and dissolved constituents from the plant wastewater and allowing the treated water to be recycled or reused in the industrial process, resulting in no discharge of process wastewater to the environment.

The FutureGen Project would use a ZLD system to eliminate industrial wastewater discharges. Cooling tower blowdown (i.e., water removed from the cooling system) would be routed to the ZLD system to remove solids and dissolved constituents before reuse in the cooling tower. The ZLD process would first remove suspended solids in a clarifier, concentrate the dissolved solids using a reverse osmosis system, and then remove water from the dissolved solids through heating and vaporization. The ZLD process results in a solid filter cake material, which would be collected and transported off site for proper disposal. Based on the conceptual design estimates, up to 1,545 tons (1,402 metric tons) of clarifier sludge and 5,558 tons (5,043 metric tons) of solids (filter cake) would be generated by the ZLD system per year of operation.

2.5.1.1 Technology Options and Bounding Conditions

To support this EIS, the Alliance in consultation with DOE developed an initial conceptual design, which includes reference information for use in the impact analyses of this EIS. To develop bounding conditions, a range of outputs was developed based on the three technology cases summarized in Table 2-5. To provide a conservative assessment of impacts, the assumptions and quantities (particularly air emissions, other waste streams, and land impacts) relate to the upper bound of the range of possible impacts. For example, the upper bound for air emissions was derived by assuming facility operations would result in the highest emission rate of individual pollutant species (e.g., NO_x) selected from among all three cases. Therefore, while used to develop the performance boundary, the aggregate upper bound is worse than any single technology case under consideration.

An important part of the FutureGen Project is to incorporate the latest technologies ready for full-scale or sub-scale testing or commercial deployment. To identify technology options, the Alliance started with a list of major components and subsystems of the power plant facility and created a matrix of potential configurations of equipment. After presentations by various technology vendors and with assistance from numerous power plant experts, the matrix of potential configurations was narrowed to three to support the conceptual design. While the final technology selections have not yet been made, the IGCC processes would be generically similar, regardless of specific technologies.

The Alliance is evaluating three potential technology cases. These cases share many components and processes in common, with the primary difference being the type of gasifier technology used. Table 2-5 summarizes the technology cases and their components. Cases 1, 2, and 3A are stand-alone alternatives that are capable of meeting the design requirements of the project. Case 3B is a smaller, side-stream power train that would enable more research and development activities than the main train of the power plant (Cases 1, 2, and 3A). Case 3B, if implemented, would be paired with Cases 1 and 2, and 3A. Case 3A is similar to Case 1, except the gasifier output is greater.

One goal of the FutureGen Project is to demonstrate gasification technology over a range of different coal types. Therefore, the facility would be designed to use bituminous, sub-bituminous, and lignite coals. For developing the performance boundary, the Alliance assumed technology cases and operation of the plant using three coal types: PRB sub-bituminous, Illinois Basin bituminous, and Northern Appalachia Pittsburgh bituminous.

The Alliance estimated the operating parameters for a bounding combination of the technologies and coal types. Emissions of air pollutants, quantities of coal and process chemicals, and waste generation were calculated for the maximum possible under Cases 1, 2, and 3A for the three coal types, plus the maximum possible under Case 3B for the three coal types. This resulted in conservative estimates of possible air emissions and impacts related to use of process materials, waste management, and the associated transportation.

The FutureGen Project would have a sophisticated control system to safely manage normal operations as well as planned and unplanned restarts. Unplanned events include situations where a specific component or system has a performance problem and actions are required to restore normal operations or shut down the plant. Unplanned events may involve such actions as venting syngas to a flare for a short period (hours). Air emissions during startups and unplanned events (upset conditions) tend to be very high in pollutants emitted relative to normal operations, but occur for short durations (minutes to hours). For purposes of estimating the upper bound of air emissions, the air emissions profile used in this EIS includes an estimated number of unplanned restarts. Therefore, the air emissions profile would be greater than anticipated from steady-state operation of the project. Details on the air emissions estimates and assumptions are provided in Section 2.5.6.1. Even with including all unplanned restarts, the FutureGen Project is still expected to have low air emission levels when compared to traditional coal combustion power plants. As is the case with any new technology, the anticipated number of unplanned restarts usually declines with experience.

The FutureGen Project would also conduct research on additional technologies, which were described in Section 2.5.1. After the 4-year initial testing and research phase, it is likely that the power plant could still be used for additional research activities and would gradually over time be operated as a commercial power plant. Additionally, the Alliance could undertake various activities that would help offset the cost of operation. These activities include selling some or all of the CO_2 for enhanced oil recovery (EOR) or enhanced coalbed methane recovery, removing the Claus plant and co-sequestering H_2S with the CO_2, and possibly selling a portion of the H_2. These other operating scenarios are discussed in Section 3.3.

2.5.2 CARBON SEQUESTRATION

2.5.2.1 Overview of CO_2 Capture and Geologic Sequestration

A key component of the FutureGen Project is the geologic sequestration of CO_2 to help achieve near-zero emissions. Geologic sequestration is the storage of CO_2 in a suitable subsurface formation with the capability to contain it permanently. The injection of gases underground is not a new concept and has been performed successfully for decades, including natural gas storage projects around the world and acid gas injection at EOR projects.

Geologic Sequestration is the placement of CO_2 or other GHGs into subsurface porous and permeable rocks in such a way that they remain permanently stored.

Deep Saline Formation is an underground rock formation, generally more than 0.45 mile (731 meters) beneath the ground surface, composed of permeable materials and containing highly saline water.

Geologic storage of anthropogenic (man-made) CO_2 as a GHG mitigation option was first proposed in the 1970s, but little research was done until the early 1990s. In a little over a decade, geologic storage of CO_2 has grown from a concept of limited interest to one that is quite widely regarded as a potentially important mitigation option. Technologies that have been developed for and applied by the oil and gas industry can be used for the injection of CO_2 in deep geologic formations. Well-drilling technology, injection technology, computer simulation of reservoir dynamics, and monitoring methods can potentially be adapted from existing applications to meet the needs of geologic storage (IPCC, 2005).

Types of geologic formations capable of storing CO_2 include oil and gas bearing formations, saline formations, basalts, deep coal seams, and oil- or gas-rich shales. Not all geologic formations are suitable for CO_2 storage; some are too shallow and others have low permeability (the ability of rock to transmit fluids through pore spaces) or poor confining characteristics. Formations suitable for CO_2 storage have specific characteristics such as thick accumulations of sediments or rock layers, permeable layers saturated with saline water (saline formations), extensive covers of low permeability sediments or rocks acting as seals, (caprock), structural simplicity, and lack of transmissive faults (IPCC, 2005).

Under the FutureGen Project, CO_2 from the power plant would be captured, transported by pipeline (if necessary), and injected into a deep saline formation (see Figure 2-20). The deep saline formation would be overlain by several other formations, including one or more low permeability caprock layers. Deep saline formations are the focus of the FutureGen Project because they are believed to have the largest capacity for CO_2 storage and are much more widespread geographically than other geologic sequestration options.

Improving the fundamental understanding of the transportation and geologic sequestration of large quantities of CO_2 is critical to advancing the commercial feasibility of this technology. This understanding is also important to public acceptance of this technology. The FutureGen Project would conduct subsurface research related to geologic storage of CO_2, and would function as a platform for testing and deploying new technologies related to CO_2 storage, monitoring, and, perhaps, leak mitigation. The project would help to develop a critical understanding for planners, engineers, and scientists to understand CO_2 sequestration in the context of formation structure, chemistry, and performance.

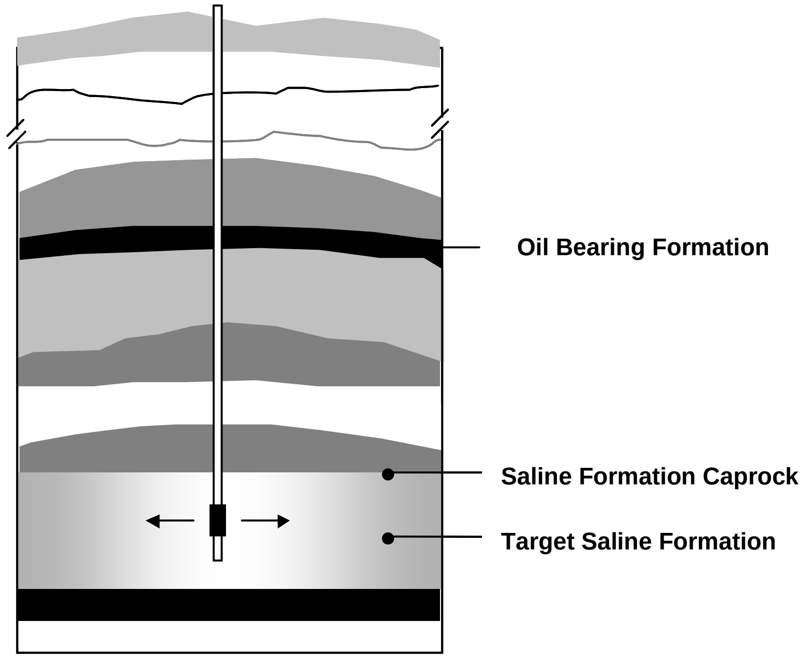


Figure 2-20. Geologic Sequestration in a Deep Saline Aquifer

Depending on the choice of monitoring technologies versus the length and costs for the pipelines, monitoring could be the most costly single component of the CO_2 storage effort because of the infrastructure required (e.g., deep monitoring wells) as a research and development project. The FutureGen Project would represent a first-of-a-kind environment in which to evaluate combinations of existing and new monitoring techniques and to determine the efficacy and cost of providing quantitative data on the location of the CO_2 plume, seal integrity, and early warning of CO_2 seepage. It is envisioned that the FutureGen Project would identify and validate less expensive and less invasive geologic sequestration technologies that could be used in future commercial applications (FG Alliance, 2007).

CO_2 Capture

CO_2 capture from an IGCC power plant is generally less costly than capture from a conventional coal-fueled power plant because the CO_2 is relatively concentrated (50 volume percent) and at high pressure. The FutureGen Project would capture and remove CO_2 during the second stage of syngas cleanup using a physical solvent, before the syngas is mixed with air and burned in a combustion turbine.

CO_2 Compression and Transport

A CO_2 pipeline would transport the gas to one or more injection wells at the sequestration site. For three of the four alternative sites, injection wells would be miles away from the power plant site, requiring the construction of varying lengths of CO_2 pipeline. Depending upon the site selected, the Alliance would contract with a pipeline company or operator to use an existing CO_2 pipeline or to construct a new pipeline.

To deliver the captured CO_2 to the injection site, the gas would be compressed into a supercritical state (i.e., exhibiting properties of both a liquid and a gas) to make it more efficient to transport. CO_2

compression uses the same equipment as natural gas compression, with some modifications to suit the properties of CO_2. Avoiding corrosion and hydrate formation are the main pipeline operational issues with CO_2. Multi-stage centrifugal compressors are preferred for large volume, high-pressure applications because of their ability to handle large flow rates (several hundred thousands cubic feet per minute).

The water content in the CO_2 stream must be strictly limited to prevent corrosion. A glycol dehydrator can be used for this purpose. To avoid potential heat exchanger problems, stainless steel can be used throughout the compressor piping if H_2S is present in the CO_2 stream. Special sealing materials and gaskets are used to avoid hardening of some petroleum-based and synthetic lubricants in compressors and pipelines. Other impurities in the captured CO_2 streams may also affect the compressor and pipeline operations. Their impact is currently being researched (Wong, 2005). Once compressed, the CO_2 would be conveyed by pipeline to the sequestration site.

Approximately 1,500 miles (2,500 kilometers) of CO_2 pipelines exist in the United States. CO_2 pipelines are regulated as hazardous liquids pipelines. The U.S. Department of Transportation's CO_2 Pipeline and Hazardous Materials Safety Administration has responsibility for safe and secure movement of hazardous materials to industry and consumers by all transportation modes, including the Nation's pipelines. Ordinarily, federal approval is not required for development of a new hazardous liquids pipeline unless it would cross federal lands. Generally, state and local laws regulate construction of new hazardous liquids pipelines. However, under federal and state regulations, pipeline operators are responsible for ensuring the safe operation of their pipelines. Operators must use qualified materials and sound construction practices; thoroughly inspect, test, maintain, and repair their pipelines; ensure their workers are trained and qualified; implement best management practices (BMPs) to prevent damage to pipelines; and develop adequate risk management and emergency response plans. A Computational Pipeline Monitoring System is required by federal regulation (49 CFR Section 195.444) for leak detection in CO_2 pipelines. This type of leak detection system automatically alerts the operator when a leak occurs so that appropriate actions can be taken to minimize the release.

Most pipelines for hazardous liquids are located or buried within ROWs. A ROW consists of consecutive property easements acquired by, or granted to, the pipeline company. The ROW provides sufficient space to perform pipeline maintenance and inspections, as well as a clear zone where encroachments can be monitored and prevented. If an existing utility ROW is not available or suitable for the proposed CO_2 pipeline for the FutureGen Project, either the Site Proponents or the Alliance would obtain a new ROW.

The diameter of the pipeline would depend on many factors, particularly the length of the pipeline and transport pressure. For the FutureGen Project, the pipeline would be buried at least 3 feet (0.9 meter) below the surface except where it is necessary to come to the surface for valves and metering. Although valve spacing has not been determined at this time, a typical distance between metering stations is 5 miles (8 kilometers). These features may be aboveground or could be located below ground in concrete vaults. The pipeline would require protection from above ground loading at road crossings, either by increased wall thickness or by casing the pipe. In cold climates, transporting warm CO_2 could increase the ground temperature, which may affect ground frost and freeze in the winter. To avoid problems with icing at road crossings, the pipeline depth or pipe insulation thickness may be increased or the pipe can be armored.

CO_2 Injection and Storage

An objective of the FutureGen Project is to inject between 1.1 and 2.8 million tons (1 and 2.5 MMT) per year of CO_2 into a deep saline reservoir, providing permanent storage of the CO_2 underground. Most likely, all captured CO_2 would be stored in deep saline reservoirs; however, the goal is to sequester at least 1.1 million tons (1 MMT) of CO_2 per year in deep saline reservoirs. It is possible that CO_2 captured in excess of 1.1 million tons (1 MMT) per year would be sold for use in EOR or coalbed methane recovery. If any excess CO_2 is sold, DOE anticipates that the Alliance would restrict the uses of the CO_2 as a condition of the sales agreement so that the sequestration is permanent.

Assuming a 1.1 million ton (1 MMT) per year CO_2 injection rate and a 50-year power plant life span, the target formation could receive up to 55 million tons (50 MMT) of CO_2. The CO_2 gas would be injected at a pressure of approximately 2,200 psig (15,168 kPa). The number of injection wells required to meet the injection goal would vary, depending on the characteristics of the target formation. In addition, the Alliance may install one or more backup injection wells to accommodate periods of time for routine maintenance and inspection of the primary injection well(s). Where necessary, one or more extraction wells would be installed to remove formation water and thereby decrease the risk of over-pressurization caused by the injection of CO_2.

The alternative sites identified by the Alliance met stringent screening criteria with regard to their proposed injection sites. The Alliance, working in coordination with nationally recognized scientists and engineers, developed screening criteria that ensure that proposed formations provided not only adequate storage capacity but also exhibited features that would secure lasting, safe storage of CO_2. Some of these criteria are:

- The proposed target formation must have a primary seal (caprock) capable of long-term containment of the injected CO_2. Although “long-term” was not defined, the Alliance believed the criteria would provide secure and lasting storage of CO_2. Figure 2-20 shows an illustration of geologic sequestration depicting layers of caprock.
- The primary seal must have sufficient thickness (greater than 20 feet [6 meters]), be regionally extensive, and be continuous over the entire projected CO_2 plume area after injection of 55 million tons (50 MMT) of CO_2.
- The primary seal must also have sufficiently low vertical permeability and have sufficiently high capillary entry pressure to provide a barrier to the migration of CO_2 out of the target formation.
- The proposed target formation(s) must not be an underground source of drinking water.
- The offeror must own or have a demonstrated ability to obtain, purchase, or obtain a waiver of subsurface mineral rights within and immediately adjacent to proposed target formation(s) to accommodate an injection capacity of 55 million tons (50 MMT) of CO_2.
- In addition to the required total storage capacity of the site, the proposed target formation(s) also must support a minimum CO_2 injection rate goal of 1.1 million tons (1 MMT) of CO_2 per year for up to 50 years.
- The proposed target formation(s) must not intersect marine shorelines or other major surface bodies of water. The bottomhole location of any injection well must be no closer than 10 miles (16 kilometers) to marine shorelines and major surface water bodies.
- Land above the proposed target formation(s) must not intersect large dams, water reservoirs, hazardous materials storage facilities, Class 1 injection wells, or other sensitive features. The bottomhole location of any injection well must be no closer than 10 miles (16 kilometers) to any sensitive feature.
- The primary seal must not be intersected by any known historically active or hydraulically transmissive faults.
- The proposed power plant site must have low risk from significant seismic events.
- The land above the proposed target formation(s) must not be on a public access area. The bottomhole location of any injection well must be no closer than 10 miles (16 kilometers) from any public access area (FG Alliance, 2006a).

The underground injection of CO_2 would be regulated under the U.S. Environmental Protection Agency’s (EPA’s) Underground Injection Control (UIC) Program. The UIC Program works with state and local governments to oversee underground injection of waste in an effort to prevent contamination of drinking water resources. All injection wells require authorization under general rules or specific permits. Many states, including Illinois and Texas, have primary enforcement responsibility (primacy) for the UIC Program. It is likely that the FutureGen Project injection wells would be treated as Class V (experimental) wells under the UIC Program.

Fate and Transport of Injected CO_2

Injection of CO_2 in its supercritical state into a deep geologic formation would be achieved by pumping the CO_2 down an injection well. The injected CO_2 would displace the existing saline water occupying the formation's pore space. Without this displacement, CO_2 could only be injected by increasing the formation's fluid pressure, which could result in formation fracturing. If a formation's fluid pressure is too high, the sequestration process may require installation of extraction wells that remove water from the formation.

To increase the storage potential, CO_2 would be injected into very deep formations where it could maintain its dense supercritical state. The fate and transport of CO_2 in the formation would be influenced by the injection pressure, dissolution in the formation water, and upward migration due to CO_2's buoyancy.

> **Dissolution** is the process of a liquid dissolving into another liquid.
>
> **Miscible** refers to the property of liquids that allows them to be mixed together and form a single homogeneous phase.

Injection would raise the fluid pressure near the well allowing CO_2 to enter the pore spaces initially occupied by the saline water within the formation. Once injected, the spread of CO_2 would be governed by the following primary flow, transport and trapping mechanisms:

- Fluid flow (migration) in response to pressure gradients created by the injection process;
- Fluid flow (migration) in response to natural groundwater flow;
- Buoyancy caused by the density differences between CO_2 and the groundwater;
- Diffusion;
- Dispersion and fingering (localized channeling) caused by formation heterogeneities and mobility contrast between CO_2 and the groundwater;
- Dissolution into the formation groundwater or brine;
- Mineralization;
- Pore space trapping; and
- Adsorption of CO_2 onto organic material.

The magnitude of the buoyancy forces that drive vertical flow depends on the type of fluid in the formation. When CO_2 is injected into a deep saline formation in a liquid or liquid-like supercritical dense phase, it is only somewhat miscible in water. Because supercritical CO_2 is much less viscous than water (by an order of magnitude or more), it would be more mobile and could migrate at a faster rate than the saline groundwater. In saline formations, the comparatively large density difference (30 to 50 percent) creates strong buoyancy forces that could drive CO_2 upwards.

> **Supercritical CO_2** - CO_2 usually behaves as a gas in air or as a solid in dry ice. If the temperature and pressure are both increased (above its supercritical temperature of 88ºF [31.1ºC] and 73 atmospheres [1,073 psi]), it can adopt properties midway between a gas and a liquid, such that it expands to fill its container like a gas, but has a density like that of a liquid.

To provide secure storage (e.g., structural trapping), a low permeability layer (caprock) would act as a barrier and cause the buoyant CO_2 to spread laterally, filling any stratigraphic or structural trap it encounters. As CO_2 migrates through the formation, it would slowly dissolve in the formation water. In systems with slowly flowing water, reservoir-scale numerical simulations show that, over tens of years, up to 30 percent of the injected CO_2 would dissolve in formation water. Larger basin-scale simulations suggest that, over centuries, the entire CO_2 plume would dissolve in formation water. Once CO_2 is dissolved in the formation water, it would no longer exist as a separate phase (thereby eliminating the buoyant forces that drive it upwards), and it would be expected to migrate along with the regional groundwater flow.

As migration through a formation occurs, some of the CO_2 would likely be retained in the pore space, commonly referred to as "residual CO_2 trapping." Residual trapping could immobilize large amounts of the CO_2. While this effect is formation-specific, researchers estimate that 15 to 25 percent of injected CO_2 could be trapped in pore spaces, although over time much of the trapped CO_2 dissolves in the formation water (referred to as "dissolution trapping"). The dissolved CO_2 would make the formation water more acidic, with pH dropping as low as 3.5, which would be expected to dissolve some mineral grains and mineral cements in the rock, accompanied by a rise in the pH of the formation water. At that point, some fraction of the CO_2 may be converted to stable carbonate minerals (mineral trapping), the most permanent form of geologic storage. Mineral trapping is believed to be comparatively slow, taking hundreds or thousands of years to occur (IPCC, 2005).

To ensure the safe storage of sequestered CO_2, a monitoring and mitigation strategy would be implemented. The purposes of monitoring include assessing the integrity of plugged or abandoned wells in the region; calibrating and confirming performance assessment models; establishing baseline parameters for the storage site to ensure that CO_2-induced changes are recognized; detecting microseismicity associated with the storage project; measuring surface fluxes of CO_2; and designing and monitoring remediation activities. During the DOE-sponsored activities, a suite of monitoring approaches would be used to verify the safe containment of the CO_2 in the formation. Potential monitoring methods are described in Section 2.5.2.2.

Potential Leakage Pathways

A leading concern regarding geologic sequestration is the potential leakage of sequestered CO_2 from underground formations into the atmosphere or into an overlying water supply aquifer. The mechanisms for leakage are highly dependent on the storage formation's geologic conditions. Pathways and mechanisms for leakage can include:

- Failure of seals near the borehole (due to corrosion of the formation rock, the casing, or the cement between the casing and the formation);
- Leakage through abandoned boreholes and wells;
- Migration of CO_2 through the caprock formation due to its innate permeability;
- Failure of the caprock by formation stress and fluid pressure changes from injection; and
- Failure of the caprock by external forces such as tectonic movement, stress caused by subsidence, or earthquakes.

Overall, the main risks of leakage of geologically sequestered CO_2 are due to well borehole leakage and caprock failure. Under the Proposed Action, the Alliance would identify, plug and abandon (according to state regulations) existing unused wells and boreholes that penetrate the primary seals of the injection reservoir. The Alliance conducted a search for such wells at each of the sites and their presence relative to the storage formation was addressed in the Risk Assessment (TetraTech, 2007) that was prepared in support of this EIS. Risks associated with other leakage pathways, such as migration through caprock and failures caused by external forces are expected to be small because the alternative sites have met the geologic and seismic criteria developed for the FutureGen Project.

Pathways that could be created through the execution of the project, such as failures of the injection well casing or caprock failure due to injection pressure, could be avoided or minimized through preparatory and operational measures (see Section 2.5.2.2). The risk assessment prepared for this EIS considers potential leakage scenarios from the subsurface and estimates the risks to groundwater quality, biota, and humans (see Section 2.5.4).

Reservoir Modeling of Injected CO_2

Predictions of the distribution of CO_2 injected into the saline formations at the alternative sites were made using numerical simulation performed at DOE's Pacific Northwest National Laboratory (PNNL). This simulation involves the solution of mathematical equations that describe the migration and properties of CO_2 as it is injected into the subsurface. The flow and transport equations address parameters such as viscosity, solubility, relative permeability, and density. For numerical simulations performed for the proposed injection of CO_2, the Alliance used a model called Subsurface Transport Over Multiple Phases (STOMP), which was developed at PNNL. The model is a general-purpose tool for simulating subsurface flow and transport and addresses a variety of subsurface environments and flow mechanisms. Since its creation, the STOMP program has been validated by comparing its results against laboratory-scale experiments and field-scale demonstrations. PNNL used the STOMP-CO_2 version of the model to simulate the CO_2 injection and dispersion at the sites.

Viscosity is a material's resistance to flow.

Solubility is the ability or tendency of one substance to dissolve into another at a given temperature and pressure.

Permeability indicates the rate at which fluids would flow through the subsurface and reflects the degree to which pore space is connected.

Density is the ratio of the weight of a substance relative to its volume.

STOMP model documentation and information can be found at:

- http://www.netl.doe.gov/publications/proceedings/01/carbon_seq/p36.pdf
- http://www.princeton.edu/~cmi/events/Workshop%20Summary%202005.pdf

Each alternative Site Proponent provided PNNL and the Alliance a data package containing detailed information on the geological, geochemical, hydrological, tectonic, and other physical properties of the planned injection site's subsurface environment. Where information from a third-party source was used, the source was documented to ensure traceability. Much of the subsurface data for the sites were provided by state or university sources (e.g., Bureau of Economic Geology [University of Texas], Illinois State Geologic Survey).

An important component of executing a numerical simulator is documenting the sources of inputs and cataloging the results. PNNL created a FutureGen Application Log to maintain these records to allow external reviewers to understand the data path from the site-specific data to the simulator inputs and allow the simulations to be replicated in the future.

Two scenarios were considered as representing reasonable bounds on the expected CO_2 output and sequestration operations for the FutureGen Project. Although CO_2 output depends on many factors, such as the coal type being gasified, the probable upper bound would be 7,551 tons (6,850 metric tons) per day, which results in an annual injection rate of 2.8 million tons (2.5 MMT) per year (assuming 100 percent operation over an entire year). Therefore, the first scenario modeled assumed this maximum injection case. A second case analyzed a constant injection rate of 1.1 million tons (1 MMT) per year, corresponding to the minimum rate of sequestration to be met over the first 4-year operating period. For both scenarios, a total of 55 million tons (50 MMT) of CO_2 would be injected into the target formation. This maximum quantity is based on the requirement set forth in the RFP for candidate sites.

To achieve an injection target of 55 million tons (50 MMT) of CO_2, an injection period of 20 years was used for the 2.8 million tons (2.5 MMT) per year scenario, and an injection period of 50 years was used for the 1.1 million tons (1 MMT) per year scenario. However, the reservoir model was run for 50 years in both cases. For all the sites except Jewett, the largest plume radius predicted by the numerical modeling was associated with the injection of 1 MMT for 50 years. As a result of the modeling, it is estimated that the largest plume radius at Jewett would be associated with the injection of 2.8 million tons (2.5 MMT) for 20 years, followed by 30 years of gradual plume spreading. These differences in plume size are due to site-specific geologic conditions.

DOE assessed impacts to environmental resources based on the plume footprint at each site. Predicted plume radii for each site are provided as part of the site descriptions in Section 2.4. The plume radius is defined as the radius within which 95 percent of the gas-phase CO_2 mass occurs.

Computer simulations of plume behavior were based on the best available data, which would be supplemented with additional data collection at the chosen site, should the project proceed. For purposes of analysis in this EIS, plume radii were calculated by defining the radius as the radial distance from the injection well within which 95 percent of the CO_2 mass would be contained. The 95 percent cutoff was used to ensure that the reported plume radii represented the bulk of the injected CO_2. The model results showed thin layers "stringer layers" of CO_2 that advanced ahead of the main plume due to high-permeability zones interpreted from well log data. These "stringers" account for a very small fraction of the injected CO_2; neither the existence or extent of such high-permeability zones at each site is known. Hence, use of the 95 percent cutoff prevented these stringers from unrealistically inflating the plume radius calculations in a way that would not be justified by the available reservoir data. Because permeability values for different horizontal directions or at different locations in the area were available, the reservoir model resulted in a circular plume based on the assumption that permeability values were constant horizontally. However, under real-world conditions, there are various factors that would cause the injected plume of CO_2 to be non-circular in shape (plan view or footprint) or larger or smaller than has been predicted here. If the permeability of the rock differs as a function of direction (e.g., less in an east-west direction than in a north-south direction), the plume would have an elliptical (oval) shape instead of a circular shape. Variations in the permeability of the rock over short distances within the formation may also cause the plume to take an irregular shape. Similarly, if the formation has a network of moderately to poorly connected fractures, the plume could follow these fractures, resulting in irregular flow paths.

Although limited data on directional permeability can be obtained through a single well core, three or more nearby wells would be required to estimate directional permeability. Drilling and testing such deep wells would be exorbitantly expensive if done for all four sites and it is unlikely to be essential to site selection.

The size and shape of the plume would also be a function of pressure forces between the formation and injected CO_2. While real-world injections require the regulation of fluid pressure buildup to prevent fracturing of the overlying caprock or seals, the computer simulations did not explicitly account for pressure-induced effects on the target formation or overlying caprock (i.e., geomechanical modeling was not included in the simulations). Most likely, failure to include geomechanical effects causes small errors in the simulation results that would not affect site selection.

While dissolution and buoyancy effects were considered in the plume model, natural flow of the native fluids in the reservoirs was not considered. Natural flow rates are usually extremely slow and in most situations would not be a concern. Dip (or inclination) of the strata is low (generally a few degrees) at each of the four sites and was not considered in the simulations as an influence on plume migration under buoyant forces. Furthermore, the size of the plume would be a function of various chemical reactions with the reservoir rock and native fluids, such as mineralization which occurs over hundreds of years. Geochemical effects, other than salt precipitation, were not considered in the calculations of the plume radii used in this EIS.

2.5.2.2 Monitoring, Mitigation, and Verification

The Alliance would rigorously monitor the sequestration efforts, including conditions in the proposed target formation as well as conditions in overlying strata, soil, groundwater supplies, and air. The comprehensive monitoring program would likely include installation of monitoring wells in strategic locations around the injection site in addition to atmospheric and shallow subsurface monitoring stations.

MM&V encompasses the process for ensuring the safe and permanent storage of sequestered gases. Injection of CO_2 into the subsurface would be regulated under EPA's UIC program. Monitoring would help to satisfy the protection requirements under the UIC program and would be used for a number of purposes, including but not limited to:

- Tracking the location of the plume of injected CO_2;
- Ensuring that the injection well and any monitoring wells or abandoned wells in the area are not leaking; and
- Verifying the quantity of CO_2 that had been injected.

> **MM&V** is the capability to measure the amount of CO_2 stored at a specific sequestration site, to monitor the site and mitigate the potential for leaks or other deterioration of storage integrity over time, and to verify that the CO_2 is being stored and is not harmful to the host ecosystem.

MM&V relevant to geologic sequestration can be divided into three broad categories of subsurface, soils, and the overlying air. Subsurface MM&V would involve tracking the fate of the injected CO_2 within the geologic formation and possible migration or leakage to the surface. Soil MM&V would involve detecting CO_2 in the first several feet of topsoil and tracking potential leakage pathways into the atmosphere. Methods to track CO_2 leaking to the atmosphere are challenging due to the difficulty in detecting small changes in CO_2 concentration above background concentrations that already exist in the atmosphere. However, tracers could be added to injected CO_2 to aid the monitoring process. These tracer chemicals can easily be measured at monitoring wells, are not commonly found in nature, do not rapidly degrade or interact with compounds in the formation, and exhibit low toxicity to biota.

The Alliance would monitor the injected CO_2 with methods that continuously measure or record data as well as methods that are conducted periodically. In general, the sampling and measurement frequency would be higher during the active injection period and would decrease afterwards. Baseline data would be collected during the year preceding injection. In terms of DOE's research program, the total monitoring timeline is 6 years, including the 1-year of baseline data collection, 3 years of active injection, and 2 years of post-injection monitoring. The monitoring scheme would be tailored to the characteristics of the site. If the CO_2 injection operation continues past the research phase, the Alliance or its successor would continue basic monitoring until sometime after the injection stops in accordance with UIC regulations and applicable permit conditions.

A preliminary schedule of monitoring during the first 6 years is provided in Table 2-6. Full descriptions of these techniques are found in the site Environmental Information Volumes (EIVs) (FG Alliance, 2006b, c, d, e). The Alliance may change the types and frequencies of monitoring activities after the initial research and testing phase of the project. As part of the Cooperative Agreement, at the end of the 4-year operating period, the Alliance would be obligated to prepare a plan, which is mutually acceptable to DOE, to address the extent of continued monitoring of the sequestered CO_2. On March 23, 2007, the Full Scope Cooperative Agreement was signed by both parties. Because the FutureGen Project is a research project, the Alliance may use some new and experimental monitoring methods, in addition to those listed in Table 2-6, to determine the fate and transport of the injected CO_2.

Table 2-6. Preliminary Schedule of Possible FutureGen Project CO_2 Plume Monitoring Activities

	Baseline	Active Injection				Post Injection	
Time (Years)	**-1**	**1**	**2**	**3**	**4**	**5**	**6**
Injection System Monitoring							
Supervisory Control and Data Acquisition (SCADA) Monitoring of Injection Wells (Pressure, Temperature, Flow Rate)	n/a	**CONTINUOUS**					
Remote Sensing							
Light Detection and Ranging (LiDAR) Survey	**X**	**X**	**X**	**X**	**X**		**X**
Atmospheric Monitoring							
Eddy Covariance	**CONTINUOUS**						
Near Surface Monitoring							
Soil Gas Monitoring	**XX**	**X**	**X**	**X**	**X**		**X**
Surface Flux Emissions	**XX**	**X**	**X**	**X**	**X**		**X**
Vehicle Mounted CO_2 Leak Detection System	**X**	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**X**	**X**
CO_2 Surface Well Monitoring	**CONTINUOUS**						
Borehole Tiltmeters	**CONTINUOUS**						
Subsurface Monitoring							
In-Situ Pressure/Temperature Monitoring (Injection Reservoir)	**CONTINUOUS**						
Fluid Sampling–Drinking Aquifer Monitoring Wells	**X**	**XX**	**XX**	**XX**	**XX**	**X**	**X**
Fluid Sampling–Primary Seal Monitoring Wells	**X**	**XX**	**XX**	**XX**	**XX**		**X**
Fluid Sampling–Injection Reservoir Monitoring Wells	**X**	**XX**	**XX**	**XX**	**XX**		**X**
Crosswell Seismic	**X**	**X**	**X**	**X**	**X**		**X**
Wireline Logging/Coring	**X**	**X**	**X**	**X**	**X**		**X**
Downhole Microseismic	**CONTINUOUS**						
Surface Seismic (2D,3D)	**X**	**X**	**X**		**X**		**X**

X = single monitoring event per year; XX = semi-annual monitoring; XXXX = quarterly monitoring; n/a = not applicable.
Source: FG Alliance, 2007.

Although the classification of UIC wells would be determined at the time of permitting, there is an overall standard of protection under the UIC Program that prohibits the movement of fluids into underground sources of drinking water. The citation below (from 40 CFR Part 144) provides the standard that all injection wells must be measured, including Class V (shallow and other) wells. This standard is currently in effect:

§ 144.12 Prohibition of movement of fluid into underground sources of drinking water.

(a) No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into

underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 142 or may otherwise adversely affect the health of persons. The applicant for a permit shall have the burden of showing that the requirements of this paragraph are met.

Furthermore, if any water quality monitoring of underground sources of drinking water indicates the movement of any contaminant into the water source, the state or EPA would require corrective action, operation, monitoring, or reporting as necessary to prevent such movement. The injection permit would be modified to reflect these additional requirements or the permit may be terminated. Appropriate enforcement action can be taken if a permit is violated.

Quarterly Monitoring Methods

On a quarterly basis (see Table 2-6), the Alliance would use a vehicle-mounted CO_2 leak detection system equipped with a global positioning system. This system would monitor atmospheric concentrations overlying the area of the plume and allow real-time leak detection and mapping over broad areas.

Semi-Annual Monitoring Methods

Fluid sampling from various monitoring wells would occur twice each year during the 4-year active injection period (research and development phase of the project). Fluid would be sampled from above the primary seal and in the reservoir. Fluid samples would be submitted to a laboratory for the following analyses: anions; carbonate and total alkalinity; metals; gases (methane, ethane, CO_2, CO, nitrogen gas); salinity; and stable isotopes.

Annual Monitoring Methods

A Light Detection and Ranging (LiDAR) survey would be conducted annually during the period that DOE would sponsor the FutureGen Project. LiDAR is an aerial technique that uses radar pulse travel times from an aircraft to the land surface to obtain high resolution topography data. The data would be used to detect changes in surface elevation that could occur due to subsurface CO_2 injection and movement. Additionally, soil gas probes would be installed annually along transects extending away from the injection well(s) and would be analyzed for CO_2, perfluorocarbon tracers, and stable carbon and O_2 isotopes. These soil gas probes help to detect leaks from the storage reservoir. Surface flux measurements would be conducted in a similar array as the soil gas probes and would aid in distinguishing a release of CO_2 from the injection reservoir from background CO_2.

The Alliance would annually conduct crosswell seismic imaging, which is a geophysical technique that creates a two-dimensional (2D) image in a vertical plane through the CO_2 plume between pairs of wells. Sources and receivers are placed in wells completed in the injection reservoir to allow the best measurement of changes in rock properties (such as the velocity of seismic signals) that are affected by the presence of CO_2. Similarly, wireline logging would be conducted whereby various sensors are lowered and raised inside a well to collect information about CO_2 saturation in rock surrounding the well. Other devices can be lowered into a well to collect rock-core samples for geochemical and geomechanical analyses. This technique can yield information about the mechanical integrity of the well bores and can verify the interpretation of data from wireline logging.

The Alliance would also conduct seismic imaging to create 2D or three-dimensional (3D) images of the CO_2 plume by measuring changes in rock properties such as seismic velocity that are affected by the presence of CO_2. Seismic imaging uses either large vibroseis trucks weighing up to 56,000 pounds

(25,401 kilograms), with heavy steel vibrators on them, or small explosives (often detonated in shallow boreholes) to produce seismic signals. This is done along potentially hundreds of "shot" points along lines that are surveyed across the study area. The vibrations caused at the surface travel downward and reflect from geologic layers and features, which cause echoes or reflections that travel back up to the land surface. Electromagnetic transducers, or geophones, detect the echoes and convert them into electrical signals. These signals are then processed into images of the subsurface.

Although leakage would not be expected, operators of the injection site(s) would need to be prepared to address a leak if one occurs. Active or abandoned wells (including the injection wells themselves) are potential pathways, and identifying options for remediating leakage of CO_2 from these pathways is especially important.

Similar to occurrences in oil and gas extraction wells, a blow-out could occur at the injection wellhead. Stopping blow-outs or leaks from injection wells or abandoned wells could be accomplished using standard oil field techniques (one such method is to inject a heavy mud into the well casing). If access to the well head is not safe or possible, heavy mud could still be introduced into the well by drilling a new well that would intercept the casing below the ground surface, and then mud would be pumped through this interception well and into the injection well. After control of the well is re-established, the well could either be repaired or abandoned.

Leaking injection wells could be repaired by replacing the injection tubing and packers. If the annular space behind the casing was leaking, the casing could be perforated to allow injection of cement behind the casing until the leak was stopped. If the well could not be repaired, it would be sealed and abandoned using established methods. Table 2-7 provides an overview of remediation options for typical leakage scenarios.

Table 2-7. Remediation Options for Geological CO_2 Storage Projects

Scenario	Remediation Options
Leakage up faults, fractures, and spill points	• Lower injection pressure by injecting at a lower rate or through a larger number of wells. • Lower reservoir pressure by removing water or other fluids from the storage structure. • Intersect the leakage with extraction wells in the vicinity of the leak. • Create a hydraulic barrier by increasing the reservoir pressure upstream of the leak. • Lower the reservoir pressure by creating a pathway to access new compartments in the storage reservoir. • Stop injection to stabilize the project. • Stop injection, produce the CO_2 from the storage reservoir, and reinject it back into a more suitable storage structure.
Leakage through active or abandoned wells	• Repair leaking injection wells with standard well re-completion techniques such as replacing the injection tubing and packers. • Repair leaking injection wells by squeezing cement behind the well casing to plug leaks behind the casing. • Plug and abandon injection wells that cannot be repaired by the methods listed above. • Stop blow-outs from injection or abandoned wells with standard techniques to 'kill' a well such as injecting a heavy mud into the well casing. After control of the well is re-established, the recompletion or abandonment practices described above can be used. If the wellhead is not accessible, a nearby well can be drilled to intercept the casing below the ground surface and 'kill' the well by pumping mud down the interception well.

Table 2-7. Remediation Options for Geological CO_2 Storage Projects

Scenario	Remediation Options
Accumulation of CO_2 in the vadose zone and soil gas	• Accumulations of gaseous CO_2 in groundwater can be removed or at least made immobile, by drilling wells that intersect the accumulations and extracting the CO_2. The extracted CO_2 could be vented to the atmosphere or reinjected back into a suitable storage site. • Residual CO_2 that is trapped as an immobile gas phase can be removed by dissolving it in water and extracting it as a dissolved phase through a groundwater extraction well. • CO_2 that has dissolved in the shallow groundwater could be removed, if needed, by pumping to the surface and aerating it to remove the CO_2. The groundwater could then either be used directly or reinjected back into the groundwater. • If metals or other trace contaminants have been mobilized by acidification of the groundwater, 'pump-and-treat' methods can be used to remove them. Alternatively, hydraulic barriers can be created to immobilize and contain the contaminants by appropriately placed injection and extraction wells. In addition to these active methods of remediation, passive methods that rely on natural biogeochemical processes may also be used.
Leakage into the vadose zone and accumulation in soil gas	• CO_2 can be extracted from the vadose zone and soil gas by standard vapor extraction techniques from horizontal or vertical wells. • Fluxes from the vadose zone to the ground surface could be decreased or stopped by caps or gas vapor barriers. Pumping below the cap or vapor barrier could be used to deplete the accumulation of CO_2 in the vadose zone. • Because CO_2 is a dense gas, it could be collected in subsurface trenches. Accumulated gas could be pumped from the trenches and released to the atmosphere or reinjected back underground. • Passive remediation techniques that rely only on diffusion and 'barometric pumping' could be used to slowly deplete one-time releases of CO_2 into the vadose zone. This method would not be effective for managing ongoing releases because it is relatively slow. • Acidification of the soils from contact with CO_2 could be remediated by irrigation and drainage. Alternatively, agricultural supplements such as lime could be used to neutralize the soil.
Large releases of CO_2 to the atmosphere	• For releases inside a building or confined space, large fans could be used to rapidly dilute CO_2 to safe levels. • For large releases spread out over a large area, dilution from natural atmospheric mixing (wind) would be the only practical method for diluting the CO_2. • For ongoing leakage in established areas, risks of exposure to high concentrations of CO_2 in confined spaces (e.g., cellar around a wellhead) or during periods of very low wind, fans could be used to keep the rate of air circulation high enough to ensure adequate dilution.
Accumulation of CO_2 in indoor environments with chronic low-level leakage	• Slow releases into structures can be eliminated by using techniques that have been developed for controlling release of radon and volatile organic compounds (VOCs) into buildings. The two primary methods for managing indoor releases are basement/substructure venting or pressurization. Both would have the effect of moving soil gases away from the indoor environment.
Accumulation in surface water	• Shallow surface water bodies that have significant turnover (shallow lakes) or turbulence (streams) will quickly release dissolved CO_2 back into the atmosphere. • For deep, stably stratified lakes, active systems for venting gas accumulations have been developed and applied at Lake Nyos and Monoun in Cameroon.

Source: IPCC, 2005.

2.5.3 RISK ASSESSMENT OF LEAKAGE OF CAPTURED GASES BEFORE GEOLOGIC SEQUESTRATION

One of the distinguishing aspects of the FutureGen Project is the capture of CO_2 (and other gases) from the gasification process. While there are existing power plants that capture CO_2, a FutureGen Project goal is to demonstrate the integration of CO_2 capture with a state-of-the-art IGCC power plant. The FutureGen Project would also provide a test bed for newer capture technologies, such as membranes that can separate H_2 from other gases, including CO_2. Because CO_2 capture technologies do pose some risks not commonly found in power plants, DOE assessed the risks and hazards of alternative capture technologies and pipeline transmission of captured gases. DOE worked with nationally recognized experts in relevant fields (e.g., natural gas transmission engineering, pipeline design, and EOR) to develop and apply its risk assessment methodology (see Appendix D). The results of this risk assessment are incorporated in this EIS.

2.5.4 RISK ASSESSMENT OF LEAKAGE OF SEQUESTERED GASES FROM GEOLOGIC RESERVOIRS

A key objective of the FutureGen Project is to verify the effectiveness, safety, and permanence of CO_2 stored in geologic formations. Because geologic sequestration of CO_2 in deep saline formations is a relatively new endeavor in the U.S. and abroad, it is important to advance the understanding of the pathways and associated risks of potential leaks of CO_2 from geologic formations.

In general, standardized, well-accepted methods of assessing risks and impacts of the sequestered gases (CO_2 and any other captured gases) do not exist. To assess the potential environmental impacts of CO_2 sequestration, DOE developed a protocol and methods to assess the risks of both slow leaks (including contamination of groundwater supplies and surface water supplies by sequestered gases and by displaced native fluids) and catastrophic rapid releases of sequestered gases (e.g., a well blow out). Subsequently, DOE asked nationally recognized experts in relevant fields (e.g., reservoir simulation, EOR, natural gas storage field management, geochemistry, geophysics, and reservoir engineering) to review and provide input on the risk assessment methodology (see Appendix D). While the risk assessment has been performed as part of this EIS, it should be noted that after selection of the host site, the Alliance would undertake a more comprehensive evaluation of the sequestration site and target reservoirs. At that point, the Alliance would drill one or more exploratory wells and conduct more characterization of the risks and potential impacts. DOE then would evaluate the resulting information as part of its preparation of a Supplement Analysis to determine whether a Supplemental EIS would be required. The Risk Assessment Report is posted on the NETL website (http://www.netl.doe.gov/technologies/coalpower/futuregen) and is available on the Draft EIS distribution CD.

2.5.5 RESOURCE REQUIREMENTS

2.5.5.1 Coal Requirements

The Alliance plans to test a variety of coal types during the DOE-sponsored 4-year operating period. While specific coal types and properties have yet to be selected, the conceptual design was developed based on representative properties for three common coal types: Northern Appalachia Pittsburgh coal, Illinois Basin coal, and PRB coal. These three coal types are broadly representative of eastern bituminous, mid-western bituminous, and western low-rank coals. Because the FutureGen Project is a research and development effort of Nation-wide (and world-wide) significance, it is desirable for the facility to incorporate a degree of fuel flexibility that would not necessarily be included in the design of a conventional power plant. After the 4-year operating period, the Alliance or its successor may choose a different type of coal or fuel type based on economic factors or continuing research needs.

The power plant would require up to 1.89 million tons (1.7 MMT) of coal per year. DOE assumed that coal would be delivered by rail to all the candidate sites because it is the most economically feasible option. For the purposes of analysis within this EIS, this assumption was used. Based on the type of coal, rail shipments would average five trains per week, with each train consisting of approximately 100 railcars.

2.5.5.2 Infrastructure Requirements

Alternative sites were selected based on a number of factors, including proximity to utilities such as electricity transmission, natural gas, water, and sewer lines. The FutureGen Project requires the ability to connect to the local electric grid, a potable water source (unless an on-site potable water treatment plant is constructed), a process water source, a natural gas supply, and a sanitary sewer (or construction of a packaged system on site). The Alliance may construct a holding pond or reservoir on site to store process water to meet water requirements. Connection to the electric grid may require the construction of additional transmission lines, installation of new electrical substations, or upgrades to existing substations. Furthermore, electricity would be needed at the CO_2 injection sites to power pumps, compressors, and monitoring equipment. New utility lines may require new easements and ROWs or the expansion of existing ROWs. The utilities available and method of interconnection would be dependent on the characteristics of the site location.

The FutureGen Project would include the construction and operation of a research and development facility to be co-located on the power plant site. The scope of activities that would occur at this facility has not yet been determined. The plant may also include an on-site Visitor Center, where the public and invited guests could learn about the plant and its technologies through displays and possibly interactive exhibits.

2.5.5.3 Natural Gas Requirements

During gasifier unplanned restart, natural gas-fired burners would heat the gasifier to a temperature sufficiently high to initiate coal feed and gasification. Exhaust gas from the natural gas-fired burners would be vented to the flare stack. The frequency of restarts would depend upon the research and development needs, the rate of plant upsets, and how often coal types are changed. During a restart event, natural gas would be used at a rate of up to 1.8 million cubic feet per hour (50,970 cubic meters per hour). During restarts, natural gas would primarily be required for warming up the gasifier (up to 4 hours) and the combustion turbine (up to 2 hours).

2.5.5.4 Process Water Requirements

The plant would consume up to 3,000 gallons (11,356 liters) per minute of water. The cooling tower system would account for most of this water requirement. Other uses of water at the power plant would include coal handling (slurry preparation and dust suppression) and replacement of HRSG blowdown water.

Water would be required at the sequestration sites during construction to support the drilling of injection and monitoring wells. As this is a short-duration activity, DOE assumes that water would be trucked to the site for this purpose. Water would also be required for integrity testing of the new CO_2 pipelines before the start of sequestration activities. This testing would occur before the operational phase. The water could be supplied from the power plant site's proposed process water source or it could be supplied by tanker truck.

2.5.5.5 Transportation Requirements

All the sites are bordered by existing freight railroad lines. Rail transportation would be used for coal and other shipments to the site. A rail loop and siding on the property would be constructed to allow trains with approximately 100 railcars to exit the mainline and load and unload shipments within the plant boundary (see Figure 2-18). In addition, all of the candidate sites would be accessible by roads and highways to allow for other deliveries of products and materials to and from the plant site, as well as to facilitate commuting for workers.

2.5.5.6 Land Area Requirements

To allow adequate land area for the FutureGen Power Plant, coal storage, potential rail loop and siding, employee parking, potential research and development activity, possible on-site storage of slag, and other supporting structures, the Alliance estimates up to 200 acres (81 hectares) of land would be required. Easements and ROWs would also be required for new or expansions of existing utility, road, and rail corridors.

Land or easements would also be needed for injection wells, monitoring wells, and other supporting infrastructure at the sequestration site. The amount needed would depend on the geologic attributes of the sequestration reservoir, and for MM&V purposes, the projected size of the plume. However, it is expected that the disturbance footprint for these corridors would be up to than 10 acres (4 hectares) (either contiguous or noncontiguous).

2.5.6 DISCHARGES, WASTE, AND PRODUCTS

2.5.6.1 Air Emissions

IGCC power plants that are currently in operation have achieved the lowest levels of criteria air pollutant, Hg and other hazardous air pollutants (HAPs) emissions of any coal-fueled power plant technologies (DOE, 2002). The six criteria air pollutants are sulfur dioxide (SO_2), CO, ozone, nitrogen dioxide (NO_2), lead (Pb), and inhalable particulates, which are also known as respirable particulate matter (PM). The PM_{10} standard covers particles with diameters of 10 micrometers or less and the $PM_{2.5}$ standard covers particulates with diameters of 2.5 micrometers or less. Ozone is not emitted directly from a combustion source. It is formed from photochemical reactions involving emitted VOCs and NO_X. Table 2-8 provides FutureGen Project performance targets for air emissions compared with DOE's Fossil Energy Clean Coal Power Initiative (CCPI) targets.

Table 2-8. FutureGen Project Performance Targets

Pollutant	FutureGen Performance Targets (by 2016)[1]	DOE's Fossil Energy CCPI Targets (by 2020)
SO	>99 percent sulfur removal [2] (0.032 lb [0.015 kg]/10^6 Btu) [3, 4]	>99 percent sulfur removal
NO_X	<0.05 lb [0.02 kg]/10^6 Btu	<0.01 lb (0.005 kg)/10^6 Btu
PM_{10}	<0.005 lb [0.002 kg]/10^6 Btu	<0.002 lb (0.001 kg)/10^6 Btu
Hg	> 90 percent Hg removal (≤0.611 lb [0.277 kg]/10^{12} Btu)[4]	95 percent Hg removal
CO	n/a [5, 6]	n/a

Table 2-8. FutureGen Project Performance Targets

Pollutant	FutureGen Performance Targets (by 2016)[1]	DOE's Fossil Energy CCPI Targets (by 2020)
VOC	n/a [6]	n/a
Pb	n/a [5, 6]	n/a
CO_2	>90 percent capture and sequestration	n/a

[1] FutureGen facility operating at full load under steady-state conditions.
[2] Sulfur removal from feed coal.
[3] Based on the FutureGen Project performance target and calculated with AP-42 (Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources) emissions factors.
[4] Mass emission rates are based on conceptual design coal properties and performance estimates. See Table 2-9 for tons per year estimates.
[5] No FutureGen Project Performance Target for Pb and CO; however, existing IGCC power plants have demonstrated CO emission levels of <0.033 lb (0.015 kg)/10^6 Btu and Pb emissions ranging from trace amounts to 2.9 lb (1.3 kg)/10^{12} Btu. Trace amounts means the pollutant is present in levels no greater than 1,000 ppm or <0.1 percent by weight.
[6] n/a = No performance target or no CCPI target.
Btu = British thermal unit; kg = kilogram.
Sources: DOE, 2002; DOE, 2006a; DOE, 2006b.

Geologic CO_2 sequestration would be a unique component of the FutureGen Project that would help significantly lower air emissions of CO_2. However, this project's feature adds to the capital cost of the plant and consumes some of the power plant's energy output, resulting in an overall decrease in the net efficiency of the power plant. Although the FutureGen Project is being developed to be the first near-zero-emissions coal power plant, low levels of air emissions would be generated by process units such as the gasifier, combustion turbines, and the cooling towers.

When switching between coals, performing certain tests, or experiencing a malfunction, the facility would need to be brought down to a reduced state of operations or perhaps be shut down completely. Upon restart, facility emissions would be higher than steady-state operations as process units are brought online and ramped up to optimum performance. In addition, due to the complexity of integrating advanced technologies, unexpected shutdowns are likely to occur. Associated with such unplanned restarts are short-term increases to facility emissions due to the need to flare process gases for a short period, as well as to restart the facility (i.e., unplanned restarts). The types of unplanned restarts and the frequencies of their occurrence are uncertain. Therefore, estimates for unplanned restarts over the life of the project were developed based on experience at existing IGCC facilities. DOE expects that, over time, learning and experience would reduce the frequency and types of unplanned restarts reflected in estimates shown in Table 2-9. DOE and the Alliance estimate that the first year of the research and development period would have the greatest number of unplanned restarts with 29 occurrences. Years 2, 3, and 4 are estimated to have 18, 14, and 13 unplanned occurrences, respectively.

The Alliance provided the FutureGen Project's estimate of maximum air emissions that would be expected from the facility. DOE has reviewed and verified that this estimate of maximum air emissions provides a reasonable upper bound for air emissions considered in the EIS. However, given the early stages of plant design, there is some uncertainty with these data. Table 2-9 compares the FutureGen Project's estimate of maximum air emissions (based on the predicted number of startups during the first year) with the performance target emission rates for the FutureGen Project. Because emissions of criteria pollutants are projected to exceed 100 tons per year, the FutureGen Project would be classified as a major source under Clean Air Act regulations.

Table 2-9. FutureGen Project Potential Air Emissions: FutureGen Project Estimated Maximum Air Emissions vs. Performance Target

Air Emissions	Initial Startup Emissions(2012)[1] (tpy [mtpy])	Planned Performance Target Emissions (by 2016)[2] (tpy [mtpy])
SO_2	543 (493)	212 (192)
NO_2	758 (688)	326 (296)
PM_{10}	111 (101)	33 (30)
Hg	1.1x10-2 (1.0x10-2)	0.4x10-2 (0.36x10-2)
CO	611 (554)	n/a[3]
VOC	30 (27)	n/a[3]
CO_2[4]	0.18 x 106 (0.17 x 106) up to 0.45 x 106 (0.41 x 106)	0.12 x 106 (0.11 x 106) up to 0.28 x 106 (0.25 x 106)

[1] Maximum emissions for the first year of operations and includes steady-state at 85 percent availability of facility plus unplanned restart emissions. First year of operations is estimated to have 29 unplanned outage events, the most of the 4-year research and development period. Year 2 would have 18; Year 3 would have 14; Year 4 would have 13.
[2] Calculated based upon emission targets for the project (see Table 2-8). Calculated at 85 percent availability of facility. Parameters are for "average" coal and average annual heat input rate of 1,754 million Btu/hour obtained from similar plants. Heat input at 70oF. "Average coal" estimates are based on the parameters averaged out for the three proposed coal types: PRB, Illinois Basin, and the Northern Appalachia Pittsburgh.
[3] n/a indicates that emission targets for these pollutants have not been established.
[4] Calculated based on maximum emissions of up to 2.5 MMT/year for 100 percent availability of facility and 1.0 MMT/year for less than 100 percent availability. The FutureGen Project's initial startup emissions assumes 85 percent capture and 15 percent release to the atmosphere. The FutureGen Project performance target emissions assumes 90 percent capture and 10 percent release to the air.
tpy = tons per year; mtpy = metric tons per year.
Source: FG Alliance, 2006g.

A key goal of the FutureGen Project is to improve power plant technology and reduce emission levels. Table 2-10 provides baseline emissions to show the differences in air emissions between the FutureGen Project performance targets for air emissions and existing IGCC power plants and non-IGCC state-of-the-art (SOTA) conventional pulverized coal-fueled power plants. Figure 2-21 illustrates how advancements in technology have reduced major criteria pollutants from power plants over time.

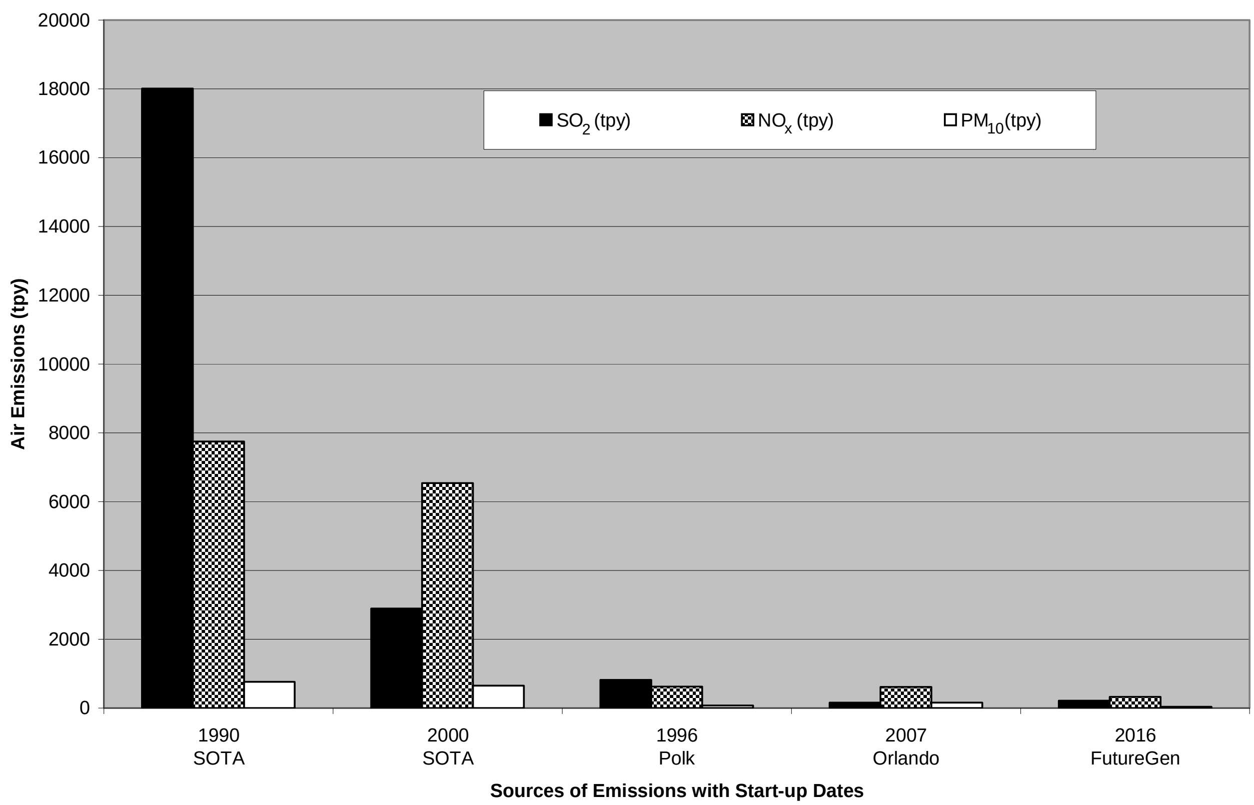
Table 2-10. Comparison of FutureGen Project Performance Target to Other IGCC and SOTA Power Plant Technologies (tpy [mtpy])

Air Emissions	2016 FutureGen Project[1] (275 MW)	2007 Orlando[2, 3] (275 MW)	1996 Polk[2, 4] (275 MW)	2000 SOTA[2, 5] (275 MW)	1990 SOTA[2, 6] (275 MW)
SO_2	212 (192)	155 (140)	821 (744)	2,891 (2,622)	18,013 (16,341)
NO_2	326 (296)	611 (554)	620 (562)	6,537 (5,930)	7,747 (7,028)
PM	33 (30)	159 (144)	75 (68.0)	653 (592.4)	758 (687.7)

Table 2-10. Comparison of FutureGen Project Performance Target to Other IGCC and SOTA Power Plant Technologies (tpy [mtpy])

Air Emissions	2016 FutureGen Project[1] (275 MW)	2007 Orlando[2, 3] (275 MW)	1996 Polk[2, 4] (275 MW)	2000 SOTA[2, 5] (275 MW)	1990 SOTA[2, 6] (275 MW)
Hg	0.004 (0.0036)	0.015 (0.0136)	0.017 (0.0154)	0.112 (0.1016)	0.103 (0.0934)
CO_2 (MMT/yr)	0.11 (0.10) to 0.28 (0.25)	1.80 (1.6)	1.37 (1.243)	4.47 (4.055)	6.22 (5.643)

[1] SO_2, NO_2, PM_{10}, and Hg emissions calculated from FutureGen Project Performance Target as presented in the Report to Congress using "average" coal with a heat input rate of 1,754 MMBtu/hr at 70°F (DOE, 2004). CO_2 calculated based on 90 percent capture and sequestration goal (FG Alliance, 2006g).
[2] Orlando Gasification Project (Orlando) and Tampa Electric Company Polk Power Station (Polk) planned and operating IGCC power plants, respectively, and the SOTA are conventional coal-fueled power plants.
[3] SO_2, NO_2, and Hg are based on emission limiting conditions in the Final Prevention of Significant Deterioration (PSD) Permit (FLDEP, 2007a). PM_{10} emissions based on potential emissions from the combustion turbine/HRSG as reported in PSD Permit Application (FLDEP, 2007b). CO_2 emissions are projected based on estimates reported in Orlando Gasification Project Final EIS (DOE, 2007).
[4] SO_2 and CO_2 emissions are actuals reported for Acid Rain Program (EPA, 2007a). Hg emissions from limiting conditions in Title V permit (FLDEP, 2007c). NO_2 and PM emissions from limiting conditions in Title V permit modification (FLDEP, 2007d).
[5] SO_2 and CO_2 emissions are actuals reported for Acid Rain Program from Hayden, Routt, CO facility. NO_X are actuals reported for Acid Rain Program from E.D. Edwards, Peoria, IL facility. PM emissions calculated from rates obtained from DOE database for Hayden, Routt, CO facility. Hg emission factors and heat value as reported in EPA's ***Locating and Estimating Air Emissions from Sources of Mercury and Mercury Compounds*** (EPA, 1997).
[6] SO_2 and NO_2 emissions are actuals reported for Acid Rain Program from Meramac, St. Louis, MO facility. CO_2 emissions are actuals reported for Acid Rain Program from C G Allen, Gaston, NC facility. Hg emissions for 2005 as reported in EPA Envirofacts website from Cholla, Navajo, AZ facility. PM emissions calculated from rates obtained from DOE database for C G Allen, Gaston, NC facility (275 MW) that made modification in 1996.
MMT/yr = million metric tons per year; MW = megawatt.



tpy = tons per year.

Figure 2-21. Comparison of FutureGen Project Performance Target to Other IGCC and SOTA Power Plant Technologies

Emissions from the FutureGen Project would be lower than emissions from other IGCC power plants and SOTA coal plants, with the exception of SO_2 emissions rates from the Orlando Gasification Project (Orlando). The primary reason for lower SO_2 emissions from Orlando is the fact that this facility uses low sulfur PRB sub-bituminous coal. As a research platform, the FutureGen Project would use various types of coal with varying sulfur content.

2.5.6.2 Solid Waste

The primary solid waste stream produced by the power plant would be slag and ash. It is estimated that 96,865 tons (87,874 metric tons) and 47,565 tons (43,150 metric tons) of slag and ash would be generated each year, respectfully. If technology Case 3B is not implemented, only slag would be generated (96,865 tons [87,874 metric tons]). If a beneficial reuse could not be found for the slag or ash, it could be disposed of on the power plant site in accordance with state regulations. The ZLD would also generate solids on the order of 5,558 tons (5,042 metric tons) per year and sludge at a rate of up to 1,545 tons (1,402 metric tons) of solid waste per year. The sludge and ZLD solids could be disposed of at a sanitary landfill if they do not exhibit hazardous waste characteristics. Elemental sulfur would be disposed of as a waste if there were no market. Carbon filters for Hg removal would probably be returned to the vendor for reactivation or recycling. The power plant would also generate regular trash (non-hazardous solid waste) that would be sent to a sanitary (municipal) landfill. As a BMP, the Alliance would institute a comprehensive pollution prevention and recycling program to minimize waste.

2.5.6.3 Marketable Products

As previously stated, the FutureGen Project would produce salable quantities of elemental sulfur or sulfuric acid. Most of the sulfur or sulfuric acid sold in the U.S. is used in the manufacture of fertilizer. Sulfuric acid is also used in oil refining, wastewater processing, and chemical synthesis. The Alliance would attempt to negotiate a contract to sell its sulfur, most likely to a fertilizer manufacturer.

The FutureGen Project would also generate 96,865 tons (87,874 metric tons) of slag and 47,565 tons (43,150 metric tons) of ash per year. If economical, the slag or ash would be transported off site to a recycling facility or manufacturer that could recycle it into a beneficial product. Slag is often recycled into blasting grit or roofing material, or it can be incorporated into hot-mix asphalt (Kalyoncu, 2002). It can also be used in railroad track ballast, fertilizer, and seawalls. Ash is often included in concrete products to enhance strength and durability. It is also used in structural fills, as feed material for cement clinker, and for road base construction. The method of slag or ash disposal would depend on the site selected to host the FutureGen Project and its local or regional markets for these products. Off-site transportation of the slag or ash could be achieved by rail or truck, which would be determined after site selection based on the location of delivery points and economic factors.

Potential markets for products and likely purchasers may be identified during the best and final offers by Site Proponents or as part of the ultimate selection of the host site. Potential environmental impacts from the use or fate of these products and impacts from the transport of products away from the power plant site would be addressed by a Supplement Analysis that would be conducted after further site characterization and site-specific design work at the host site.

2.5.6.4 Toxic and Hazardous Materials

The FutureGen Project would use a variety of process chemicals, primarily used in the treatment of process water and maintenance of the cooling towers. The selective catalytic reduction process would use approximately 1,333 tons (1,209 metric tons) per year of aqueous ammonia. If the plant generates sulfur waste in the form of sulfuric acid instead of elemental sulfur, it is possible that some sulfuric acid could be recycled for use in water processing at the plant, although some pre-treatment may be required. Table 2-11 lists the estimated quantities and uses of chemicals required to operate the FutureGen Power Plant.

Table 2-11. Estimated Quantities and Uses of Chemicals for FutureGen Plant Operation

Process	Chemical Type	Estimated Annual Quantity[1] (tpy [mtpy])	Estimated Storage On Site (gallons [liters])
H_2S and CO_2 Separation (1st and 2nd Stage)	Physical Solvent	11,300 gallons (42,775 liters)	940 (3,558)
SCR for NO_x removal	Aqueous Ammonia	1,333 (1,209)	28,700 (108,641)
Cooling Tower Operation and Maintenance	Sulfuric Acid	8,685 (7,879)	94,200 (356,585)
	Antiscalant	0.47 (0.43)	8 (30.3)
	Sodium Hypochlorite	1,684 (1,527)	32,900 (124,540)
Water Make-Up Demineralizer	Sodium Bisulfite	7 (6.4)	88 (333)
	Sulfuric Acid	21 (19.1)	225 (851)
	Liquid Antiscalant and Stabilizer	17 (15.4)	281 (1,064)
Wastewater Treatment Demineralization	Sodium Bisulfite	5.0 (4.5)	67 (253.6)
	Sulfuric Acid	85 (77.1)	921 (3,486)
	Liquid Antiscalant and Stabilizer	10 (8.7)	163 (617.0)
Clarifier Water Treatment Chemicals	Lime	1,237 (1,122)	7,380 (27,936)
	Polymer	295 (268)	5,020 (19,002)

[1] Expressed in tpy (mtpy) unless otherwise indicated.
tpy = tons per year; mtpy = metric tons per year.

2.5.6.5 Pollution Prevention, Recycling, and Reuse

The FutureGen Project would be designed to minimize process-related discharges to the environment. A plan for pollution prevention and recycling would be developed during the site-specific design and permitting steps and would be put into practice after the power plant becomes operational. Table 2-12 lists some measures that may be employed as part of that plan.

Table 2-12. Possible Pollution Prevention, Recycling, and Reuse Features

Spill Control Plan	The Spill Control Plan would specify measures to take in the event of a spill, thereby protecting environmental media from the effect of accidental releases. All aboveground chemical storage tank containment areas would be lined or paved, curbed/diked, and have sufficient volume to meet regulatory requirements. A site drainage plan would also be developed to prevent routine, process-related operations from affecting the surrounding environment.

Table 2-12. Possible Pollution Prevention, Recycling, and Reuse Features

Feed Material Handling	The coal storage area may be outdoors or covered. Measures would be taken to reduce releases of coal dust and contamination of stormwater runoff.
Coal Grinding and Slurry Preparation	The coal grinding equipment would be enclosed and any vents would be routed to the tank vent auxiliary boiler. The water used to prepare the coal slurry would be stripped process condensate (recycled).
Gasification, High Temperature Heat Recovery, Dry Char Removal and Slag Grinding	The char produced in gasification would be removed and returned to the first stage of the gasifier (recycled). This improves the carbon conversion in the gasifier and reduces the amount of carbon contained in the gasifier slag.
Slag Handling	The slag dewatering system would generate some flash gas that contains H_2S. The flash gas would be recycled back to the gasifier via the syngas recycle compressor. Water that is entrained with the slag would be collected and sent to the sour water stripper for recycle.
Sour Water System	Sour water would be collected from slag dewatering and the low temperature heat recovery system, and the NH_3 and H_2S would be stripped out and sent to the SRU. The stripped condensate would be used to prepare coal slurry. Surplus stripped condensate would be sent to the ZLD unit.
ZLD Unit	The ZLD unit would concentrate and evaporate the process condensate. The ZLD unit would produce high purity water for reuse and a solid filter cake for disposal off site. The ZLD would concentrate and dispose of heavy metals and other constituents in the process condensate. The ZLD would also be a recycle unit because the recovered water could be reused, reducing the total plant water consumption.
Hg Removal Features	The Hg removal unit would use specially formulated activated carbon to capture trace quantities of Hg in the syngas. Hg in the sour water handling system would be captured via activated carbon filters placed upstream of potential release points.
AGR	The AGR system would remove H_2S and CO_2 from the raw syngas and produce a H_2-rich synthetic fuel (synfuel) for use in the combined cycle power system. The AGR would produce concentrated H_2S feed for the SRU and concentrated CO_2 for drying, compression, and sequestration. For co-sequestration activities, a mixed stream of H_2S and CO_2 would be compressed and dried for sequestration.
SRU	The SRU would convert the H_2S to elemental sulfur that would be marketed for use as a fertilizer additive or for production of sulfuric acid. The tail gas from the SRU would be recycled back to the gasifier.
Boiler Blowdown and Steam Condensate Recovery	Boiler blowdown and steam condensate would be recovered from the combined cycle power system and gasification facilities, and would be reused as cooling tower makeup water.
Training and Leadership	All corporate and plant personnel would be trained on continuous improvement in environmental performance, especially as such training and programs apply to 1) setting, measuring, evaluating and achieving waste reduction goals; and 2) reporting the results of such programs in annual reports made available to the public.

2.5.7 CONSTRUCTION PLANS

2.5.7.1 Construction Staging and Schedule

The FutureGen Project facilities would be constructed over the course of up to 44 months, including the installation of utility lines and connections, sequestration site wells and equipment, and supporting structures. Before construction, environmentally sensitive areas at the selected site would be identified so that impacts could be minimized. A Stormwater Pollution Prevention Plan (SWPPP) would be developed to identify BMPs for erosion prevention and sediment control during construction. The plan would include a description of construction activities and address the following:

- Potential for discharge of sediment or pollutants from the site.
- Location and type of temporary and permanent erosion prevention and sediment control BMPs, along with procedures to be used to establish additional temporary BMPs as necessary for the site conditions during construction.
- Site map with existing and final grades, including dividing lines and direction of flow for all pre- and post-construction stormwater runoff drainage areas located within the project limits. The site map must also include impervious surfaces and soil types.
- Location of areas not to be disturbed.
- Location of areas where construction would be phased to minimize duration of exposed soil.
- Identify surface waters and wetlands, either on site or within 0.5 mile (0.8 kilometer) of the site boundaries, which could be affected by stormwater runoff from the construction site during or after construction.
- Methods to be used for final stabilization of all exposed soil areas.

Initial site preparation activities may include, depending on the site selected, building access roads, clearing brush and trees, leveling and grading the site, connecting to utilities, and dewatering activities. Construction of temporary parking, offices, and material storage areas would involve the use of large earthmoving machines to clear and prepare the site. Trucks would bring fill material for roadways and the power plant site, remove harvested timber, remove debris from the site, and temporarily stockpile materials. Construction crews would spread gravel and road base for the temporary roads, material storage areas, and parking areas.

During construction, worker vehicles, heavy construction vehicles, diesel generators, and other machinery and tools would generate emissions. Fugitive dust would result from excavation, soil storage, and earthwork. Construction-related emissions and noise would be minimized by running electricity to the site from the local utility provider to reduce reliance on diesel generators and by wetting soil to reduce dust during earthwork.

2.5.7.2 Construction Materials and Suppliers

Construction material would be delivered to the site by truck and rail. An access road to the power plant site would be developed for construction traffic and completion of the rail spur at the start of construction activities would allow some plant equipment to be delivered by rail. An estimated 20 trucks, and approximately two trains per week would deliver material to the site on a daily basis.

During construction, temporary utilities would be extended to construction offices, worker trailers, lay down areas, and construction areas. The local electricity service would provide temporary construction power. Temporary generators could also be used until the temporary power system would be completed. Construction crews would position temporary lighting for safety and security. Local telecommunication lines would be installed for phone and electronic communications.

Water would be required during construction for various purposes, including personal consumption and sanitation, concrete formulation, preparation of other mixtures needed to construct the facilities, equipment washdown, general cleaning, dust suppression, and fire protection (DOE, 2007).

2.5.7.3 Construction Labor

Based on other coal-fueled power plant construction projects, it is estimated that an average of 350 construction workers would be employed throughout the project; however, during peak construction the projected number of employees could be as many as 600 to 700 workers on site (DOE, 2007). The Alliance expects that labor would be supplied through the local building trades. It is estimated that construction workers would work a 50-hour work week and that construction activity would not always be restricted to daytime hours.

2.5.7.4 Construction Safety Policies and Programs

Emergency services during construction would be coordinated with the local fire departments, police departments, paramedics, and hospitals. A first-aid office would be located on site for minor first-aid incidents. Trained and certified health, safety, and environmental personnel would be on site to respond to and coordinate emergency response. All temporary facilities would have fire extinguishers, and fire protection would be provided in work areas where welding work would be performed.

The natural gas and CO_2 pipeline facilities would be designed, constructed, tested, and operated in accordance with applicable requirements included in the Department of Transportation regulations in 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, and other applicable federal and state regulations, including U.S. Department of Labor Occupational Safety and Health Administration requirements. These regulations provide for adequate protection for the public and workers and prevention of natural gas pipeline accidents and failures. Among other design standards, 49 CFR Part 192 specifies pipeline materials and qualifications, minimum design requirements, and protection from internal, external, and atmospheric corrosion.

2.5.7.5 Construction Waste

Construction of the FutureGen Project would generate certain amounts of waste. The predominant waste streams during construction would include vegetation, soils, and debris from site clearing; scrap metal; hydrostatic pressure test (hydrotest) water; used oil; surplus materials; pallets and other packaging materials; and empty containers.

Surplus and waste materials would be recycled or reused to the extent practical. If feasible, removed site vegetation would be salvaged for pulp and paper production, or recycled for mulch. Construction water use would be heaviest during the CO_2 pipeline testing phase. Hydrotest water would be reused for subsequent pressure tests if practical. Spent hydrotest water would be tested to determine if it exhibits hazardous characteristics (e.g., traces of pipe oil or grease). If hazardous, the hydrotest water would be sent off site for treatment; if non-hazardous, it would be routed to the detention basin for discharge to local surface waters (in accordance with the National Pollutant Discharge Elimination System [NPDES] permit). Potential scrap and surplus materials, and used lubricant oils would be recycled or reused to the maximum extent practical.

The Alliance would ultimately be responsible for the proper handling and disposal of construction waste. However, construction management, contractors, and their employees would be responsible for minimizing the amount of waste produced by construction activities. They would also be expected to adhere to all project procedures and regulatory requirements for waste minimization and proper handling, storage, and disposal of hazardous and non-hazardous waste. Each construction contractor would be required to include waste management in their overall project health, safety, and environmental site plans. Typical construction waste management activities may include:

- Dedicated areas and a system for waste management and segregation of incompatible waste. Waste segregation should occur at time of generation.
- A waste control plan detailing waste collection and removal from the site. The plan would identify where waste of different categories would be collected in separate stockpiles, bins, etc. and clear, appropriate signage would be required to identify the category of each collection stockpile, bin, etc.

- Storage of hazardous waste, as defined by the applicable regulations, separately from non-hazardous waste (and other, non-compatible hazardous waste) in accordance with applicable regulations, project-specific requirements, and good waste management practices.
- Periodic inspections to verify that waste are properly stored and covered to prevent accidental spills and to prevent waste from being blown away.
- Appropriately labeled waste disposal containers.
- Good housekeeping procedures. Work areas would be left in a clean and orderly condition at the end of each working day, with surplus materials and waste transferred to the waste management area.

2.5.8 OPERATION PLANS

As stated in Section 2.2, DOE-sponsored activities under the FutureGen Project would include 1 year of startup (scheduled to begin in 2012); 3 years of plant operation, testing, and research; followed by 2 years of additional geologic monitoring of the sequestered CO_2. Section 2.2 describes expected research activities. However, it is generally expected that the plant would continue to operate for at least 20 to 30 years and possibly up to 50 years. After the DOE-sponsored research activities conclude, the Alliance and DOE would develop a disposition plan that addresses the future management and operation of the power plant.

2.5.8.1 Operational Labor

Operator hiring and training would begin about 1 year before the commencement of startup. Gasification area personnel would need extensive training in plant operations, reactive chemicals, and safety, industrial hygiene, and environmental compliance similar to that of operators in refineries and chemical plants. Process simulators would be used as part of the training program. Generally, the staff would consist of management and engineers, shift supervision and operations management, and shift operating personnel. The operations staff would be integrated into the commissioning team so that they would have hands-on experience with the power plant when each system becomes operational after construction.

In addition to operations and management personnel, the FutureGen Project would require qualified staffing in the following areas: power production planning; equipment maintenance; procurement; research and development; health, safety, and environmental protection; administrative support; benefits/human relations; and other necessary functions. The Alliance estimates that the plant would employ approximately 200 full-time workers (FG Alliance, 2006g).

2.5.8.2 Health and Safety Policies and Programs

Facility design features and management programs would be established to address hazardous materials storage locations, emergency response procedures, employee training requirements, hazard recognition, fire control procedures, hazard communications training, personal protective equipment training, and reporting requirements. For accidental releases, significance criteria would be determined based on federal, state, and local guidelines, and on performance standards and thresholds adopted by responsible agencies.

Basic approaches to prevent spills to the environment include comprehensive containment and worker safety programs. The comprehensive containment program would ensure the use of appropriate tanks and containers, as well as proper secondary containment using walls, dikes, berms, curbs, etc. Worker safety programs would ensure that workers are aware of, and trained in, spill containment procedures and related health, safety and environmental protection policies.

2.5.9 POST-OPERATION ACTIVITIES

2.5.9.1 Post-Injection Monitoring

One goal of the FutureGen Project is to prove the safe and effective storage of CO_2 in a deep saline formation. At a minimum, post-injection monitoring activities would be conducted in accordance with applicable UIC regulations and permit conditions. The UIC program is evolving to specifically address geologic sequestration and its long-term safety. At this time, it is difficult to precisely predict the types and frequency of post-operational monitoring and testing that may be required under the UIC program.

However, it is likely that seismic and atmospheric monitoring surveys would occur periodically after closure of the injection site. Some subset of monitoring equipment and structures installed during the period of injection may be kept in place to assess long-term, post-closure changes in surface deformation, soil gas, or atmospheric fluxes in CO_2 (FG Alliance, 2006g).

Both the Alliance and DOE acknowledge the need for continued monitoring of the sequestered CO_2 during the period of continued plume expansion or migration following cessation of injection. During the co-funded period of the project, the Alliance would apply a variety of monitoring techniques in an effort to identify those that provide the most useful and practical means of determining movement of CO_2 and storage integrity of the formation of the CO_2.

As part of the Full Scope Cooperative Agreement activities, DOE and the Alliance will develop a plan for continued monitoring of the sequestered CO_2 after completion of the project.

2.5.9.2 Final Closure Phase Provisions

The planned life of the FutureGen Project would be 20 to 30 years. However, if the facility is still economically viable, it could be operated up to 50 years. A closure plan would be developed at the time that the power plant was to be permanently closed. The removal of the facility from service, or decommissioning, may range from “mothballing” to the removal of all equipment and facilities, depending on conditions at the time. The closure plan would be provided to state and local authorities as required.

Upon completion of CO_2 injection, all surface facilities would be decommissioned, including connections between the power plant and injection wells. All exposed pipes, along with other surface facilities, would be decommissioned and removed during site closure. All wells drilled for injection or monitoring, and that intercept the target formation, would be plugged and abandoned in accordance with state and federal regulations. However, some monitoring wells could remain in place, to monitor the long-term integrity of the caprock and to test for potential leakage into aquifers above the CO_2 reservoir.

2.6 FUTURE ACTIVITIES

2.6.1 FOLLOW-ON DECISIONS AND PLANNING

No sooner than 30 days after EPA publishes a Notice of Availability (NOA) of the Final EIS, DOE will publish a Record of Decision (ROD) in the *Federal Register* that explains the agency’s decision on whether to fund the FutureGen Project and, if so, which of the alternative sites, if any, would be acceptable to host the FutureGen Project.

2.6.1.1 Design Development and Refinement

The design of the power plant and CO_2 injection process would continue to be refined until commencement of construction. Some of the assumptions made in this EIS may be modified as the design progresses. The site selected for the project would primarily affect the design elements related to supporting utilities and transportation systems. Additional utility interconnection studies of road and rail designs may be conducted.

2.6.1.2 Additional Site Characterization Activities

At the selected site, the Alliance would undertake more detailed site-characterization, which would support site-specific design work. For the power plant site, these activities could include detailed surveys and elevation measurements, soil tests to support foundation design, biological surveys if warranted, and local traffic studies. For the sequestration site, these activities could include installation of exploratory wells, seismic imaging of the target reservoir, small-scale injection tests, and additional computer simulation and modeling of plume fate and transport.

Additional site-specific information would be needed to better determine the injectivity and storage capacity of the target reservoirs as well as the integrity of the caprock. The Alliance would gather this information by drilling one or more exploratory wells into the target formation and undertaking various tests and sampling. While drilling, core samples would be taken from the target formation, the primary seal and portions of the overlying zones to determine the bulk permeability and other geologic characteristics of the rock. Well testing could include pressure and temperature readings or fluid testing as described in Section 2.5.2.2.

Well drilling activities would include the creation of a temporary or permanent access road (paved or unpaved) to the well site and installing a temporary catch basin to store produced saline water and drill cuttings. Because these wells would be thousands of feet deep, a single well could require 3 to 5 weeks of drilling depending on the well depth, diameter and formation properties.

The Alliance may also conduct seismic surveys (see Section 2.5.2.2) which are generally conducted over a very large area (larger than the predicted plume radius). The Alliance would secure permission prior to conducting these surveys from affected land owners to gain access, run geophone lines and possibly dig shot-holes. While these surveys use either very small amounts of explosives or heavy steel vibrators to produce sound waves that would be reflected by the subsurface rock layers to varying degrees, vibrations are rarely felt at the surface because the energy levels are small.

2.6.1.3 Future NEPA Activities

Based on the results of the additional site-characterization and site-specific preliminary design, DOE will complete a Supplement Analysis to determine whether a Supplemental EIS must be prepared. A Supplemental EIS would be required if there are substantial changes to the Proposed Action or significant new circumstances or information relevant to environmental concerns. If DOE completes a Supplement Analysis or Supplemental EIS, DOE would determine whether to revise its ROD.

3. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

3.1 COMPARISON OF IMPACTS OF ALTERNATIVES

3.1.1 INTRODUCTION

This chapter provides a comparison of the potential environmental impacts to physical, natural, cultural, and socioeconomic resources for all four site alternatives for the FutureGen Project.

Many of the differences in potential impacts described in this chapter relate to project features that are dependent upon the alternative site. Although the FutureGen Power Plant would be very similar regardless of the location that hosts the facility, there are notable differences in the approaches for the supporting infrastructure at the different sites. Table 3-1 highlights these differences to provide the reader with some context when examining potential impacts. The major differences among the alternatives from a siting perspective relate to the extent and need for utility corridors (e.g., process water pipeline, potable water pipeline, sanitary wastewater pipeline, natural gas pipeline, electrical transmission line, and carbon dioxide [CO_2] pipeline) and whether these lines would need new right-of ways (ROWs) or could be constructed in existing ROWs. Other differences include the approach to supply process water to the site: Mattoon proposes to use wastewater effluent from local wastewater treatment plants (WWTPs); Tuscola proposes to use primarily Kaskaskia River water pumped from an industrial neighbor's reservoir; and Jewett and Odessa propose to use groundwater sources.

3.1.2 AIR QUALITY

DOE reviewed public data and studies performed by the FutureGen Alliance, Inc. (the Alliance) to determine the potential for impacts based on air pollutant emissions from the construction and operation of the FutureGen Project. The FutureGen Project emissions of criteria air pollutants were modeled to determine potential changes to ambient air quality in relation to the national ambient air quality standards (NAAQS). Additionally, hazardous air pollutant (HAP) and mercury (Hg) emissions were estimated. Impacts related to visibility, regional haze, and nitrogen and sulfur deposition in Class I areas were also considered. DOE also reviewed the applicability of air regulations and regional air quality plans and the potential for impacts from vapor plumes and odors.

DOE used conservative emissions estimates for the Environmental Impact Statement (EIS) analysis that the Alliance developed using the highest pollutant emission rates for various technology options being considered for the FutureGen Project, as described in Section 2.5.1.1. The FutureGen Project's maximum emissions (including steady-state emissions and unplanned restart emissions) of air pollutants are estimated to be:

- Sulfur dioxide (SO_2) – 543 tons (493 metric tons) per year;
- Nitrogen dioxides (NO_2) –758 tons (688 metric tons) per year;
- Particulate matter with a diameter of 10 micrometers or less (PM_{10}) – 111 tons (101 metric tons) per year;
- Carbon monoxide (CO) – 611 tons (554 metric tons) per year;
- Volatile organic compounds (VOCs) – 30 tons (27 metric tons); and
- Hg – 0.011 ton (0.010 metric ton) per year.

Intermittent increases in emissions over steady-state facility emissions rates would be expected during plant upsets because of the need to flare process gases (syngas) for a short period of time (i.e., minutes or hours), resulting in unplanned restart emissions. These unplanned restart emissions are included in the FutureGen Project's estimates of maximum annual air emissions. The annual maximum emissions of SO_2, NO_2, PM_{10}, and CO estimated for the FutureGen Project would exceed the Prevention of Significant Deterioration (PSD) major source thresholds of 100 tons (91 metric tons) per year. The estimated annual HAP and Hg emissions would be below the PSD major source threshold of 10 tons (9.1 metric tons) per year. Because the power plant features would be the same at each alternative site, estimated source emissions of criteria air pollutants, HAPs, and CO_2 would be the same. However, the potential impacts of these emissions would be dependent on the existing ambient air quality at each site.

Construction of the proposed power plant and sequestration facilities, utility corridors, and transportation corridors would result in localized increases in ambient concentrations of SO_2, NO_X, CO, VOCs, PM_{10}, and particulate matter with diameter of 2.5 micrometers or less ($PM_{2.5}$). These emissions would occur as a result of the use of construction equipment and vehicles, including trucks, bulldozers, excavators, backhoes, loaders, dump trucks, forklifts, pumps, and generators, as well as earth moving activities. For all sites, impacts on local air quality would be short-term (i.e., during the construction phase).

Air modeling was conducted to assess the potential for impacts to ambient air quality conditions at each site from operating the proposed power plant. Because local air quality monitoring data were not available for any of the alternative sites, monitoring data from the closest attainment area to each site were used as a surrogate data for the local background ambient air quality. There are no local or regional air quality management plans for the area of any of the alternative sites. However, the regions of influence (ROIs) for the proposed locations are considered to be in attainment of the NAAQS. Table 3-2 presents the predicted concentration increases for criteria air pollutants that would result from FutureGen Project emissions and the resulting ambient concentrations.

The FutureGen Project would not result in an exceedance of the NAAQS at any of the alternative sites. However, because of high ambient concentrations of $PM_{2.5}$, several of the sites would approach the $PM_{2.5}$ 24-hour standard, with Mattoon being the closest at 93 percent of the standard. Tuscola would be at 92 percent of the standard, Jewett would be at 86 percent, and Odessa would be at 59 percent. For the annual $PM_{2.5}$ standard, Jewett would be at 92 percent of this standard, while Mattoon and Tuscola would be at 84 percent, each. Odessa would be at 52 percent of the annual $PM_{2.5}$ standard.

For areas that are already in compliance with the NAAQS, the PSD requirements provide maximum allowable increases in concentrations of pollutants, which are expressed as increments. During plant upset scenarios, the unplanned restart emissions are higher than steady-state (i.e., from normal plant operations) emissions, especially SO_2 emissions. This could result in exceedances of short-term 3-hour SO_2 Class II PSD increments at the Mattoon, Tuscola, Jewett, and Odessa sites and short-term 24-hour SO_2 Class II PSD increments at the Jewett Site. However, the probabilities of such exceedances are very low. For the 3-hour SO_2 PSD increment, the probability of exceedance during upset conditions would be 0.23 percent at the Mattoon Site and the maximum distance of impact would be 0.67 mile (1.1 kilometers); 0.22 percent at the Tuscola Site and the maximum distance of impact would be 2.55 miles (4.1 kilometers); 1.66 percent at the Jewett Site and the maximum distance of impact would be 0.58 mile (0.9 kilometer); and 0.09 percent at the Odessa Site and the maximum distance of impact would be 0.79 mile (1.3 kilometers). At the Jewett Site, the probability of exceeding the 24-hour SO_2 PSD increment during unplanned restart would be 0.2 percent and the maximum distance of impact would be 0.6 mile (0.9 kilometer). During normal plant operation, the FutureGen Project would consume a maximum of 1.75 percent (24-hr PM_{10}) at the Mattoon Site, 1.31 percent (24-hr PM_{10}) at the Tuscola Site, 2.76 percent (24-hr PM_{10}) at the Jewett Site, and 1.38 percent (annual NO_2) at the Odessa Site.

Table 3-2. Predicted Maximum Concentrations and Resulting Ambient Concentrations

Pollutant	NAAQS[1]	Mattoon		Tuscola		Jewett		Odessa	
		FG[2]	FG+A[3]	FG[2]	FG+A[3]	FG[2]	FG+A[3]	FG[2]	FG+A[3]
Concentrations During Normal Plant Operation (Steady-State)[4]									
SO_2, 3-hr	1,300	0.717	123.75	0.536	123.57	0.820	34.85	0.542	52.89
SO_2, 24-hr	365	0.262	70.93	0.197	70.87	0.415	13.51	0.188	13.28
SO_2, Annual	80	0.184	10.65	0.048	10.52	0.483	3.10	0.248	5.49
NO_2, Annual	100	0.256	30.35	0.067	30.09	0.674	27.01	0.346	15.40
PM_{10}, 24-hr	150	0.524	57.86	0.393	57.73	0.829	55.83	0.376	51.71
PM_{10}, Annual	50	0.038	26.04	0.010	26.01	0.099	26.10	0.051	18.05
$PM_{2.5}$, 24-hr	35	0.524	32.46	0.393	32.33	0.829	30.16	0.376	20.71
$PM_{2.5}$, Annual	15	0.038	12.54	0.010	12.51	0.099	13.80	0.051	7.75
CO, 1-hr	40,000	11.333	5,622.76	9.470	5,620.90	10.447	4,018.62	8.418	7,234.37
CO, 8-hr	10,000	5.005	3.462.94	4.729	3,462.66	7.879	1,954.70	4.855	3,906.86
Concentrations During Plant Upset Events (Unplanned Restart)[5]									
SO_2, 3-hr[6]	1,300	511.819	634.85	511.958	634.99	511.913	545.94	511.979	564.33
SO_2, 24-hr[6]	365	88.000	158.67	67.000	137.67	89.500	102.59	73.000	86.09

[1] NAAQS expressed in micrograms per meter cubed (µg/m^3)
[2] FG = Potential concentration increase from FutureGen emissions expressed in µg/m^3
[3] FG+A = Resulting ambient concentrations expressed in µg/m^3. Include FutureGen plus existing ambient concentrations.
[4] The normal operating scenario is based on steady-state emissions and is a period when the plant is operating without flaring, sudden restarts, or other upset conditions.
[5] Unplanned restart emissions of PM_{10} and $PM_{2.5}$ do not occur during plant upset events. Unplanned restart emissions of NO_2 and CO would be lower than steady-state emissions (i.e, <2 percent and <0.2 percent, respectively), therefore impacts would be lower than normal plant operations. Impacts of plant upset event is based on unplanned restart emissions and is a period when a serious malfunction of any part of the IGCC process train usually results in a sudden shutdown of the combined cycle units gas turbine and other plant components.

Class I Areas, those areas designated as pristine, require more rigorous safeguards to prevent deterioration of air quality and include many national parks and monuments, wilderness areas, and other areas as specified in 40 Code of Federal Regulations (CFR) Part 51.166(e) (40 CFR 51.166). The distance to the closest Class I Area for each site is 190 miles (305 kilometers) for Mattoon, 204 miles (328 kilometers) for Tuscola, 240 miles (386 kilometers) for Jewett, and 110 miles (177 kilometers) for Odessa. These distances are well beyond the 62 miles (100 kilometers) distance required to consider impacts to Class I areas under the PSD regulations. Because of the great distance to Class I areas, no air quality impacts are expected to these resources as a result of FutureGen Project emissions.

The FutureGen Power Plant at each of the proposed sites would be subject to requirements of the Acid Rain Program and would be required to offset SO_2 and NO_X emissions. Because of the advanced FutureGen Project technology, the proposed power plant would emit Hg below the Clean Air Mercury Rule limits. Because of the size of each proposed site, odors of hydrogen sulfide (H_2S) and ammonia are expected to be limited to within the facility boundary. There is the potential for solar loss, fogging, icing, or salt deposition because of the vapor plume from the cooling tower and gas turbine exhaust stack(s). However, because of the size of the proposed properties, impacts related to vapor plumes would be limited to within the facility boundary and would not interfere with quality of life in the area of any of the four sites.

The FutureGen Project would begin to capture and sequester CO_2 when the facility begins operations. With an 85 percent capture initially, FutureGen would emit to the atmosphere 0.18 to 0.45 million tons per year (0.17 to 0.41 metric tons per year). If the facility achieves the 90 percent capture and sequestration goal, FutureGen would emit 0.12 to 0.28 million ton (0.11 to 0.25 million metric ton [MMT]) of CO_2 per year when sequestration is taking place. One of the goals of the FutureGen Project is to capture and permanently sequester 90 percent of the CO_2 from the plant. Although the facility would still emit a certain amount of CO_2, it would test and implement the technology needed to advance the near-zero emissions concept. The advancement of near-zero-emission power plants could have a long-term beneficial impact of reducing greenhouse gas (GHG) emissions related to coal-fueled energy production.

3.1.3 CLIMATE AND METEOROLOGY

Climate and meteorology data were evaluated for each of the four candidate sites to provide a comparison of potential risks from extreme weather conditions at the sites. Data collected included temperature norms and extremes, average annual rainfall and snowfall, average wind speeds, a wind rose, periods of drought, and a history of extreme weather events such as ice storms, tornados, and floods.

The region of Illinois that includes the Mattoon and Tuscola sites has a greater potential for extreme weather events and can expect two or three hail storms, one snowfall of 6 inches (15.2 centimeters) or more, and one ice storm per year. Snowfall, hailstorms, and ice storms in the Jewett and Odessa regions are rare. All of the proposed power plant sites are located well above the 100-year floodplain (see Section 3.1.8).

Historical data indicate that as many as four tornados greater than F1 intensity may occur in the Mattoon and Tuscola regions over a 50-year period. Historical tornado activity is greatest in the Jewett region with data indicating a frequency of one tornado greater than F1 intensity every 5 years. The Odessa region has the lowest historical tornado activity, with one tornado greater than F1 intensity occurring every 200 years. All four sites could experience severe or extreme drought.

3.1.4 GEOLOGY

The project would sequester (inject) CO_2 in deep geologic formations (e.g., saline formations) and could impact geologic formations. Similarly, the geologic conditions or instabilities of the formation could impact the secure storage of the injected CO_2. Therefore, the potential for impacts was reviewed based on the occurrence of local seismic destabilization and damage to structures; occurrence of geologic-related events (e.g., earthquake, landslides, and sinkholes); destruction of high-value mineral resources or unique geologic formations, or rendering them inaccessible; alteration of geologic formations; migration of sequestered CO_2 through faults, inadequate caprock or other pathways such as abandoned or unplugged wells; human exposure to radon gas; and noticeable ground heave or upward vertical displacement of the ground surface.

The four sites were deemed reasonable alternatives because they met key geologic qualifying criteria that would increase the likelihood that injected CO_2 would remain permanently sequestered. These criteria addressed, but were not limited to: storage capacity; injection rates and formation permeability; primary seal thickness and expanse; and proximity of active or hydraulically transmissive faults.

DOE based its evaluation on a review of reports from state geologic surveys and information provided by the Alliance that pertain to the geological features of the proposed sequestration formations. DOE reviewed the numerical reservoir modeling of CO_2 injection, conducted by the Alliance, which showed that each site would be able to achieve the goals of the FutureGen Project. The predicted maximum extent of the CO_2 plume in the formation for injection wells located at each site was considered to be the subsurface ROI. To achieve an injection target of 55 million tons (50 MMT) of CO_2, an injection period of 20 years was used for the 2.8 million tons (2.5 MMT) per year scenario, and an injection period of 50 years was used for the 1.1 million tons (1 MMT) per year scenario. However, the reservoir model was run for 50 years in both cases. For all sites except Jewett, the largest plume radius predicted by the numerical modeling was associated with the injection of 1 MMT for 50 years. As a result of the modeling, it is estimated that Jewett would have the largest plume radius associated with the injection of 2.8 million tons (2.5 MMT) for 20 years, followed by 30 years of gradual plume spreading. These differences in plume size are due to site-specific geologic conditions. The predicted extent of the CO_2 plume for each candidate site would be as follows:

- Mattoon – Radius of 1.2 miles (1.9 kilometers); area equal to 2,789 acres (1,129 hectares), based on 1.1 million tons (1.0 MMT) injected annually for 50 years.
- Tuscola – Radius of 1.1 miles (1.8 kilometers); area equal to 2,432 acres (984 hectares), based on 1.1 million tons (1.0 MMT) injected annually for 50 years.
- Jewett – Radius of 1.7 miles (2.7 kilometers); area equal to 5,484 acres (2,219 hectares) per well, based on 2.8 million tons (2.5 MMT) injected annually for the first 20 years (radius within Woodbine formation) of a 50-year period.
- Odessa – Radius of 1.0 mile (1.6 kilometers); area equal to 2,136 acres (864 hectares) per well, based on 1.1 million tons (1.0 MMT) injected annually for the first 20 years of a 50-year period.

Each site is located in a tectonically stable region where earthquakes are not common and typically are no higher than medium in intensity. Significant structural damage to buildings from seismic events is rare. The New Madrid fault system is the closest major seismic zone for three of the sites and is approximately 200 miles (322 kilometers) from Mattoon, 230 miles (370 kilometers) from Tuscola, 400 miles (644 kilometers) from Jewett, and more than 800 miles (1,287 kilometers) from Odessa. The Rio Grande Rift system creates the nearest seismic zone to the Odessa Site and is at least 210 miles (338 kilometers) to the southwest of the proposed power plant site. The Mexia-Talco is the closest major fault to Jewett at a distance of 30 to 35 miles (48.3 to 56.3 kilometers). There are no high-value or unique geologic resources or features at any of the sites.

The proposed sequestration reservoir at each candidate site would consist of brine-filled, fine-grained sandstone. The estimated injection depths for these formations would be:

- 1.3 to 1.6 miles (2.1 to 2.6 kilometers) for Mattoon for the Mt. Simon sandstone; 0.9 mile (1.4 kilometers) for the St. Peter sandstone, optional.
- 1.3 to 1.5 miles (2.1 to 2.4 kilometers) for Tuscola for Mt. Simon; 0.9 mile (1.4 kilometers) for the St. Peter sandstone, optional.
- 1 to 1.1 miles (1.6 to 1.8 kilometers) for Jewett for the Woodbine formation; 1.7 to 2.1 miles (2.7 to 3.4 kilometers) for the Travis Peak formation, secondary.
- 0.4 to 1 mile (0.6 to 1.6 kilometers) for Odessa for the Lower Delaware Mountain Group and upper interval of the Queen formation.

Injection of CO_2 at any of the proposed sites would initially cause a slight acidification of the formation water. However, these alterations are expected to be minimal because all proposed reservoir formations consist primarily of quartz, which is very resistant to geochemical reactions. Over time (hundreds to thousands of years) the CO_2 would react with formation minerals causing slight alterations and cause the CO_2 to move from a gas or liquid phase to a solid phase. Using conservative assumptions on increases in the potential for CO_2 to displace radon, DOE concluded that it was unlikely that the U.S. Environmental Protection Agency (EPA) established action levels for radon would be exceeded as a result of CO_2 injection at any of the sequestration sites.

The primary caprock formations directly overlying the proposed sequestration formations at each of the four sites exhibit low permeability and are laterally continuous with estimated thicknesses of 400 to 700 feet (122 to 213 meters). DOE believes it unlikely that injection of CO_2 would cause fracturing or other alterations of the geologic formations at any of the sites. Site-specific fracture pressures would be established as part of the underground injection control (UIC) permitting process, and pressures in the formations would be monitored during injection to avoid or minimize fracturing. For the same reasons, it is unlikely that injection of CO_2 would cause new faults to form or induce seismicity by causing existing faults to slip. Current microseismic monitoring technology can detect very small releases of energy, and injection pressures could be reduced to prevent fault slippage.

Faults, wells, or other penetrations in the caprock could act as conduits for the migration of CO_2 from the sequestration formation. However, as part of the site-specific assessment to be conducted on the selected site, geophysical surveys would be conducted to locate existing wells and, if found to be improperly abandoned, such wells could be properly sealed and abandoned to meet state regulations and prevent CO_2 leakage. Information on faults and penetrations to the primary caprock formations for the four candidate sites is summarized below:

- At the Mattoon Sequestration Site, the Site Proponent conducted two-dimensional (2D) seismic tests and no transmissive faults were detected. The possibility exists for faults associated with a nearby anticline; however, they are likely to be sealing faults. No known penetrations of the primary caprock exist within the subsurface ROI, although numerous shallower petroleum exploration and production wells are located within the ROI.
- At the Tuscola Sequestration Site, the Site Proponent conducted 2D seismic tests and no transmissive faults were detected. A strong possibility exists for faults associated with the steep flank of a nearby anticline; however; they are likely to be sealing faults. No known penetrations of the primary caprock exist within the subsurface ROI, although numerous shallower petroleum exploration and production wells are located within the ROI.
- At the Jewett Sequestration Site, a fault has been mapped in the subsurface ROI; however, it is likely to be a sealing fault. Multiple surface faults are located within 10 miles (16 kilometers). As many as 57 oil or gas wells may penetrate the primary caprock within the subsurface ROI.
- At the Odessa Sequestration Site, no faults have been mapped in the subsurface ROI or in the general area other than quiescent basement faults located beneath the target formation. As many as 16 petroleum exploration wells may penetrate the primary caprock within the subsurface ROI.

3.1.5 PHYSIOGRAPHY AND SOILS

DOE evaluated the FutureGen Project impacts on physiography and soils to analyze the potential for permanent and temporary soil removal, soil erosion and compaction, soil contamination due to spills of hazardous materials, and changes in soil characteristics and composition.

Land disturbance would occur primarily during construction at the proposed power plant sites and sequestration sites, and could result in permanent removal or displacement of soils on up to 200 acres (81 hectares) at the plant site and up to 10 acres (4 hectares) at the sequestration site (at Mattoon the sequestration site would be on the power plant site). The impacts during construction could include erosion or compaction of soils, soil contamination due to spills of hazardous materials, and changes in soil composition (e.g., due to fill) and characteristics (e.g., infiltration rate). These impacts would be comparable for all four proposed FutureGen Project sites and would be minimized through the use of best management practices (BMPs) for erosion control, proper storage of hazardous materials, and spill prevention and response measures. The soils at all four candidate sites generally have low potential for erosion, no potential for landslides (based on topography), and minimal potential for subsidence.

After completion of construction at the power plant and sequestration sites, land disturbance would end, temporarily disturbed areas would be revegetated, and further impacts to soils would be negligible. The potential for soil contamination from minor spills of hazardous materials during operations would be low, based on the use of proper storage facilities and implementation of spill response procedures. The potential for CO_2 to reach the soil after injection into the sequestration reservoir would be negligible and was not considered as a potential cause for impacts.

Land disturbance along utility and transportation corridors would likewise occur primarily during construction and could include erosion or compaction of soils, soil contamination due to spills of hazardous materials, and changes in soil composition (e.g., due to fill) and characteristics (e.g., infiltration rate). After completion of construction along utility and transportation corridors, land disturbance would end, disturbed areas would be revegetated, and further impacts to soils would be negligible. The land areas potentially affected by construction of utilities and transportation features at the four FutureGen Project candidate sites would be as follows:

- Mattoon – Up to 25.6 acres (10.4 hectares) of land area for utility corridors and up to 15.9 acres (6.4 hectares) of land area for transportation corridors.
- Tuscola – Up to 32.4 acres (13.1 hectares) of land area for utility corridors and up to 6.7 acres (2.7 hectares) of land area for transportation corridors.
- Jewett – Up to 358 acres (145 hectares) of land area for utility corridors and up to 73 acres (30 hectares) of land area for transportation corridors.
- Odessa – Up to 341 acres (138 hectares) of land area for utility corridors and up to 1.8 acres (0.7 hectare) of land area for transportation corridors.

3.1.6 GROUNDWATER

DOE evaluated the FutureGen Project's potential to adversely affect the availability and current uses of groundwater and the potential to cause impairment of groundwater resources through construction and operational activities. The four sites meet key water availability and groundwater protection qualifying criteria.

Groundwater would not be used during construction at any of the four power plant or sequestration sites. A low probability exists that the surface activities carried out during construction could affect the quality of the groundwater; however, the use of BMPs and spill response procedures would prevent spills from reaching groundwater. Although CO_2 injection wells would be drilled through surficial aquifers used for drinking water, conductor casing would be used during drilling to avoid contamination of surficial aquifers. The three existing surficial groundwater wells located at the Mattoon Site would be properly abandoned in accordance with state and federal regulations to avoid any contamination to the aquifer.

The 3,000-gallon (11,356-liter) per minute demand for process water could be met for all four proposed sites. The proposed Mattoon Power Plant would utilize effluent from local WWTPs (e.g., surface water resources); therefore, direct impacts to the groundwater supply would not be anticipated. The process water for the proposed Tuscola Power Plant would be provided by an existing human-made reservoir that is supplied by the Kaskaskia River, which has the capacity to meet plant demand. The Kaskaskia River flow could be supplemented during periods of drought by the Mahomet aquifer. The supplemental use of this aquifer is not anticipated to affect current groundwater usage or sustainability. Both the proposed Jewett and Odessa sites would rely entirely on existing groundwater resources for process water. The Jewett Site has an excess groundwater availability of 22.6×10^6 gallons (85.6×10^6 liters) per minute, and the Odessa Site has an excess groundwater availability of 2.4×10^6 to 13.2×10^6 gallons (9.1×10^6 to 50×10^6 liters) per minute. The available excess groundwater at either site would be adequate to support the required 3,000 gallons (11,356 liters) per minute process water demand while maintaining aquifer sustainability for current and future uses.

The sequestration of CO_2 in a deep saline formation has the potential to impact groundwater resources, although this possibility is very low due to the depth and geologic characteristics of the sequestration sites. CO_2 injection is a concern for groundwater resources because it has the ability to cause pH changes, mineralization, displacement of brine water into overlying aquifers, mobilization of metals in groundwater, and leaks of CO_2 into other aquifers. However, the four sites were deemed reasonable alternatives in part because they met key geologic and groundwater criteria, including the presence of one or more primary geologic seals and lack of local seismic activity. Furthermore, impacts to groundwater would be minimized through monitoring and mitigation techniques that would identify leaks and leakage pathways that could impair overlying and usable groundwater sources.

Although a low probability, the most likely pathway for upward migration of CO_2 at each proposed site would be through improperly abandoned deep wells that penetrate the main seal of the CO_2 formation. The proposed Mattoon and Tuscola sites contain no known wells that could pose such a risk. The proposed Jewett Site has the greatest number, with up to 57 wells known to penetrate the primary seal in the ROI. The proposed Odessa Site has up to 16 wells that penetrate the primary seal in the ROI. As part of the site-specific assessment to be conducted on the selected site, geophysical surveys would be conducted to locate existing wells that penetrate the primary seal. If found to be improperly abandoned, such wells would be properly sealed and abandoned in accordance with state regulations.

The distance between the CO_2 injection zone and the deepest potable aquifers, along with the hundreds of feet of low permeability caprock formations separating them, create an unlikely probability of occurrence for upward migration of CO_2 into potable aquifers. The separation between the injection zone and potable aquifers is 1.3 miles (2.1 kilometers) at the Mattoon Site, 1.3 miles (2.1 kilometers) at the Tuscola Site, at least 1 mile (1.6 kilometers) at the Jewett Site, and 0.4 mile (0.6 kilometer) at the Odessa Site.

Construction and operations of associated utility and transportation infrastructure are not anticipated to directly impact groundwater resources at any of the four proposed sites. BMPs and spill response procedures would prevent hazardous material spills from reaching groundwater.

3.1.7 SURFACE WATER

DOE assessed construction and operation impacts to surface water resources using existing literature, studies and data. The analysis evaluated water resource capacity, water rights and regional management plans, water quality, stormwater patterns, and management plans for each proposed site. As discussed in 3.1.8, the Jewett and Odessa sites (excluding the proposed power plant sites) required field verifications to confirm the existence of the ephemeral and intermittent surface water features.

Construction of the Mattoon Power Plant may impact one jurisdictional, low-quality farm pond (see Section 3.1.8). Construction at the proposed Jewett Power Plant Site may impact several acres of low quality wetlands (see Section 3.1.8). However, due to the available acreage of both sites, these features could be avoided in the final design. There are no surface water resources directly on the proposed Tuscola or Odessa Power Plant sites.

Construction of the proposed water supply pipeline at the Mattoon Site would cross five surface waters, the proposed CO_2 pipeline at the Tuscola Site would cross seven surface waters, the proposed CO_2 pipeline at the Jewett Site would cross approximately 30 surface waters, and the proposed CO_2 and water supply pipelines at the Odessa Site would cross approximately four ephemeral and intermittent streams.

These crossings would potentially cause direct and temporary impacts to these surface waters during construction. Underground utility installation, if open trench methods are used, would cause a direct and temporary impact to surface water resources by potentially diverting stream flow within the area of utility installation and by temporarily increasing turbidity and sedimentation. BMPs outlined in the required National Pollutant Discharge Elimination System (NPDES) Permit for Construction Activities would minimize or avoid impacts. Impacts could be further avoided or reduced through use of directional drilling. Transmission lines at the Tuscola Site would cross an additional three surface waters; however, no impacts from construction are anticipated to surface water quality or flow because poles would be sited outside of these resources.

For both the Mattoon and Tuscola sites, hydrostatic test water for pipelines would involve the use of surface water, which may temporarily affect downstream users and aquatic organisms temporarily by lowering stream flow. Such impacts can be minimized by obtaining hydrostatic test water from bodies of water with sufficient flow or volume to supply required test volumes without significantly affecting downstream flow. Both the Jewett and Odessa sites would use groundwater as the hydrostatic test water source.

The 3,000 gallons (11,356 liters) per minute demand for process water can be met for all four proposed sites. The Mattoon and Tuscola sites would primarily use surface water resources. Because the Jewett and Odessa sites would use groundwater resources, direct impacts to surface water resources would not be anticipated. By using surface water as the process water source, the Mattoon and Tuscola sites have the potential to reduce surface flows within the streams and water available to downstream users. For Mattoon, the combined effluent from the Mattoon and Charleston WWTPs (7 million gallons per day [MGD] (27 million liters per day [MLD]) on average) would be sufficient to supply the FutureGen Project demand. However, reduced flow rates in Kickapoo Creek and Cassell Creek would occur. Flow rates in the Kaskaskia River are expected to be adequate even if the current Lyondell-Equistar effluent is diverted to supply the FutureGen Project due to the current water withdrawal and storage practices, which minimize adverse impacts to stream flow and the increasing flow from the upstream discharge of municipal WWTPs. However, the river could be augmented by groundwater sources if low flow occurred.

Normal operation of the FutureGen Power Plant would result in minimal to no adverse impacts from point and non-point effluent sources. The FutureGen Power Plant would use a zero liquid discharge (ZLD) system that would eliminate industrial wastewater discharges associated with plant operations. An increase of up to 200 acres (81 hectares) of impervious surface could result in non-point pollution of adjacent surface waters, as well as off-site stream channel erosion during precipitation events. However, during operation, stormwater from parking lots and industrial areas (e.g., coal storage areas) would likely be collected on site through retention ponds and recycled as additional process water for the power plant. The Tuscola, Jewett, and Odessa sites would include underground crossings of surface waters by CO_2 pipelines. In the unlikely event of a CO_2 pipeline leak near one of these crossings, surface water impacts could include a reduction in pH and localized high concentrations of CO_2 and H_2S.

3.1.8 WETLANDS AND FLOODPLAINS

DOE assessed the potential impacts to wetland and floodplain resources based on field verification (wetland delineations) and National Wetland Inventory (NWI) mapping. The Mattoon and Tuscola sites included field verification for the power plant sites and other project components (e.g., utility corridors), allowing for a quantitative analysis using potential acreage (hectares) of impacts. The Jewett and Odessa sites included field verification for only the power plant sites and relied on NWI mapping for all other project components, allowing for a qualitative assessment limited to wetland type occurring within the project component areas. This assessment was conducted in accordance with 10 CFR 1022 "Compliance with Floodplain and Wetland Environmental Review Requirements."

All four proposed sites would be subject to the Clean Water Act's Section 404 (hereafter referred to as Section 404) jurisdiction before wetland permit approval. Variables regarding utility corridors to be used, uncertainties regarding the method of construction for utilities, and Section 404 jurisdictional determination required at each of the proposed sites prevent assessment of specific acreage (hectare) mitigation requirements. The appropriate type and ratio of wetland mitigation would be determined through the Section 404 permitting process.

Planning and site design standards would be applied at each of the four proposed sites and include the location of injection wells and transmission line poles outside of the 100-year floodplain and wetland areas to avoid direct impacts to these resources. In addition, construction of utilities at all four proposed sites where wetlands are present would result in temporary wetland disturbances such as removal of vegetation, soil erosion and compaction, and sedimentation. Periodic trimming of vegetation and the potential application of herbicides would be required to control plant growth within any utility corridors during operations, resulting in conversion of forested wetlands (impacted during construction of the utility) to herbaceous and shrub wetlands. Operations at any of the proposed power plant sites and sequestration sites would not require additional fill or disturbance to wetlands or floodplains, resulting in no additional impacts to these resources.

None of the proposed power plant sites encroaches on the 100-year floodplain; therefore, no direct impacts are anticipated. The Mattoon and Tuscola Sequestration sites are located outside of the 100-year floodplain; therefore, no direct impacts are anticipated. Areas of the Jewett Sequestration Site are within the 100-year floodplain. Currently, there is no floodplain mapping available for the Odessa Sequestration Site. The proposed utility corridors for all four proposed sites would involve construction within the 100 year floodplain. However, these impacts would be temporary and could include placement of construction equipment and trenching (for underground utilities) within the 100-year floodplain. Operations of these utilities at any of the sites would not affect the floodplain; therefore, no long-term impacts are anticipated. Comparisons of stream crossings and stream impacts for each of the four proposed sites are provided in Sections 3.1.7 and 3.1.9.

The proposed Mattoon Power Plant and Sequestration Site has one jurisdictional, low-quality farm pond (0.05 acre [0.02 hectare]). This pond could be directly impacted through placement of fill during construction, or the pond could be avoided during the site layout and planning process. Up to 29.2 acres (11.8 hectares) of wetlands could be impacted along the transmission line and process water corridors.

The proposed Tuscola Power Plant Site contains no jurisdictional wetlands; therefore, construction would not directly impact wetland resources. During operations of the power plant, the Lyondell-Equistar pond (industrial retention pond) would experience water level fluctuations through process water withdrawals. Overall impacts to the pond would be minimal due to the current industrial use by Equistar for operations. Four wetland areas totaling approximately 5 acres (2 hectares) are located within the sequestration site. Up to 4.2 acres (1.7 hectares) of wetlands would potentially be impacted along the transmission line and CO_2 corridors.

The proposed Jewett Power Plant Site contains 2 acres (0.8 hectare) of low quality wetlands, 0.1 acre (0.04 hectare) of moderate quality wetlands, and up to 18 acres (7.3 hectares) of low quality ponds, which could be directly impacted through placement of fill during construction. If unavoidable, these impacts would be minimal due to the low value of these resources, which have been previously modified as part of the Jewett Surface Lignite Mine operation. NWI mapping indicates that the sequestration site contains over 43 potential wetlands and the proposed utility corridors contain over 90 potential wetland areas, respectively, which include forested, scrub-shrub, and emergent wetlands associated with streams and several on-channel impoundments (ponds). With the exception of wetlands at the power plant site, all other areas would require a wetland delineation to verify NWI mapping.

The proposed Odessa Power Plant Site contains no jurisdictional wetlands; therefore, construction and operations would not directly impact wetland resources. NWI mapping indicates the sequestration site and the utility corridors contain several surface water features (see Sections 3.1.7 and 3.1.9). With the exception of wetlands at the power plant site, all other areas would require a wetland delineation to verify NWI mapping.

3.1.9 BIOLOGICAL RESOURCES

DOE reviewed the biological resource investigations that were conducted for each of the four proposed sites. The investigations included background research to determine the aquatic and terrestrial resources present at the proposed power plant sites, sequestration sites, and utility and transportation corridors. Federal and state agencies were contacted to determine the potential for threatened and endangered species to occur within the proposed construction areas at all four sites.

There are no unique or rare aquatic or terrestrial habitats present at any of the alternative sites or corridors. Therefore, no direct impacts to these resources are expected. The majority of the land proposed for construction at the Mattoon and Tuscola sites is active cropland. Reclaimed mine land and pastureland are the principal lands at the Jewett Site, and ranch land and scrubland are the principal lands at the Odessa Site. The habitats present at each alternative site are prevalent within the respective regions.

Up to 200 acres (81 hectares) of land at the power plant site may be converted to industrial use. With the exception of the Mattoon Site, up to 10 acres (4 hectares) of land at each alternative sequestration site could also be converted to industrial use. Because the Mattoon and Tuscola power plant and sequestration sites have been actively farmed with row crops, the potential for resident wildlife populations at these sites is low. Therefore, impacts related to the displacement of wildlife communities for these sites would be minimal. The Jewett and Odessa sites provide a greater opportunity for wildlife to be present due to the lack of current intrusive human activities. As a result, resident wildlife populations within the areas to be used by the FutureGen Project would be lost or permanently displaced. Displaced wildlife would likely relocate to similar adjacent habitats that are prevalent in the respective regions of the Jewett and Odessa sites.

The proposed Mattoon Power Plant Site contains a small farm pond that may be directly impacted through placement of fill during site construction. Aquatic habitats and species would be lost; however, this impact would be minimal as the pond provides low-value habitat. The Jewett Power Plant Site contains three intermittent tributary streams and three human-made impoundments that could be directly impacted through placement of fill during site construction. Two of these features are disturbed and the third is an ephemeral stream of moderate value. Aquatic habitats and species may be lost through construction; however, this impact would be minimal as none of these features is known to contain any habitat or species that are not plentiful in this area of Texas. These features could potentially be avoided during the site layout and planning process. No surface waters exist on either the Tuscola or Odessa Power Plant sites.

Differences among the alternative sites that affect the potential for biological impacts are primarily related to the length of the various utility corridors and the type of environments they traverse. The Mattoon alternative includes up to 35 miles (56.8 kilometers) of utility corridors, most of which are associated with above ground electric transmission lines and below ground process water supply lines. Up to 18.8 miles (30.3 kilometers) of these corridors would require use of a new ROW. The corridors traverse mainly agricultural lands that contain some riparian habitats at the stream crossings. The process water supply line would cross five perennial streams, which may result in temporary and minor impacts to aquatic habitat from trenching and stream flow diversion. However, these impacts could be avoided or minimized through the use of construction methods.

The Tuscola alternative includes up to 31.9 miles (51.3 kilometers) of utility corridors, most of which are associated with above ground electric transmission lines and below ground CO_2 pipelines. Up to 16.9 miles (27.2 kilometers) of these corridors would require use of a new ROW. The below ground utility corridors would only cross intermittent streams. No impacts to aquatic habitats would be expected from construction of the corridors.

The Jewett alternative includes up to 63 miles (101 kilometers) of utility corridors, most of which are associated with the CO_2 pipeline. Up to 13 miles (20.9 kilometers) of these corridors would require use of a new ROW. These corridors traverse mixed oak/grassland and rangeland habitat, some of which is deemed as high-quality deer and turkey hunting ground. Up to 14 perennial and 39 intermittent streams may be crossed by the CO_2 pipelines, and could be temporarily disturbed during construction. Temporary and minor impacts to aquatic habitat from trenching and stream flow diversion may occur. However, these impacts could be avoided or minimized through the use of construction methods.

The Odessa alternative includes up to 128.5 miles (207 kilometers) of utility corridors, most of which are associated with the process water and CO_2 pipelines. This alternative has the greatest potential length of combined new ROW corridor (approximately 68.7 miles (111 kilometers). This corridor traverses habitats consisting of mesquite lote-bush brush and mesquite juniper brush that are typical of the region. Most of these utilities would be below ground.

There are no known federally- or state-listed rare, threatened, or endangered species on any of the four proposed sites; however, there is the potential for occurrence of listed species. The proposed Mattoon Power Plant and Sequestration Site has potential habitat for the federally-listed Eastern sand darter and the Indiana bat. Habitats for the state-listed Kirtland's snake and the federally-listed Eastern sand darter have been found in the vicinity of the process water supply line corridor. The electrical transmission line corridor associated with the proposed Tuscola Power Plant Site has potential habitat for the state-listed Kirtland's snake. The proposed Jewett Power Plant Site has potential habitat for the federally listed Navasota's ladies' tresses, and the sequestration site has potential habitat for the federally-listed Interior least tern, Houston toad, Bachman's sparrow, white-faced ibis, and rare invertebrates. The proposed Odessa Power Plant Site and corridors have potential habitat for the state-listed Texas horned lizard, which occurs within two-thirds of the land area in west Texas.

Although considered unlikely, if listed species were to occur within construction areas, they could be directly impacted through temporary loss of habitat or through casualties. Surveys would be conducted before ground breaking activities to confirm the presence or absence of species. If species were found in the vicinity of disturbance, consultation would be initiated with respective agencies to develop and implement species protection plans to avoid impacts. Consultation with the Illinois Department of Natural Resources would be initiated for a site in Illinois. In Texas, consultation would be initiated with the Texas Parks and Wildlife Department. At any site, consultation would be initiated with the U.S. Fish and Wildlife Service (FWS).

Operational impacts on biological resources would be limited to the Mattoon Site attributable to the use of wastewater effluent from the Charleston and Mattoon WWTPs that would reduce flows in Cassell and Kickapoo creeks, respectively. During extreme drought conditions, the 0.6 mile (0.9 kilometer) of Cassell Creek above the confluence with Riley Creek may be dry if discharges from the Charleston WWTP were diverted to the FutureGen facility. Because the Charleston WWTP would be a secondary source, these impacts are not considered likely. Flow would be maintained in Kickapoo Creek even under drought conditions. The diversion of the WWTP effluent from these streams and the associated reduction in flow would have minimal impacts on the state-listed Eastern sand darter that is present several miles downstream.

3.1.10 CULTURAL RESOURCES

Initial cultural resource investigations were conducted for each of the four sites under consideration. The investigations included background research designed to identify previously recorded cultural resources in the ROI for each alternative and to determine the potential for additional unrecorded cultural resources in the ROI. At the Mattoon and Tuscola sites, background research was followed by Phase I archaeological surveys within the ROI for all components of the FutureGen Project, including the power plant site, sequestration site, and areas of new utility construction. At the Jewett and Odessa sites, background research was followed by field reconnaissance surveys within the power plant sites. However, field investigations were not conducted at the sequestration sites and areas of new utility construction. Therefore, there is a greater degree of uncertainty for the presence of cultural resources for the Jewett and Odessa sites, particularly for the utility corridors and sequestration sites.

DOE has initiated consultation with Native American Tribes regarding Traditional Cultural Properties (TCPs) that may be present at the alternative sites. No responses from Tribal governments have been received that indicate the presence of TCPs at any of the alternative sites. However, consultation is ongoing (see Appendix A).

No direct or indirect impacts are anticipated at any of the four candidate power plant sites. Principal differences between the sites are related to the uncertainties for the presence of cultural resources along utility corridors and at the sequestration sites. For both the Mattoon and Tuscola alternatives, there are no known cultural resources identified for the utility corridors or the sequestration sites. However, an additional survey may be needed along a segment of the proposed electrical transmission line corridors at both the Mattoon and Tuscola sites. The need for these studies would be determined in consultation with the Illinois Historic Preservation Agency.

Because the Jewett and Odessa alternatives have longer utility corridors for pipelines, these alternatives also have a higher potential for encountering both known and unknown cultural resources. This potential is the greatest for Jewett, which contains known cultural sites along various segments of the CO_2 corridor including A-C (3 sites), B-C (15 sites), C-D (13 sites), D-F (1 site), and F-H (3 sites). In addition, 33 recorded archaeological sites were identified within the ROI for the Jewett Sequestration Site. The presence of these features results in the need for additional survey and consultation to determine the status of these cultural sites, the potential for impact to them, and mitigation that may be required if the Jewett Site was selected for the FutureGen Project.

At the Odessa Site, the Texas Historical Commission (THC) has concurred that no additional cultural resource investigations are necessary at the plant site, the CO_2 pipeline corridor east of the proposed power plant, or the proposed transmission line north of the power plant; however, an archaeological survey would be required for the proposed transmission line corridor south of the power plant, all water pipeline corridors, and for the CO_2 corridors east and west of the sequestration site. A distinguishing feature of the Odessa alternative is the potential for paleontological resources. However, because fossil-bearing rock formations are extensive throughout the region, impacts to unique or irreplaceable paleontological resources are considered low. Consultation with the THC is recommended at the Odessa Site to determine the need for cultural resource investigations associated with any new road construction or improvements to existing roads that may occur.

3.1.11 LAND USE

DOE evaluated impacts on land uses with respect to the compatibility of project construction and operations with the current land uses. Impacts were determined based on whether the project would introduce structures and uses that are incompatible with land uses on adjacent and nearby properties; whether the project would introduce structures or operations that require restrictions on current land uses on or adjacent to a proposed site; whether the project would conflict with jurisdictional zoning ordinances; or whether the project would conflict with local or regional land use plans or policies.

None of the sites are considered incompatible with proposed FutureGen Project components. In addition, none of the sites are near a national or state recreation area, incompatible with any local or regional land use plans or zoning classifications, or associated with cleanup under regulations related to voluntary site remediation programs, leaking underground storage tanks, permitted hazardous waste activities, or solid waste landfills. The proposed Mattoon Power Plant Site is in an area planned for industrial development and additional commercial and industrial development is expected over time in this area. The proposed Tuscola Power Plant Site provides a compatible setting because it is near other industrial facilities, and additional unrelated commercial and industrial development would be expected over time. Existing industrial uses occur also in the vicinities of both the Jewett and Odessa Power Plant sites.

With respect to local parks and recreation areas, the proposed Mattoon process water pipeline would have a short-term direct impact on a parallel bike path during construction, which would involve temporary closure or detour. None of the other sites are located near local parks and recreation areas.

For the Mattoon and Tuscola Power Plant sites, there would be a conversion of up to 200 acres (81 hectares) of prime farmland to industrial use (255 Land Evaluation and Site Assessment (LESA) Points at Mattoon and 239 LESA Points at Tuscola). The remaining acreages (244 acres [99 hectares] at the Mattoon Site and 145 acres [59 hectares] at the Tuscola Site) could continue to be used for existing purposes (prime farmland). Construction of the Jewett Power Plant Site would result in the conversion of approximately 200 acres (81 hectares) of range and pasture land (formerly mined and restored; not prime farmland). Also at the Jewett Site, two or three active gas well operations and a storage/maintenance area may be displaced. Construction of the Odessa Power Plant Site would result in the conversion of approximately 200 acres (81 hectares) of range and scrub land and may displace one active oil well and one active gas well.

At the Mattoon Power Plant Site, construction and operations would affect two adjacent residential properties. The Tuscola Power Plant Site construction and operations would affect three adjacent residences. Construction and operations at the Odessa Power Plant Site would affect three nearby residences. There are no residences in the ROI for the Jewett Power Plant Site.

Although stacks at any of the sites must be lighted to meet Federal Aviation Administration (FAA) regulations, Tuscola is the only site that would require FAA notification and evaluation. A 250-foot (76-meter) stack constructed at nearly any location on the proposed Tuscola Power Plant Site would extend into the controlled airspace around the Tuscola Airport. Construction would require advance FAA notification and evaluation.

At both the Mattoon and Tuscola sites, partial subsurface rights have been optioned at the proposed sequestration site (177 acres [72 hectares] at Mattoon and 289 acres [117 hectares] at Tuscola); however, all applicable subsurface rights would need to be acquired or negotiated before construction. At the Jewett Site, there is a 50-year lease option with a waiver for mineral rights for three injection wells, and for Odessa, the University of Texas controls the land and historically provides subsurface access through easements. For both Jewett and Odessa, title searches would be needed, and all rights would need to be acquired or negotiated before construction.

For the proposed sequestration sites associated with the Tuscola, Jewett, and Odessa sites, up to 10 acres (4 hectares) of land would be converted from current uses. Acreage affected would consist of prime farmland at Tuscola, ranch land or Texas Department of Criminal Justice property at Jewett, and grazing and oil and gas development land at Odessa. The Mattoon Sequestration Site would be located on the power plant site and no additional acreage would be affected.

Construction and operations associated with utility and transportation corridors would impact land use at all four candidate sites. There would be a temporary loss of existing land uses in corridors during construction. Depending on the depth of underground utilities and the need to retain a cleared ROW, it is likely that most lands within the proposed utility corridors could return to current use after construction. Corridors would be compatible with agricultural and recreational use after construction; however, the corridors would be incompatible with other uses, such as residential development. There would be a minor long-term loss of agricultural production at specific transmission line tower sites and minor long-term impacts due to vegetative maintenance in non-crop segments of any transmission line corridor. Within the proposed utility corridors for both Mattoon and Tuscola, several of the soil types have been identified as prime farmland or would be prime farmland if drained. DOE did not conduct a formal farmland conversion impact rating for these corridors because they are on existing utility ROWs or because they would not result in conversion of significant areas of soils to non-agricultural uses. Because the pipelines would be buried and the electrical transmission lines would be elevated, agricultural use of the land could continue following the construction of any new corridor.

The transmission line corridor requirements for the respective plant sites would result in temporary impacts on land uses as follows:

- The Mattoon transmission line would affect mostly agricultural and recreational land uses along 0.5 to 16 miles (0.8 to 25.7 kilometers) of corridor depending on the option selected.
- The Tuscola transmission line would affect mostly agricultural land use along 0.5 to 17 miles (0.8 to 27.4 kilometers) of corridor depending on the option selected. Under Option 2, 3 miles (4.8 kilometers) of new ROW would be required.
- The Jewett transmission line would affect range land use along up to 2 miles (3.2 kilometers) of corridor.
- The Odessa transmission line would affect mostly scrubland in one of two potential corridors (0.7 to 1.8 miles [1.1 to 2.9 kilometers]).

The pipeline corridor requirements for the respective plant sites would result in temporary impacts on land uses as follows:

- The Mattoon process water pipeline would affect mostly agricultural, recreational, and transportation land uses along 14.3 miles (23 kilometers) of corridor. The CO_2 pipeline would be constructed within the power plant site boundaries.
- The Tuscola process water pipeline would affect agricultural use and road ROW along 1.5 miles (2.4 kilometers) of corridor. The CO_2 pipeline would be constructed along 11 miles (17.7 kilometers) of existing ROWs.
- The Jewett process water pipeline would affect range land along up to 1 mile (1.6 kilometers) if an on-site well is not used. The CO_2 pipeline would be constructed mainly along cattle ranching and oil and gas production lands for up to 59 miles (95 kilometers).
- The Odessa process water pipeline would affect mainly scrubland along 24 to 54 miles (38.6 to 86.9 kilometers) of corridors depending on the option selected. The CO_2 pipeline would

affect land use along 2 to 72 miles (3.2 to 115 kilometers) of corridors, with up to 58 miles (93.3 kilometers) within existing ROW. Intra-well piping would also be required at the sequestration site.

3.1.12 AESTHETICS

DOE evaluated impacts to aesthetic resources with respect to the visual compatibility of project features to the surrounding landscape and the potential effect the project would have on those who would be able to see the facilities and its associated components (e.g., transmission lines). Generally, the degree of aesthetic impact depends on surrounding land uses and the distance between the receptor and the proposed project component. The receptors of most concern include residential and public space areas. None of the proposed power plant site alternates are located near national or state recreation areas or federal, state, or local scenic resources.

During construction, trucking and equipment activities would result in temporary impacts to aesthetic resources, such as visual intrusion and increased daytime noise, dust, and traffic, to nearby properties. Other project features that could have temporary aesthetic impacts during construction include the proposed utilities, which would be limited to the corridors, and the construction of the facilities at the sequestration sites. Except for the Mattoon Site, for which the sequestration site would be located at the power plant site, the sequestration sites consist of rural areas with low population densities. Thus, potential visibility of the construction activities at these sites would primarily be limited to travelers on adjacent roads.

During operations, the elements of the proposed FutureGen Power Plant that may cause direct and unavoidable aesthetic impacts would primarily be the tallest structures (stacks would have a maximum height of 250 feet [76 meters]), emission plumes, flare, and security lighting at the facility. During nighttime hours, plant lighting and flare would be visible to surrounding residents and travelers on roadways at a distance of 7 to 8 miles (11.3 to 12.9 kilometers). Direct and unavoidable impacts would be greatest for residential properties nearest the proposed plant site. To minimize these impacts for residences directly adjacent to the proposed power plant site, the final site layout could be configured to place the more intrusive industrial features, such as material handling facilities, away from the residential properties. Additionally, various lighting design schemes could be used to mitigate light pollution. At the proposed sequestration sites, potential visibility of operational activities would be limited to travelers on adjacent roads as the equipment would be relatively short in elevation (maximum height would be 10 feet [3 meters]) and require a relatively small acreage of land disturbance (up to 10 acres [4 hectares]). Once constructed, the degree of visual impacts from the transmission corridors would depend largely on the length of the corridors, the locations of receptors, and whether existing lines would be upgraded or new lines and ROWs would be required.

The landscape surrounding the proposed Mattoon Power Plant and Sequestration Site is primarily farmland with relatively flat topography. Two residential properties directly adjacent to the proposed power plant site, two residences within 0.25 mile (0.4 kilometer), and approximately 20 residences within a 1-mile (1.6-kilometer) radius of the site would have unobstructed views of the facility. Up to 16 miles (25.7 kilometers) of a new transmission line and ROW may be required; however, this line would mainly traverse croplands and be within 0.25 mile (0.4 kilometer) of a few residential properties.

The landscape surrounding the proposed Tuscola Power Plant Site is similar to that in the Mattoon region; however, there are two industrial facilities that are visible from the proposed site. Three residences directly adjacent to the site and seven residences within 0.5 mile (0.8 kilometer) of the site would have unobstructed views of the power plant. Site features would also be visible to several dozen residences within a 1-mile (1.6-kilometer) distance from the site. Up to 17 miles (27.4 kilometers) of additional lines or taller towers within existing ROWs may be required and would be visible to as many as 150 residential properties within 0.25 mile (0.4 kilometer) of the existing ROW. Up to 3 miles (4.8 kilometers) of a new ROW for the transmission line could be required.

Much of the proposed Jewett Power Plant Site and surrounding environs are situated in a rural area with rolling hills and lands already disturbed by gas wells and mining activities. There are no residential properties near the proposed plant site. Potential visibility of the site would be limited to a nearby mine and the NGR Limestone Generating Station. Because these are industrial facilities, the existing visual characteristics of the area would generally remain unchanged. A new 2-mile (3.2-kilometer) transmission line and ROW for the proposed power plant may be required; however, there are few, if any, residences within the ROI.

Penwell, a historic and largely abandoned oil town with three habitable residences, is located within the ROI of the proposed Odessa Power Plant Site, and remnants of its industrial past are evident throughout the region. Considerable grazing in the region has created a mostly homogenous environment dominated by scrub rangeland interspersed with bare ground. As many as four residential properties along with motorists on Interstate-20 (I-20) would have unobstructed views of the proposed plant site. There are two options for the proposed transmission corridors, one is 0.7 mile (1.1 kilometers) and the second is 1.8 miles (2.9 kilometers) and both would traverse areas devoted to natural gas and oil wells. The southern corridor option would require new lines in an existing ROW that passes through Penwell. The northern corridor option would require new lines and ROWs that would be visible from adjacent county roads.

3.1.13 TRANSPORTATION AND TRAFFIC

DOE reviewed transportation data, including existing vehicular and rail traffic volumes in the regions of the project sites. Vehicular traffic impacts were assessed using standard transportation planning methods that measure levels of service (LOS) to a particular traffic facility. Letter designations are used to assign a LOS that reflect the level of traffic congestion and qualify the operating conditions of a roadway or intersection. The levels range from A to F, with “A” representing the best operating conditions (free flow, little delay) and “F” the worst (congestion, long delays).

Potential impacts to transportation resources would arise during the construction and operation of the FutureGen Project as a result of additional employee vehicles commuting to and from the site, and from trucks and railcars delivering materials. For all of the proposed site alternates, construction- and operations-related traffic at the sequestration sites would be low and would not degrade the LOS of the surrounding county roads. Construction of utility lines would cause temporary and localized congestion, particularly where these lines would cross existing roads and provide access to the construction areas. Additional traffic for the construction of utilities would mainly impact afternoon peak periods; however, because construction of the utilities would be spread out along lengths of corridors, delays to traffic would be minor and temporary.

Construction of the new railroad sidetracks at the Tuscola, Jewett, and Odessa Power Plant sites is expected to have temporary and minor impacts to the existing rail lines at each of these sites. No rail impacts are anticipated during construction at the Mattoon Site. Impacts to the existing CSX rail operations at the Tuscola Site would be minimized through use of the existing switching facilities at the site. At the Jewett and Odessa sites, the impacts to existing rail operations would be minimized by completing construction during hours when the tracks are expected to have the lightest rail traffic.

Proposed operations-related rail traffic would result in less than two additional trains per day for all proposed power plant site alternatives. The following percentage increases to current rail frequencies would occur for the proposed power plant site alternatives:

- In Mattoon, Canadian National main line and Peoria spur would increase by 10 and 71 percent, respectively.
- In Tuscola, CSX rail line would increase up to 36 percent.
- In Jewett, the Burlington Northern Santa Fe line would increase up to 14 percent.
- In Odessa, the Union Pacific line would increase up to 11 percent.

The additional train traffic would cause 6- to 7-minute delays for two at-grade crossings on the Peoria spur (near the proposed Mattoon Site) and for one at-grade crossing on County Road (CR) 750E near the proposed Tuscola Power Plant Site. The at-grade crossing on CR 750E may require actuated gates and warning lights.

Project-related traffic for the proposed Mattoon Power Plant Site would generally be oriented toward the town of Mattoon and the new I-57/County Highway (CH) 18 interchange, and it would mainly impact State Route (SR) 121 and CR 13. During the 44-month construction period, the operation of SR 121 would temporarily degrade from LOS C to D, which represents traffic conditions approaching unstable flow; however, this is typically considered acceptable for construction periods. The operation of CR 13 (between SR 121 and CH 18) would temporarily degrade from LOS A to LOS C, which represents stable flow. Traffic during plant operations is expected to cause CR 13 (between SR 121 and CH 18) to experience a slight change in operations from LOS A to LOS B, which represents reasonably free flow of traffic. Changes to traffic signal timings may be required at the CH 18/I-57 ramp intersections to accommodate changes in the turning volumes during construction and operation of the project. The Illinois Department of Transportation (IDOT) may provide improvements to CH 13 from CH 18 to SR 121, which would cause temporary and localized traffic delays at these improvement sites during construction; however, it is expected that these improvements would be completed before construction activities at the power plant site would begin and would help minimize traffic impacts in the project area.

Construction and operations activities at the proposed Tuscola Power Plant Site would mainly impact CR 1050N and CR 750E. Both of these roadways would degrade from LOS A to LOS C during construction and from LOS A to LOS B during operations. Changes to traffic signal timings may be required at the U.S. 36/I-57 ramp intersections to accommodate changes in turning volumes at those intersections during construction and operation of the project.

Construction and operations activities at the proposed Jewett Power Plant Site would mainly impact Farm-to-Market Road (FM) 39 and State Highway (SH) 164. During construction, FM 39 would degrade from LOS B to LOS D; however, this is typically considered acceptable for construction periods. SH 164 would degrade from LOS B to LOS C. During operations, both of these roadways would degrade from LOS B to LOS C. Changes to traffic signal timings may be required at the U.S. 79/I-45 ramp intersections to accommodate changes in turning volumes at those intersections.

Construction and operations activities at the proposed Odessa Power Plant Site would mainly impact FM 1601. This roadway would degrade from LOS A to LOS D during construction and from A to B during operations. Traffic signals may be required at two key intersections on FM 1601 to accommodate changes in the turning volumes. Access to the power plant site via FM 1601 would need to be improved before initiating project construction and would require construction of a new underpass at the Union Pacific rail line near the site. The construction of this grade-separated crossing would result in temporary localized traffic delays; however, the additional traffic volume for this project component was included in the traffic analysis conducted for the proposed power plant site.

3.1.14 NOISE AND VIBRATION

DOE assessed the potential for noise and vibration impacts from construction and operation of the proposed FutureGen Project. Impacts were determined based on whether the project would conflict with a jurisdictional noise ordinance; permanently increase the ambient noise levels for receptors in the ROI during operations; temporarily increase the ambient noise levels for receptors in the ROI during construction; cause an airblast noise level in excess of 133 decibels (dB); cause a blasting peak particle velocity greater than 0.5 inch/second (12.7 millimeters/second) at off-site structures; or exceed the Federal Transit Administration's (FTA's) distance screening and human annoyance thresholds for ground-borne vibrations of 200 feet (61 meters) and 80 vibration decibels (VdB).

The impact assessment evaluated noise and vibrations generated by stationary (e.g., fixed location) sources such as construction-related and power plant operating equipment, and mobile (e.g., moving) sources such as construction-related vehicle trips and operational deliveries by rail, car, and truck. For the purposes of this analysis, all construction activities within the boundaries of the proposed project sites were considered an area-wide stationary noise source. To be conservative, noise from construction was assumed to originate at the closest site boundary to each noise receptor. Steady-state, operational noise from the power plant was assumed to occur at the center of property. DOE also evaluated noise from plant startup, unplanned restarts due to system shutdown, and equipment units installed outside of the proposed power plant's building envelope. The additional traffic generated on the rail and road transportation corridors during both the construction and operational phases of the proposed project was evaluated as part of the mobile noise source impact assessment.

DOE considered the following generally accepted relationships (Bolt, Beranek and Newman, 1973) in evaluating human response to relative changes in noise level:

- A 2- to 3-A-weighted sound measurements (dBA) change from ambient conditions is the threshold of change detectable by the human ear;
- A 5-dBA change is readily noticeable; and
- A 10-dBA change is perceived as a doubling or halving of the noise level.

Based on these relationships, DOE adopted a 3-dBA increase in the ambient noise level at sensitive receptors located adjacent to the project boundary as a threshold indicating that further detailed noise analysis (e.g., modeling) would be needed during evaluation of the final design to determine whether the potential impacts would be significant. If below the 3-dBA threshold, DOE concluded that the anticipated increase in noise levels resulting from project-related activities would not be noticeable and would require no further analysis. Residences and any schools, hospitals, nursing homes, houses of worship, and parks within the 1-mile (1.6-kilometer) ROI were considered sensitive receptors in this analysis.

During construction of the proposed power plant, noise impacts for the respective plant sites would be as follows:

- For the Mattoon Site, noise levels would increase by as much as 41 and 37 dBA at the two closest residences (30 feet [9.1 meters] from the site boundary). An increase above the 3-dBA threshold would occur within about 1.9 miles (3.1 kilometers) of the site boundary, which includes Riddle Elementary School and several dozen residences on the western side of Mattoon.
- For the Tuscola Site, noise levels would increase by as much as 45.7 dBA at the three closest residences (adjacent to the site boundary). An increase above the 3-dBA threshold would occur within about 1.9 miles (3.1 kilometers) of the site boundary, encompassing much of downtown Tuscola.
- For the Jewett Site, noise levels would increase by as much as 13 dBA at Wilson Chapel (0.25 mile [0.4 kilometer] from the site boundary) and as much as 5 dBA at Evansville Miller Cemetery (0.7 mile [1.1 kilometers] from the site boundary). No other sensitive receptors are within the radius of the 3-dBA threshold.

- For the Odessa Site, noise levels would increase by as much as 2 dBA at the closest residence (0.5 mile [0.8 kilometer] from the site boundary). No sensitive receptors are within the radius of the 3-dBA threshold.

No vibration impacts to sensitive receptors near any of the alternative plant sites are anticipated during construction.

During power plant startups and unplanned restarts, noise impacts for the respective plant sites would be as follows:

- Noise levels for the Mattoon Site would increase by as much as 21 dBA at the two closest residences and by as much as 13 dBA at three other residences within approximately 1 mile (1.6 kilometers) of the site boundary.
- Noise levels for the Tuscola Site would increase by as much as 25 dBA at the three closest residences and by as much as 15 dBA at four other residences within approximately 1 mile (1.6 kilometers) of the site boundary.
- Noise levels for the Jewett Site would increase by up to 13 dBA at Wilson Chapel (not used for regular services) and up to 9 dBA at Evansville Miller Cemetery No other sensitive receptors are within the radius of the 3-dBA threshold.
- At the Odessa Site, no sensitive receptors are within the radius of the 3-dBA threshold.

During power plant operations, noise impacts for the respective plant sites would be as follows:

- For the Mattoon Site, noise levels would increase by as much as 6 to 9 dBA at the two closest residences. An increase above the 3-dBA threshold may occur within a radius of 1.2 miles (1.9 kilometers) of the center of the site, which includes about a dozen residences.
- For the Tuscola Site, noise levels would increase by as much as 12 dBA at the three closest residences. An increase above the 3-dBA threshold may occur within a radius of 1.2 miles (1.9 kilometers) of the center of the site, which includes several dozen residences on the western side of Tuscola.
- For the Jewett Site, noise levels would increase by less than the 3-dBA threshold at Wilson Chapel, Evansville Miller Cemetery, and the closest residences.
- At the Odessa Site, no sensitive receptors are within the radius of the 3-dBA threshold.

Potential noise and vibration impacts from train operations at the respective plant sites would be as follows:

- Noise levels for the Mattoon Site during coal unloading would increase by as much as 17 dBA at the two closest residences and less than 3 dBA at three other residences within approximately 1 mile (1.6 kilometers) of the site boundary. Potential vibration impacts would occur for one residence within the FTA threshold of 200 feet (61 meters) from the rail loop, which would require additional analysis.
- Noise levels for the Tuscola Site during coal unloading would increase by less than 3 dBA at the three closest residential receptors and by up to 12 dBA at 12 other residential receptors within approximately 1 mile (1.6 kilometers) of the site boundary. No sensitive receptors are located within the FTA threshold for rail vibration impacts.

- Noise levels for the Jewett Site during coal unloading would increase by less than 3 dBA at Wilson Chapel (not used for regular services) and up to 10 dBA at Evansville Miller Cemetery. No other sensitive receptors are within the radius of the 3-dBA threshold. No sensitive receptors are located within the FTA threshold for rail vibration impacts.
- No sensitive receptors at the Odessa Site are within the radius of the 3-dBA threshold for noise impacts from coal unloading. No sensitive receptors are located within the FTA threshold for rail vibration impacts.

For all sequestration sites, the increases in noise levels during construction and operation would be below the 3-dBA threshold at the closest sensitive receptors. Nearby sensitive receptors may experience temporary ground-borne noise during borehole micro-seismic testing and surface seismic surveys at the selected site.

For utility corridors associated with all candidate FutureGen Project sites, temporary increases in noise levels impacting adjacent receptors may occur during periods of construction. During utility operations, no increases in noise levels would be anticipated.

Analysis did not include intermittent noise and vibrations generated by rail car shakers to loosen coal material from the walls of rail cars during unloading. Typically, the shakers are mounted on an assembly and are used intermittently for a 10-second period. Pneumatic or electrical rail car shakers could generate noise levels up to 118 dBA. If the shaker is used on every rail car, the shaker would be used an estimated 253 to 428 times per week. Design of coal handling equipment would be evaluated during the final design process.

Potential noise impacts from construction traffic at the respective plant sites would be as follows:

- For the Mattoon Site, noise levels would increase by as much as 8 dBA on CH 13 south of CH 18, by 4 dBA on CH 18 east of CH 13, and by 2 dBA on SR 121 near the site.
- For the Tuscola Site, noise levels would increase by up to 14 dBA on CR 750E north of U.S. 36, up to 7 dBA on CR 1050N west of U.S. 45, and less than 3 dBA on U.S. 36 east of CR 750E.
- For the Jewett Site, there are no residences along local access route FM 39; no impacts to sensitive receptors are anticipated.
- For the Odessa Site, noise levels would increase by up to 7 dBA at one residence on FM 1601 north of I-20 and by less than 3 dBA near I-20.

Potential noise impacts from operational traffic at the respective plant sites would be as follows:

- For the Mattoon Site, noise levels would increase by up to 4 dBA on CH 13 south of CH 18, less than 2 dBA on CH 18 east of CH 13, and less than 1 dBA on SR 121 near the site.
- For the Tuscola Site, noise levels would increase by as much as 9.2 dBA on CR 750E north of U.S. 36, up to 3.5 dBA on CR 1050N west of U.S. 45, and less than 3 dBA on U.S. 36 east of CR 750E.
- For the Jewett Site, there are no residences along local access route FM 39; no impacts to sensitive receptors are anticipated.
- For the Odessa Site, noise levels would increase up to 3 dBA at one residence on FM 1601 north of I-20 and less than 1 dBA near I-20.

DOE anticipates that coal rail deliveries for the proposed FutureGen Power Plant would require five trains per week on existing rail alignments.

Noise impacts along rail alignments associated with coal delivery and other train requirements during FutureGen Project operations at the respective plant sites would be as follows:

- At the Mattoon Site, the frequency of occurrence of noise at current levels from passing trains would increase by 71 percent on the Peoria spur and 10 percent on the Canadian National main line.
- At the Tuscola Site, the frequency of occurrence of noise at current levels from passing trains on the CSX rail line would increase by 24 to 36 percent.
- At the Jewett Site, the frequency of occurrence of noise at current levels from passing trains on the Burlington Northern Santa Fe rail line would increase by 14 percent.
- At the Odessa Site, the frequency of occurrence of noise at current levels from passing trains on the Union Pacific rail line would increase by 11 percent.

3.1.15 UTILITY SYSTEMS

DOE evaluated the impacts of construction and operation of the proposed FutureGen Project on existing utilities. Impacts were determined based on whether the project would affect the capacity of public water or wastewater utilities, require extension of water or sewer mains involving off-site construction, provide sufficient water capacity for fire suppression, and affect the capacity and distribution of local and regional energy or fuel suppliers.

The effect on the regional electric systems cannot be finalized until detailed studies are completed by the Midwest Independent System Operator (MISO) transmission systems for the Illinois sites (Mattoon and Tuscola) and Electric Reliability Council of Texas (ERCOT) for the Texas sites (Jewett and Odessa). Preliminary indications are that the capacity of potential transmission line interconnections would be sufficient for the project at either Illinois site. The MISO feasibility study will determine ultimate line requirements, and whether the project would be subject to curtailment under certain conditions (i.e., project output could be reduced or put offline). For both the Jewett and Odessa sites, the ERCOT studies indicate that transmission system upgrades would be needed to handle project output. These upgrades would be required before operation in 2012 or the project could be subject to curtailment.

DOE concluded that sufficient process water capacity is available to meet the demands of the FutureGen Project at any of the four alternative sites as follows:

- At the Mattoon Site, combined effluents from the Mattoon and Charleston WWTPs would provide the source of process water. These combined effluents average 7.1 MGD (26.9 MLD), which is sufficient to meet the project demands in most years. During periods of low effluent discharge, process water would be supplemented by withdrawals from an on-site reservoir, which would be refilled during periods of higher effluent discharge.
- At the Tuscola Site, process water would be obtained from the Lyondell-Equistar Chemical Company's 150-million gallon (568-million liter) holding pond, which is maintained via withdrawals from the Kaskaskia River. DOE determined that this source would be sufficient to meet the project needs.
- At the Jewett Site, a groundwater resource assessment indicates that a sustained pumping rate of 3,000 gallons (11,356 liters) per minute is attainable from the Carrizo-Wilcox Aquifer, which would meet the project demand.
- At the Odessa Site, DOE determined that sufficient groundwater is available from the High Plains, Dockum, Capitan Reef, or Pecos Valley aquifers, any of which could individually meet the project demand.

No process water discharges would occur at any alternative site because the power plant would include a ZLD system, whereby all used process water would be recycled within the plant.

All sites are located near high-volume natural gas pipelines that have sufficient capacity to meet the maximum project demand of 1.8 million cubic feet (0.05 million cubic meters) per hour.

The relatively small demand for potable water (6,000 gallons per day [22,712 liters per day]) can be met at any of the proposed sites through existing or new sources. Both sites in Illinois would likely be served by municipal water systems that have adequate capacities to support the demand; both sites in Texas would be served by newly installed groundwater wells. Also, the relatively small demand for sanitary wastewater treatment can be met at any of the proposed sites through existing wastewater treatment systems or by construction of new on-site systems. Both sites in Illinois would be served by existing WWTPs that have adequate capacity to serve the project; both sites in Texas would require the construction of on-site sanitary wastewater facilities.

Utility needs for sequestration sites would be limited to the provision of an electric service line to operate pumps and other equipment. These needs could be met for all potential project sites.

The transmission line requirements for the respective plant sites would be as follows:

- The Mattoon transmission line would be 0.5 to 16 miles (0.8 to 25.7 kilometers) in length. depending on the option selected.
- The Tuscola transmission line would traverse 0.5 to 17 miles (0.8 to 27.4 kilometers), depending on the option selected.
- The Jewett transmission line would be 2 miles (3.2 kilometers) in length.
- The Odessa transmission line would be 0.7 to 1.8 miles (1.1 to 2.9 kilometers) in length. depending on the option selected.

The pipeline requirements for the respective plant sites would be as follows:

- The Mattoon process water pipelines would traverse up to 14.3 miles (23 kilometers). The CO_2 pipeline would be constructed within the power plant site boundaries.
- The Tuscola process water pipeline would be 1.5 miles (2.4 kilometers) in length. The CO_2 pipeline would be constructed mainly along 11 miles (17.7 kilometers) of existing ROWs.
- The Jewett process water pipeline would traverse approximately 1 mile (1.6 kilometers) if an on-site well is not used. The CO_2 pipeline would be 52 to 59 miles (83.7 to 95.0 kilometers) long, depending on the option selected.
- The Odessa process water pipeline would be 24 to 54 miles (38.6 to 86.9 kilometers) long, depending on the option selected. If existing commercial CO_2 pipelines are used, new connections would traverse 2 to 14 miles (3.2 to 22.5 kilometers).

3.1.16 MATERIALS AND WASTE MANAGEMENT

DOE evaluated the impacts of construction and operation of the proposed FutureGen Project on existing regional suppliers for materials and waste disposal. Impacts were determined based on whether the project would: cause new sources of construction materials and operational supplies to be built; affect the capacity of existing material suppliers and industries in the region; create waste for which there are no commercially available disposal or treatment technologies; create hazardous waste in quantities that would require a treatment, storage, or disposal permit; affect the capacity of hazardous waste collection services and landfills; and create reasonably foreseeable conditions that would increase the risk of a hazardous material or waste release.

DOE concluded that well-established suppliers are available with sufficient capacities to meet the demands for construction of the FutureGen Project at any of the four alternative sites as follows:

- At the Mattoon Site, suppliers have the capacity to produce concrete at 500 cubic yards (382 cubic meters) per hour, asphalt at 750 tons (680 metric tons) per hour, and aggregate at 900,000 tons (816,466 metric tons) per year. Construction of a process water reservoir would increase fill and spoils handling requirements.
- At the Tuscola Site, suppliers have the capacity to produce concrete at 330 cubic yards (252 cubic meters) per hour, asphalt at 1,900 tons (1,724 metric tons) per hour, and aggregate at 4.4 million tons (4 MMT) per year.
- At the Jewett Site, suppliers have the capacity to produce concrete at 550 cubic yards (420 cubic meters) per hour and asphalt at 8,000 tons (7,257 metric tons) per day. Multiple suppliers are available for aggregate material, although production rates were not available.
- At the Odessa Site, suppliers have the capacity to produce concrete at greater than 230 cubic yards (176 cubic meters) per hour and asphalt at greater than 2,500 tons (2,268 metric tons) per day. Multiple suppliers are available for aggregate material, although production rates were not available.

DOE concluded that solid waste landfills are available with sufficient capacity to meet the demands for construction waste from the FutureGen Project at any of the four alternative sites. Both Mattoon and Tuscola have regional landfill capacity of up to 116 years at current disposal rates. Also, Mattoon and Tuscola have available space for on-site landfills if needed. Jewett has regional landfill capacity of up to 132 years at current disposal rates, as well as available space for an on-site landfill if needed. Odessa has regional landfill capacity of up to 177 years at current disposal rates, as well as available space for an on-site landfill if needed. Given the sanitary and hazardous waste disposal capacities available in the region, the impact of disposal of generated waste would be minimal.

Small amounts of hazardous waste would be generated during construction of the FutureGen Project; therefore, DOE concluded that a Resource Conservation and Recovery Act (RCRA) permit would not be required at any of the candidate sites. Five hazardous waste landfills are located within approximately 100 to 400 miles (161 to 644 kilometers) of both the Mattoon and Tuscola sites. The closest hazardous waste landfill to either site has more than 14 million cubic yards (10 million cubic meters) of available disposal capacity. The Jewett Site is within 300 miles (483 kilometers) of two hazardous waste landfills, of which the closest has 2.7 million cubic yards (2 million cubic meters) of available disposal capacity. The Odessa Site is approximately 60 miles (96.6 kilometers) from a hazardous waste landfill that has more than 5 million cubic yards (3.8 million cubic meters) of available disposal capacity.

Coal is the principal material required for operation of the FutureGen Power Plant and is an abundant resource in the U.S., including sub-bituminous Powder River Basin (PRB) coal from Wyoming and bituminous coal from Illinois, Indiana, Kentucky, and other states. The demand for coal at either the Mattoon or Tuscola site in Illinois would represent 3.5 percent of current coal consumption by electric utilities within the state. At either the Jewett or Odessa site in Texas, the plant demand would represent 1.9 percent of current coal consumption by electric utilities within the state. Other common chemicals and materials required for operations are readily available. Also, markets exist for the sulfur, bottom slag, and ash byproducts from plant operations.

Solid waste and hazardous waste generated by the plant during operations would be disposed of at landfills used for construction waste. The regional sanitary and hazardous waste landfills available at each of the four candidate plant sites have sufficient capacity to meet the demands of the FutureGen Project.

Comparable risks from onsite chemical storage requirements would occur at any of the four alternative plant sites. Precautions would be taken to prevent and mitigate the impacts of releases of hazardous materials and waste during construction and routine operations, and personnel would be trained and equipped to respond to spills when they occur.

Relatively small amounts of materials would be consumed and small amounts of waste would be generated during construction and operation or maintenance of facilities required for sequestration, utility corridors, and transportation systems. Local and national suppliers have adequate capacity to meet FutureGen Project demands for materials and waste disposal requirements at any of the four candidate sites.

3.1.17 HUMAN HEALTH, SAFETY, AND ACCIDENTS

DOE evaluated the potential effects of the proposed power plant and sequestration activities on human health and safety, as well as the potential for accidents. The potential for occupational or public health impacts was based on criteria, including occupational health risk due to accidents, injuries, or illnesses during construction and operating conditions; health risks (hazard quotient or cancer risk) due to air emissions from the proposed power plant under routine operating conditions; health risks due to unintentional releases associated with carbon sequestration activities; and health risks due to terrorist attack or sabotage at the power plant or carbon sequestration site.

The occupational health and safety assessment evaluated exposures of hazardous chemicals that could result from routine operations. Potential occupational safety impacts were estimated based on national workplace injury incidence and fatality rates obtained from the U.S. Bureau of Labor Statistics (USBLS) for similar industry sectors. From these data, the projected numbers of total recordable cases, lost workday cases, and fatalities were calculated as stated below.

Assuming an average workforce of 350 employees during construction of the FutureGen Project at any of the four candidate sites, the following annual accident rates would be anticipated:

- Total recordable cases = 20
- Lost workday cases = 11
- Fatalities = <1 (0.1)

Assuming a peak workforce of 700 employees during construction of the FutureGen Project at any of the four candidate sites, the following annual accident rates would be anticipated:

- Total recordable cases = 39
- Lost workday cases = 22
- Fatalities = <1 (0.2)

Based on an expected workforce of 200 during operation of the FutureGen Project at any of the four candidate sites, the following annual accident rates would be anticipated:

- Total recordable cases = 2
- Lost workdays cases = 1
- Fatalities = <1 (0.002)

DOE evaluated air quality impacts on human health related to HAPs potentially released during routine operation of the FutureGen power plant site and sequestration site. The assessment of potential toxic air pollutant emissions demonstrated that all health impacts for HAPs would be below the relevant EPA-recommended exposure criteria for total cancer risk (reference of 1×10^{-6}) and total hazard quotient (non-cancer hazard index of 1) at which levels no health risks are expected to occur. The total cancer risk and hazard quotient values for the FutureGen Project would be below the EPA-recommended criteria at all four candidate sites. The respective values for each site would be:

- Mattoon – total cancer risk = 0.084 x 10^{-6}; total hazard quotient = 0.0007
- Tuscola – total cancer risk = 0.022 x 10^{-6}; total hazard quotient = 0.0002
- Jewett – total cancer risk = 0.222 x 10^{-6}; total hazard quotient = 0.0017
- Odessa – total cancer risk = 0.114 x 10^{-6}; total hazard quotient = 0.0009

DOE evaluated potential accidents associated with carbon sequestration activities and their potential health effects on workers and the general public who may be exposed to the release of gases (CO_2 and H_2S) (Tetra Tech, 2007). The expected incidence of pipeline ruptures or punctures was evaluated using existing CO_2 pipeline data. The estimated failure rate of wellhead equipment during operation was based on natural gas injection-well experience. Failure frequencies for leakage scenarios were obtained from estimates of releases from existing injection sites and natural releases. The potential for accidents considered in this analysis were expressed on a per annum basis: likely (frequency $\geq$ 1 x 10^{-2}/yr); unlikely (frequency from 1 x 10^{-2}/yr to 1 x 10^{-4}/yr), and extremely unlikely (frequency from 1 x 10^{-4}/yr to 1 x 10^{-6}/yr). The following accidents were analyzed:

- Ruptures in the pipeline transporting CO_2 and H_2S from the plant to the sequestration site (considered unlikely);
- Punctures in the CO_2 pipeline (considered unlikely to likely depending on the site);
- Wellhead failures at the injection well (considered extremely unlikely);
- Slow upward leakage of CO_2 from the injection well (considered extremely unlikely); and
- Slow upward leakage of CO_2 from other existing wells (considered extremely unlikely to unlikely).

Harm caused by released gases from these types of accidents generally decreases with distance from the point of release because of mixing with air and dilution of the gases. Thus, downwind from the release point there are potential impact zones where different levels of exposure can occur and where different effects on human health can occur. When DOE calculated the number of individuals that could be affected by a particular level of exposure, those exposed to all the higher levels were counted along with those exposed to the level of interest.

DOE categorized potential impacts on humans from unintentional releases of sequestration gases as “adverse,” “irreversible adverse,” and “life threatening” as defined below:

- **Adverse Effects:** Includes all effects ranging from mild and transient effects, such as headache or sweating at lower chemical concentrations, up to but not including Irreversible (permanent) Adverse Effects. The number of individuals affected includes the people who would suffer Irreversible Adverse Effects (described below) and those who would suffer Life Threatening Effects.
- **Irreversible Adverse Effects:** Generally occurring at higher concentrations, irreversible (permanent) adverse effects may include death, impaired organ function (such as central nervous system damage) and other effects that impair everyday functions. However, the number of people included in this group includes people who suffer Life Threatening Effects (described below).
- **Life Threatening Effects:** Includes the most harmful effects occurring at exposures to the highest concentrations of chemicals and having the capability to cause death.

Impacts of CO_2 and H_2S gas releases on workers and the public depend on the location of the releases, the equipment involved, the meteorological conditions (including atmospheric stability and wind speed and direction), the direction of any release from a puncture (e.g., upwards or sideways), and other factors that would depend on the specifics of the accident.

Simulation models were used to estimate the emission of CO_2 for the aboveground release scenarios when the gas is in a supercritical state. The model simulations were conducted for the case with CO_2 at 95 percent and H_2S at 100 parts per million by volume (ppmv). The state of the contained captured gas prior to release is important with respect to temperature, pressure, and the presence of other constituents. Release of CO_2 under pressure would likely cause rapid expansion and then reduction in temperature and pressure, which can result in formation of solid-phase CO_2 (Tetra Tech, 2007). The estimated quantity of solid-phase formed was 26 percent of the volume released; therefore 74 percent of the volume released from a pipeline rupture or puncture was used as input to the simulation model for computing atmospheric releases of CO_2 and H_2S. Carbon dioxide is heavier than air and subsequent atmospheric transport and dispersion can be substantially affected by the temperature and density state of the initially released CO_2. The meteorological conditions at the time of the release would also affect the behavior and potential hazard of such a release.

The potential effects of CO_2 and H_2S releases from pipeline ruptures and punctures were evaluated using an automated “pipeline-walk” analysis. The methodology (described in Appendix D and in greater detail in the risk assessment) estimates the maximum expected number of individuals from the general public potentially affected by pipeline ruptures or punctures at every 300 meters along the proposed pipelines for each site. The analysis takes into account the effects of site-specific variable meteorological conditions and the location of pipeline ruptures or punctures. For wellhead ruptures, the potential impact zones corresponding to health-effects criterion values for H_2S and CO_2 were determined using the same model and assuming meteorological conditions that resulted in the highest potential chemical exposures. The number of individuals potentially affected within the identified impact zone was determined from population data obtained from the 2000 U.S. Census.

While CO_2 released in a pipeline accident could harm or asphyxiate people, the H_2S presents greater risks of toxic effects. The consequences of a pipeline accident are greatest at the Jewett Site. The model simulations predicted the potential for a pipeline rupture to result in life threatening effects for one person. The model also predicted the occurrence of a pipeline rupture to cause irreversible adverse effects to one individual at the Jewett Site. Among the four candidate sites, Odessa and Mattoon would have the lowest potential for adverse impacts from gas releases, with no potential for irreversible adverse or life threatening effects from a rupture or puncture.

Nonpermanent adverse effects are a concern and could possibly reach many more people. If a pipeline rupture occurs, the Tuscola and Jewett sites would have the potential for greatest number of people experiencing nonpermanent adverse effects. Depending on where or under what conditions the release occurred, DOE’s analysis indicates that seven and 52 persons, respectively, at the above two sites could potentially experience nonpermanent adverse effects from H_2S exposure attributable to a pipeline rupture. Tuscola could have the potential for one person to experience nonpermanent adverse effects from H_2S exposure attributable to an upper-bound consequence for a pipeline puncture. Jewett could have a maximum of 6 persons experience adverse effects from H_2S if a pipeline punctured occurred.

The FutureGen Power Plant would be equipped to remove most H_2S that is captured with CO_2 and to recover the sulfur. However, future power plants may more efficiently convert coal to electricity while capturing and sequestering CO_2 if they do not remove most of the H_2S from the captured gases. To further investigate this possibility, DOE and the Alliance are considering whether to perform short-duration tests of sequestration of the CO_2 without first removing most of the H_2S. These co-sequestration tests would involve pipeline transport and sequestration of CO_2 mixed with about two percent H_2S. There could be approximately two tests) that would have durations of approximately two weeks each. Because the potential risks would be much greater, additional analyses of hazards and risks would be undertaken before such tests could be performed.

Given the initially estimated risks for each site, DOE and the Alliance would undertake design modifications to reduce the risks as much as practicable. Following selection of a host site, the Alliance would undertake more detailed site characterization work and site-specific design work, including design modifications that would reduce the risks. DOE would then re-examine the potential risks as part of a Supplement Analysis or a Supplemental EIS before proceeding with funding for construction.

The risk of a wellhead failure during sequestration activities is considered extremely unlikely. Consequences associated with a H_2S release during a wellhead failure would have the highest potential for adverse effects at Jewett (as many as four persons) or Tuscola (one person) from H_2S exposure. Irreversible or life threatening effects would likely involve no more than one person. A wellhead failure at either Odessa or Mattoon would likely affect no more than one person.

Releases from upward leakage of H_2S in the injection well or other existing deep wells within the sequestered-gas plume radius are considered extremely unlikely. Among the four candidate sites, Jewett and Tuscola would have the potential for the highest numbers of persons experiencing adverse effects in the event of such an incident (0.4 to more than 26 at Jewett and 6 persons at Tuscola). Adverse effects from such an incident at Mattoon (one person) and Odessa (0.3 person) would be lower.

DOE considered potential health and safety impacts from accidents at the FutureGen Power Plant. The analyses assumed the upper-bound situation in which no design changes or extra engineering controls are used to reduce risks. In the case of a Claus unit failure caused by a plant explosion, Mattoon would potentially have the highest irreversible adverse effects on individuals (19 and 143, respectively) from SO_2 and H_2S exposure. Claus unit failure at Tuscola could potentially cause irreversible adverse effects on 15 and 115 individuals, respectively, from SO_2 and H_2S exposure. At Jewett, SO_2 and H_2S releases could cause irreversible adverse effects on 12 and 92 individuals, respectively. Odessa would potentially have the lowest irreversible adverse effects on individuals from exposure to SO_2 (12) and H_2S (2).

Potential life threatening effects from SO_2 exposure due to a Claus unit failure would range from a high of 10 individuals at Mattoon to one individual at Odessa. H_2S releases due to a Claus unit failure would potentially have life-threatening effects ranging from a high of four individuals at Mattoon to zero individuals at Odessa. The Riddle Elementary School in Mattoon would be located outside of the area where irreversible effects from SO_2 could occur if the Claus unit were not located near the southeast boundary of the Mattoon Power Plant Site. However, the Alliance would not select the Mattoon Site unless they can ensure that the placement of the proposed power plant and appropriate design and mitigation measures avoid any potential for serious effects at the school. If sulfuric acid can be produced and sold, the need to produce elemented sulfur and, and therefore, the need for the Claus unit and the risks associated with it would be eliminated.

The potential for spills of chemicals associated with the power plant would be the same regardless of the site because the operation of the power plant would be the same at each location. However, the potential effects of a large spill could differ depending on the proximity of residences and facilities to the site. Three scenarios were evaluated to estimate the potential for effects from ammonia releases: a leak from a tank valve, a tanker truck spill, and a tank rupture. Both workers and the general public could be affected by a release due to the two large spills from a tanker truck spill and a tank rupture. The distances where effects could occur differ between the sites due to differences in maximum air temperature. The furthest distance was for a tanker truck spill, since the ammonia spill could be outside of the containment dike.

The estimated distances within which adverse effects could occur from the tanker truck release are:

- Mattoon - 14,763 feet (4,500 meters);
- Tuscola - 14,107 feet (4,300 meters);
- Jewett - 15,092 feet (4,600 meters); and
- Odessa - 15,584 feet (4,750 meters).

At two of the sites, Mattoon and Tuscola, there are residences within the estimated distances from the proposed power plant site where adverse effects on the general populace could occur. At Jewett, workers at the nearby mine and existing generating station could possibly be affected.

As with any U.S. energy infrastructure, the FutureGen Project could potentially be the target of terrorist attacks or sabotage. DOE evaluated the potential impacts from a sabotage or terrorism event by examining the results of the accident analyses of major and minor system failures or accidents at the proposed plant site and gas releases along the CO_2 pipeline(s) and at injection wells. The accident analyses evaluate the outcome of catastrophic events without determining the motivation behind the incident. The accident analyses evaluated potential releases from pipelines, wellheads, and major and minor system failures/accidents at the proposed power plant site and these accidents, as described above, could also be representative of the impacts from a sabotage or terrorism event.

3.1.18 COMMUNITY SERVICES

Effects on community services were assessed with respect to law enforcement, fire protection, emergency response, health care services, and the local school system. Evaluations were made based on whether these services would be affected as a result of the proposed project. It was determined that temporary impacts during the construction period would depend in large part upon the number of temporary construction workers who would relocate to the area for employment. Although the number of relocating workers is uncertain, it is anticipated that temporary construction worker impacts to community services would be minor at all four proposed sites.

There are an adequate number of law enforcement, fire protection, and emergency response services at all four sites to accommodate the increased temporary population during construction; therefore, no impacts are anticipated to these services. The ratio of hospital beds would remain unchanged for all four sites and, therefore, no impacts are expected to health care capacity. It is not anticipated that construction workers would relocate with their families for temporary employment and, as a result, there would be negligible impact to local schools.

Similarly, it was also determined that impacts to community services during the operational phase of the proposed facilities would be minor at all four proposed sites, less than a 1 percent reduction to the capacity for these services.

3.1.19 SOCIOECONOMICS

Socioeconomics impacts were assessed with respect to demographics, regional economics, availability of the workforce, and housing. Evaluations were made based on whether the project would cause displacement of an existing population; alter projected rates of population growth; cause demolition of existing housing; affect on housing demand; cause displacement of existing businesses; affect on local businesses and the economy; cause displacement of existing jobs; affect on local employment or the workforce; and create new employment and economic benefit.

Positive direct and indirect impacts would occur for each of the alternative sites due to increased economic activity related to the creation of 200 new direct jobs, as well as up to 220 indirect or induced jobs. Positive, short-term impacts would also occur at each site during the construction period as a result of construction jobs (between 350 and 700) and associated construction activities. In addition, tax revenues related to FutureGen Project property improvements and associated property tax, as well as public utility tax generated by the facility, would be expected for each alternative. However, projected increases to property and sales tax revenue maybe less than anticipated if the state or local government were to waive or reduce usual assessments as an element of its final offer to the Alliance.

Principal differences between the alternatives are related to the presence of residential properties near the proposed sites, and the potential for decreased property values for those residences. For both of the Texas alternatives, there are no properties near the respective sites that would be affected. Therefore, the housing markets for these alternatives would not be impacted.

Two residences are located adjacent to the Mattoon Site, two other residences are located within 0.25 mile (0.4 kilometer), and 20 additional residences located within 1 mile (1.6 kilometers) may have an unobstructed view of the site. Similarly, three residences are located adjacent to the Tuscola Site, seven residences within 0.5 mile (0.8 kilometer), and several dozen residences within 1 mile (1.6 kilometers) may have an unobstructed view of the site. Direct and adverse long-term impacts on property values in relation to comparable property values in each site's respective markets may occur for the properties adjacent to alternative sites. In addition, values for residences that are further from the site but that would have an unobstructed view of the facility may also be adversely affected. The degree to which property values would be affected is uncertain because there are many variables associated with real estate markets and public sentiment related to industrial facilities.

3.1.20 ENVIRONMENTAL JUSTICE

DOE used demographic information from the U.S. Census Bureau 2000 census to characterize low-income and minority populations, as defined under Executive Order (EO) 12898, within 50 miles (80 kilometers) of the proposed power plant site, sequestration and reservoir sites, and utility and transportation corridors (59 *Federal Register* 7629). The extent of environmental and socioeconomic impacts and anticipated health effects were used as the basis of the impact analysis on populations identified under EO 12898. As a result of this analysis, no populations defined by EO 12898 would be anticipated to experience a disproportionately adverse effect resulting from the construction or operation of any of four proposed power plant sites, sequestration sites and reservoirs, and associated utility and transportation corridors.

No minority populations as defined in EO 12898 exist within the ROI for either the Mattoon or Tuscola sites. Both the Jewett and Odessa sites have minority populations; however, these populations are interspersed among the ROIs. Therefore, impacts resulting from construction and operations identified in other resource areas throughout this EIS were determined not to have a disproportionately high and adverse effect to minority populations for these sites. One of the sequestration wells for the proposed Jewett Sequestration Site would be located within property of the Texas Department of Criminal Justice. The greatest potential health effect, considered unlikely, to this population and the general population was determined to be a release of H_2S from a pipeline rupture (see Section 3.1.17). A potential risk could also occur at all four sites from a catastrophic accident, terrorism, or sabotage; however, the risk of terrorism or sabotage cannot be predicted.

For all sites, low income populations are located within the ROI when compared to regional and national percentages; however, the percentages of these populations are far below the 50 percent low income threshold defined in EO 12898. In addition, any impacts related to construction that would affect the environment of these populations, would be temporary and not considered disproportionately high and adverse. Short-term job creation during construction may benefit low-income populations. In addition, impacts resulting from operations identified in other resource areas throughout this EIS were determined not to have a disproportionately high and adverse effect to these populations. Long-term job creation during construction may benefit low-income populations.

This section provides a summary comparioson of the potential environmental impacts to physical, natural, cultural, and socioeconomic resources for the four site alternatives for the FutureGen Project. Impacts are provided in comparative form in Table 3-3.

3.2 INCOMPLETE AND UNAVAILABLE INFORMATION

Under the National Environmental Policy Act (NEPA), federal agencies must disclose incomplete or unavailable information, if such information is essential to a reasoned choice among alternatives, when evaluating reasonably foreseeable significant adverse impacts on the human environment in an EIS and must obtain that information if the overall costs of doing so are not exorbitant (40 CFR 1502.22). If the agency is unable to obtain the information because overall costs are exorbitant or because the means to obtain it are not known, the agency must:

- Affirmatively disclose the fact that such information is unavailable;
- Explain the relevance of the unavailable information;
- Summarize existing credible scientific evidence that is relevant to the agency's evaluation of significant adverse impacts on the human environment; and
- Evaluate the impacts based upon theoretical approaches or research methods generally accepted in the scientific community (40 CFR 1502.22).

This section discusses areas where information is unavailable or incomplete and its relevance to the range of environmental impacts. Because the FutureGen Project would be conducted to research and develop technologies related to coal gasification, power generation, and carbon capture and sequestration, the project's aim is to fill existing knowledge gaps and generate data that are currently unavailable with regard to these technologies.

Some data are unavailable or incomplete due to the high costs involved in obtaining data for all the candidate sites, such as geologic data that can only be gathered through drilling wells thousands of feet deep. Under this example, subsurface data would be collected after site selection. However, there are overall uncertainties relating to sequestration technology and the approach to conducting risk assessments for these projects. Incomplete or unavailable information relating to the area of carbon sequestration is discussed in Section 3.2.1 and incomplete or unavailable information relating to the risk assessment for the project is discussed in Section 3.2.2.

The FutureGen Project is in the initial conceptual design phase and the configuration, goals, and research plans for the project have not been finalized. Therefore, unavailable and incomplete information regarding project features as they relate to some environmental resources would only become available at a later stage of design and site characterization, as this information pertains to a more complete design. Areas where information is unavailable or incomplete related to the project design are discussed in Section 3.2.3. Areas where information is unavailable or incomplete related to site-specific conditions are discussed in Section 3.2.4.

3.2.1 OVERALL DATA GAPS ASSOCIATED WITH CARBON CAPTURE AND GEOLOGIC SEQUESTRATION

The concept of CO_2 capture and storage as a means of reducing CO_2 emissions is based on a combination of known technologies. The FutureGen Project's integrated gasification combined-cycle (IGCC) power plant would provide for large-scale integrated testing of pre-combustion CO_2 capture technologies that are still being developed. As a research project, the FutureGen Project would address a number of coal gasification and CO_2 capture technology gaps to advance the science of CO_2 capture and sequestration.

Many of the technology gaps associated with coal gasification and CO_2 capture are engineering problems or challenges that the FutureGen Project would attempt to solve in a way that makes these technologies economically viable in future power plants. However, some areas related to the fate, movement, impacts, and risks associated with CO_2 that is injected underground are not entirely understood and may be considered scientifically controversial. A substantial body of information on the transport and storage of gases injected underground already exists and is derived from the geologic storage of natural gas, the deep injection of hazardous waste, and the injection of CO_2 in hydrocarbon reservoirs for enhanced oil recovery (EOR). However, several issues related to the transport and long-term geologic storage of CO_2 require further consideration.

The Intergovernmental Panel on Climate Change (IPCC) Special Report on Carbon Dioxide Capture and Storage (IPCC, 2005) discussed gaps in knowledge surrounding the capture of CO_2 and its geologic storage. The first gap identified in this report is the lack of experience with CO_2 capture from large coal-fueled and natural-gas-based power plants on the order of several hundred megawatts. This knowledge would be gained through implementation of the FutureGen Project. The second was the need for a better understanding of long-term storage, migration, and leakage processes of injected CO_2 through the implementation of more pilot and demonstration storage projects in a range of geological, geographical, and economic settings. Again, implementation of the FutureGen Project would create an opportunity to better understand these issues. The third knowledge gap is related to the legal and regulatory requirements for implementing CO_2 sequestration on a larger scale. While the EPA's UIC Program primarily governs the underground injection of fluids in the U.S., a standardized national framework to facilitate the implementation of geologic storage and address long-term liabilities has not yet been developed. Lastly, there is insufficient information regarding the potential contribution of CO_2 sequestration activities to the long-term global mitigation and stabilization of GHG concentrations.

3.2.2 FUTUREGEN RISK ASSESSMENT

In addition to the knowledge gaps described above, several other knowledge gaps were identified during the development of the FutureGen Risk Assessment (Tetra Tech, 2007). The additional data gaps were related to pipeline transport, CO_2 storage, toxicity characterization, and risk assessment methodology. These are discussed in the following subsections.

3.2.2.1 Pipeline Transport

CO_2 pipelines extend over more than 1,550 miles (2,494 kilometers) in the western U.S., and carry 50 million tons (45.4 MMT) of CO_2 annually. For example, the Dakota Gasification Plant in North Dakota delivers more than 5,500 tons (4,990 metric tons) per day of CO_2 and H_2S through a 200-mile (321.9-kilometer) pipeline to Weyburn, Canada, for EOR operations. In general, CO_2 pipelines in the U.S. operate safely with a low incidence of accidents. There were only nine reported with large volume releases [over 1,000 barrels] from 1994 to 2006, and there were no injuries or fatalities associated with any of them (OPS, 2007). However, the results of the FutureGen Risk Assessment showed that potential pipeline ruptures and leaks would represent a primary source of risk associated with operation of the FutureGen Project. Because the plant could operate for up to 50 years, it becomes more likely that at least one pipeline accident and resulting CO_2 leak would occur over the entire plant lifetime. To develop more accurate failure probabilities, additional information on frequencies of failure for CO_2 pipelines by type of failure for different-sized pipelines over a range of environmental conditions is necessary.

Defined mitigation methods for pipelines include increasing pipeline thickness, adding automatic safety shutoff valves, and monitoring various operating parameters (e.g., pressure and temperature). Models of releases must take into account the potential phase changes that can occur upon release. Therefore, a refined model to compute the mass of CO_2 released from a rupture or hole that incorporates the effect of decreasing pressure and temperature as a function of time over the duration of the release is needed. This refined model should also determine the percent of liquid droplets and solid phases present as a function of enthalpy-pressure-temperature phase relationships for supercritical CO_2 gas and for mixed CO_2 and H_2S gas.

3.2.2.2 CO_2 Storage

The information from analog sites presented in the FutureGen Risk Assessment provides strong evidence that CO_2 can be safely stored in well-characterized saline aquifer storage sites. Preliminary simulation modeling to support this inference was presented in the Environmental Information Volumes (EIVs) and the Initial Conceptual Design Study (FG Alliance, 2006a-d and 2007). The Alliance used available data from all sites to estimate preferential flow of CO_2 in different rock layers. However, due to limited data, the distribution of rock properties within the formation around the injection well and the parameters defining the hydrologic and transport properties of the formation are uncertain. The simulations, therefore, assume 100 percent radial symmetry, which is rarely encountered under actual geologic conditions. If the target formations are significantly heterogeneous in the horizontal direction – which they often are – then the plume size could be correspondingly larger in one direction and much smaller in the other. Site-specific subsurface data would be gathered after site selection to allow the models to better predict the fate and transport of the injected CO_2 over time. These models would be validated over time by comparing the results to monitoring data.

In addition, injected CO_2 is anticipated to lower the aqueous pH in the formation to values approaching 3.5, which can affect the dissolution of host minerals and cause subsequent precipitation of carbonates. However, it was assumed that the time scales for mineralization reactions to significantly affect the amount of CO_2 in the supercritical phase were well beyond the time periods of interest. Consequently, the simulations did not consider chemical reactions over time for each formation, and the effects of chemical reactions on the plume's size and migration is uncertain.

Overall, there is some degree of uncertainty related to undetected faults, wells, or other leakage pathways. Additional site-specific investigation and study would provide more complete data to help alleviate some of this uncertainty, and monitoring during and after the injection period would assist in identifying leakage pathways.

3.2.2.3 Incomplete or Unavailable Geologic Data

Mattoon and Tuscola

There are no site-specific data with regard to the porosity and permeability of the target Mt. Simon formation, because the nearest well that penetrates the formation is 36 miles (57.9 kilometers) from the proposed Mattoon Site and 56 miles (90.1 kilometers) from the proposed Tuscola Site. This information would be gained via test borings after site selection. The thickness of the Mt. Simon formation is considerably uncertain because the formation was deposited on an eroded, high-relief surface, and thicknesses have been observed to vary by hundreds of feet over small distances. Porosity and permeability are unknown because most of the data in the Mt. Simon formation is from shallower gas storage locations, and porosity and permeability usually decrease with depth, are especially below 1.5 miles (2.4 kilometers). Reduced permeability could impact injectivity; however, sensitivity analyses indicate injectivity could be 33 to 50 percent lower than expected, but still be sufficient to meet the project objectives. The Eau Claire seal, which is a mixed siltstone-shale layer, also has not been penetrated at the site, so its properties are uncertain. While the Eau Claire seal is well documented as a good seal for natural gas storage at other locations, if it has more siltstone than shale at the Mattoon or Tuscola sites, the seal is not likely to be as effective as if it is predominantly shale. The characterization of the seal is relevant to its ability to safely store the injected CO_2.

Jewett

Due to the high number of oil and gas wells in the region, a large amount of data are available with regard to subsurface characteristics near the Jewett injection site. However, there are some areas of unavailable or incomplete information, including:

- The possibility of reactivation of the existing normal faults within the plume area. However, with appropriate monitoring, fault reactivation would most likely be detected and mitigated by reducing injection pressures or moving injection to a new well.
- The number of wells penetrating the primary seal. Although a record search indicates that between eight and 57 deep wells penetrate the primary seal at one of the planned injection sites, this is an area of slight uncertainty. More importantly, the ability to locate and remediate all such wells could impact the permanence of the CO_2 storage. However, with thorough detection and characterization efforts at the injection site, the uncertainty regarding leakage pathways such as undocumented wells and their potential impacts, would be reduced or eliminated.

Odessa

Due to the high number of oil and gas wells in the region, a large amount of data are available with regard to subsurface characteristics near the Odessa injection site. However, there are some areas of unavailable or incomplete information, including:

- The number of wells penetrating the primary seal. Although at least 16 deep wells penetrate the primary seal at the injection site, this is an area of slight uncertainty. The ability to locate and plug, if necessary, remediate all such wells could impact the permanence of the CO_2 storage. However, with thorough detection and characterization efforts at the injection site, the uncertainty regarding leakage pathways (i.e., undocumented wells) and their potential impacts would be reduced or eliminated.
- The permeability and injectivity of the Queen and Delaware Mountain sandstones. If these parameters are lower than expected, the number of injection wells would need to be increased.
- Extent or integrity of the seal. The lack of hydrocarbons may be due to the lack of a seal, either laterally between the basin slope sandstones and the carbonate platform deposits, or vertically through the Upper Queen and Seven Rivers seals. However, with thorough characterization of the seals, the uncertainty regarding leakage pathways and their potential impacts would be reduced or eliminated.

3.2.2.4 Reservoir Modeling

In addition to the data gaps relating to the subsurface environment at the injection sites, several global scientific uncertainties associated with CO_2 storage should be considered. There is a need for reliable and readily available models to simulate not only storage volume, but also the geochemical and geomechanical processes that affect long-term storage and flow of CO_2 and CO_2-H_2S mixtures. These models need to address precipitation-dissolution reactions that affect the solubility and transport of CO_2 in the aquifer and the storage of CO_2 in mineral form. Also, these models should provide reliable probabilistic predictions of leakage rates from storage sites. Estimates of the sensitivity of these predictions to model inputs and outputs are crucial to extending the understanding of long-term CO_2 storage.

3.2.2.5 Subsurface Ecosystems

The scientific community has paid little attention to the impacts of subsurface ecosystems due to geologic sequestration. Although surficial microbial ecology has been extensively researched, far less work has been conducted to investigate deep, sub-soil microbial communities and the wider ecological interactions they may have. The overall functions of these deep microbial communities are unknown and the impacts on these ecosystems due to CO_2 storage are largely uncertain, but could be substantial (Johnston and Santillo, 2002). In the absence of any scientifically credible information regarding the existence, function, or value of such organisms, DOE believes that the potential for impacts is not a reason to abandon the opportunities for capture and storage of CO_2 - a GHG that contributes to global warming.

3.2.2.6 Risk Assessment Methodology

The approach to risk analysis for CO_2 capture and sequestration in geologic formations is still evolving. However, a substantial amount of information exists on the assessment and management of releases and leakage associated with natural-gas storage, deep injection of hazardous waste, and the injection of either gaseous or supercritical CO_2 in hydrocarbon reservoirs for EOR. The FutureGen Risk Assessment relied heavily on the technical approaches and findings from these previous and ongoing projects. The risk assessment also used site-specific information and a common set of performance characteristics and hazard scenarios to provide a basis for comparing the four candidate sites selected by the Alliance.

A key contribution of the FutureGen Risk Assessment was the development and use of data for natural and engineered analogs to estimate leakage rates from the saline-aquifer storage sites. Both qualitative and quantitative analyses were conducted to evaluate risks from potential releases. A qualitative risk screening of the four candidate sites was presented based upon a systems analysis of the site features and scenarios portrayed in the conceptual site models developed for each site. Risks were qualitatively weighted and prioritized using procedures identified in a health, safety, and environmental risk screening and ranking framework for geologic CO_2 storage-site selection (Oldenburg, 2005). Quantitative evaluations were based on model simulations of subsurface leakage.

The FutureGen Risk Assessment applied new approaches and contributed to the advancement of risk and assessment methodologies. With the expected expansion of CO_2 capture and storage projects, there is a need for standardized, streamlined, and readily available tools and methodologies to conduct quantitative comprehensive assessments of risks to human health and the environment.

3.2.3 INCOMPLETE OR UNAVAILABLE INFORMATION RELATING TO THE FUTUREGEN PROJECT DESIGN

Some unavailable and incomplete information regarding project features as they relate to some environmental resources would only become available at a later stage of design. Data gaps relating to the design of the FutureGen Project, and the degree to which they would influence the range of environmental impacts, are shown in Table 3-4.

Table 3-4. Incomplete or Unavailable Information Relating to the FutureGen Project Design

Resource Area	Incomplete or Unavailable Information	Relevance to the Potential Environmental Impacts
Air Quality	Maximum and steady-state air emissions	Air emissions from the FutureGen Project would be influenced to a great degree by the project's final design and components. Reasonable estimates were made based on three potential gasifiers and three example coals. Emissions (i.e., unplanned restart emission) from a number of unplanned outages (i.e., plant upset) were also estimated to account for the typical engineering hurdles encountered historically with the startup of coal gasification plants. Although there is some uncertainty related to air emissions and the project's ability to meet its target emission goals, the EIS provides a reasonable upper bound. Therefore, the range of air emissions estimated is adequate to determine the worst-case impacts of the Proposed Action.
Soils, Wetlands, and Surface Water	Site layout of facilities	The extent of impacts to soils, wetlands, and surface water on the power plant and sequestration sites would be influenced to a great degree by the site-specific layout of power plant buildings, structures, on-site utilities, roads, and rail. While the site layout would be determined after site selection, the analysis of these resources assumed a maximum disturbance footprint of up to 200 acres (81 hectares) and analyzed the impacts that would occur if wetlands and surface water features within the site could not be avoided.
Groundwater and Surface Water	Disposition of wastewater from on-site sanitary WWTPs; disposition of saline water extracted from sequestration reservoirs	Sanitary wastewater at the two Texas sites would be treated through an on-site WWTP. The disposition of the treated wastewater could include recycling it back to the power plant for process water, or releasing it to groundwater or surface water. Furthermore, saline water may be extracted from the sequestration reservoirs to alleviate formation pressures associated with CO_2 injection. The disposition of the treated sanitary wastewater and extracted saline water would be based on site-specific considerations. Although the analysis acknowledges all of these concerns, estimates of their impacts would be too speculative. Although BMPs and compliance with federal and state regulations provide some protection and would minimize environmental impacts, some water degradation could still occur if water was discharged back to surface water or groundwater. Therefore, the impacts to groundwater and surface water under these cases would need to be further examined in a Supplement Analysis.
Aesthetics	Degree of visual screening and architectural design	The level of visual intrusion of the power plant would be influenced to a great degree by its final design and layout. DOE considered two artistic concepts of the proposed FutureGen Power Plant to depict a range of aesthetic impacts from the project. One concept is of a typical power plant with minimal screening and architectural design, while the second concept includes extensive screening and architectural design. DOE compared and contrasted the two concepts to assess the relative level of visual intrusiveness for each.
Transportation and Traffic	Quantities of materials delivered and byproducts produced, and their method of transportation	The quantities of materials consumed and byproducts produced by the project would be influenced to a great degree by its final design and components. Reasonable estimates were made based on similar IGCC projects and the Initial Conceptual Design Report (ICDR). There is some uncertainty related to material and waste quantities and the transportation methods and numbers of trips.

Table 3-4. Incomplete or Unavailable Information Relating to the FutureGen Project Design

Resource Area	Incomplete or Unavailable Information	Relevance to the Potential Environmental Impacts
Noise	Noise profiles of power plant equipment, proximity of noise sources to receptors, and types and quantities of construction equipment	The noise generated during construction and operation of the power plant would be influenced to a great degree by its final design, components, site layout, and related traffic. Reasonable estimates were made for construction equipment and operational noise sources based on similar IGCC projects. The noise analysis assumed that on-site noise sources would be located 50 feet (15.2 meters) from the site boundary and nearest receptor, which is a very conservative estimate. Therefore, the potential noise levels estimated are worst-case and more refined results are desirable.
Materials and Waste Management	Quantities of materials delivered and byproducts produced; disposition of byproducts and waste	The quantities of materials consumed and byproducts produced by the construction and operation of the project would be influenced to a great degree by its final design and components. Reasonable estimates were made based on similar IGCC projects and the ICDR. Although there is some uncertainty related to material and waste quantities, the EIS provides reasonable estimates. The disposition of byproducts and waste is unavailable and would be based on site-specific conditions.

3.2.4 INCOMPLETE OR UNAVAILABLE INFORMATION RELATING TO THE AFFECTED ENVIRONMENT

There is incomplete or unavailable information with regard to aspects of the affected environment. Data gaps and the degree to which they would influence the range of environmental impacts are shown in Table 3-5.

Table 3-5. Incomplete or Unavailable Information Relating to the Affected Environment

Resource Area	Incomplete or Unavailable Information	Relevance to the Potential Environmental Impacts
Geology	Site-specific geologic data at the sequestration sites	Unavailable or incomplete information relating to geology at the sites and its bearing on geologic sequestration and the FutureGen Risk Assessment analysis are provided in Section 3.2.2.3.
Surface Water	Current and future water levels in streams receiving effluent near the Mattoon and Tuscola sites	The Mattoon Site would receive its process water from the effluent of municipal sanitary WWTPs in Mattoon and, possibly Charleston. The Tuscola Site would receive its process water from the Kaskaskia River. By diverting this water away from associated streams, surface water levels could drop locally. DOE reviewed reports from U.S. Geological Survey, EPA, and the Illinois Environmental Protection Agency (IEPA) to assess the potential impacts of the proposed FutureGen Project on surface water resources. Although site-specific data were not available, data from area discharge points and sample locations monitored by the agencies previously mentioned were evaluated. Best professional judgment was applied to determine the likelihood of surface water impairments in the area. Therefore, the estimated flow changes to surface waters are adequate to determine the impacts of the Proposed Action.

Table 3-5. Incomplete or Unavailable Information Relating to the Affected Environment

Resource Area	Incomplete or Unavailable Information	Relevance to the Potential Environmental Impacts
Transportation and Traffic	Data on LOS at road intersections and traffic accident data	Information is not available with respect to turning movements and LOS at all intersections within the ROIs for the sites. However, DOE identified key intersections and estimated the LOS qualitatively based on the relative volumes of traffic on the intersecting roadways. No general methods are available for estimating the increase in traffic accidents due to increased roadway volume because there are too many variables that influence accidents. Consequently, DOE assessed potential traffic safety impacts in a qualitative way based on predicted changes to LOS.
Utilities	Interconnection voltage and transmission line corridors	Although interconnection feasibility studies are underway for the alternative sites, these studies have not been completed. DOE evaluated different options (138 kV and 345 kV) for delivering power from the FutureGen Project to the local transmission grid. The method for evaluating impacts assumed that either option could be used and examined the impacts associated with their transmission corridors.

3.3 POTENTIAL CUMULATIVE IMPACTS

This section describes potential cumulative impacts (40 CFR 1508.7) that may result from the FutureGen Project when combined with the impacts of other relevant past, ongoing, and reasonably foreseeable future actions near the candidate sites. The Council on Environmental Quality regulations implementing NEPA require the consideration of cumulative impacts as part of the EIS process. DOE considers a reasonably foreseeable action to be a future action for which there is a realistic expectation that the action could occur. These include, but are not limited to: actions under analysis by a regulatory agency, proposals being considered by a state or local planning organization, a project that has commenced, or a future action that has obligated funding.

Actions or activities relevant to the FutureGen Project are those related to power generation, coal production, geologic sequestration, transportation, air emissions (associated with large quantity generators), and statewide initiatives related to these areas. The existing environment with respect to oil and coalbed methane resources is also discussed in terms of potential recovery through CO_2 sequestration.

Potential cumulative impacts are discussed primarily on a qualitative basis, but their aspects are estimated and quantified where sufficient data are available. For projects in an early planning stage, many environmental and socioeconomic parameters are unknown, such as air emissions, water use, land disturbance, traffic generated, waste streams, and job creation. However, in some cases, scaling based on similar projects provides reasonable estimates. For example, DOE determined that scaling air emissions, water use, and rail shipments from similar permitted projects may be a reasonable approach to estimate and quantify potential impacts. However, for other site-specific aspects, like land disturbance and impacts to cultural or biological resources, scaling from other projects would be too speculative. These are either discussed qualitatively or not addressed due to their high level of uncertainty.

Section 3.3.1 addresses the cumulative impacts associated with FutureGen Project technology and alternative operating scenarios. Section 3.3.2 presents information on relevant past and ongoing activities. Section 3.3.3 discusses reasonably foreseeable actions within 50 miles (80.5 kilometers) of each alternative power plant site and their cumulative impacts with the FutureGen Project.

3.3.1 CUMULATIVE IMPACTS OF FUTUREGEN TECHNOLOGY

3.3.1.1 Potential Alternative Operating Scenarios under FutureGen

The FutureGen Project would be a research and development project with the purpose of testing advanced coal gasification, power generation, and geologic sequestration technologies. After the DOE-sponsored phase of the project, the Alliance would have more flexibility in both the types of research projects conducted at the plant and the operating features of the plant. It is reasonably foreseeable that, over time, the Alliance or its successor would alter key aspects of plant operation based on economic factors. For example, to lower operating costs, the Alliance could choose to co-sequester H_2S with the CO_2 gas, thus eliminating the cost of operating the Claus process. Implementation of a full co-sequestration option may require pipeline upgrades or potential additional monitoring procedures.

The Alliance or its successor may also choose to sell the CO_2 for use in EOR. Although it is not a required aspect of the candidate sites, the potential to use CO_2 for EOR may be considered a "best value" aspect. The ability to transport and sell all or a portion of the CO_2 could offset operating expenses of the FutureGen Power Plant. Oil fields are within 50 miles (80.5 kilometers) of all four candidate sites. The most likely scenario for using the FutureGen CO_2 for EOR would be for the Alliance to negotiate an agreement with an existing commercial oil field operator or pipeline company. Under such an agreement, the Alliance would sell the CO_2, while construction and operation of the pipeline and the injection site would be the responsibility of their commercial partner.

A commercial CO_2 pipeline exists near the proposed Odessa Site and would most likely be the method of transport of the CO_2 to local oil fields. At the other candidate sites, a new pipeline route (in addition to that planned for the saline formation injection site) would be required to reach local oil fields. The length and route of any new pipeline would depend on the site chosen to receive the CO_2.

The use of CO_2 from the proposed FutureGen Power Plant at existing oil fields could extend the operating life of those fields, allowing for greater volumes of oil to be extracted. A small fraction of the CO_2 would mix with the recovered oil that would be removed in the processing stage. However, because of the economic value of the CO_2, it would probably be recovered and re-injected at the EOR site. Extending the life of nearly-depleted oil fields could create or prolong existing jobs at these fields and provide additional oil and gasoline for consumers. Impacts associated with using the CO_2 for EOR could potentially include, but would not be limited to:

- Developing ROWs for new CO_2 pipelines that could cause changes in land use and ownership, land clearing and soil disturbance, utility and road crossings, wetland disturbance, habitat disturbance, and potential surface leaks of CO_2.
- Constructing new CO_2 injection sites that require the permitting and drilling of new UIC wells; land clearing and soil disturbance for installing wells, pumps, distribution piping, access roads, and utility lines; sealing or mitigation of abandoned wells; potential surface leaks of sequestered CO_2; potential vertical or lateral migration of CO_2 in the subsurface that could cause changes in soil gas concentrations, cause chemical changes or mineralization, impact groundwater supplies, or mobilize heavy metals; prolong oil recovery operations at the site; and provide the economic benefits of additional oil recovery.

The amount of oil recovered would vary based on site-specific conditions. However, a nominal estimate would be three barrels of incremental oil produced per metric ton of CO_2 injected (EU DG JRC, 2005). During the DOE-sponsored phase, up to 1.7 million tons (1.5 MMT) per year of CO_2 from the FutureGen Project could be used for EOR. Over this four-year period, this could result in the additional recovery of up to 18 million barrels of oil. The excess CO_2 could also be used for enhanced coalbed methane (ECBM) recovery. Descriptions of potential areas for EOR and ECBM relative to the candidate sites are provided in Section 3.3.2.

Based on local markets for hydrogen gas, the Alliance may choose to sell a portion of the hydrogen gas stream as a commercial commodity in the future. This process may include transporting it off site or providing a fill station at the plant site.

3.3.1.2 Advancement of Near-Zero Emissions Power Plants

The FutureGen Project would be developed to provide the research needed to foster new FutureGen-like power plants (reduced GHG) by the private sector over the next decade. It is reasonably foreseeable that the lessons learned from the FutureGen Project would enable both DOE and private companies to invest further in similar power plants, which may replace traditional coal-fueled power plants as they near the end of their economical lifespan.

It is important to note that other countries are also pursuing FutureGen-like power plants that could lead to more of these types of reduced GHG emissions power plants in the future. For example, similar power plants are currently under development in Norway, Australia, and China. Australia is planning a 100-megawatt (MW) IGCC power plant called ZeroGen that would also sequester CO_2 in deep saline aquifers (ZeroGen, 2006). Construction is slated for mid-2008 with startup planned for 2011. The Norwegian project would be a 400-MW coal-fueled IGCC plant. The plant would capture 2.6 million tons (2.4 MMT) of CO_2 a year, which could then be piped or shipped to offshore oil or gas fields where it could be sequestered deep below the seabed. Proponents believe that a bid for delivering the plant could be ready in 2007, approvals received in 2008, and production could start in 2011 (CNN, 2006). China is planning a project called GreenGen. GreenGen would ultimately consist of a 300- to 400-MW coal gasification power plant that would sequester its CO_2. GreenGen would construct and begin operating the plant between 2010 and 2014, and complete its demonstration phase by 2020 (TPRI, 2006).

Another U.S. project planned with IGCC and sequestration characteristics similar to the FutureGen Project is the Carson Hydrogen Power Project in California. This project would convert petroleum coke byproducts from the existing British Petroleum Carson Refinery into hydrogen and burn the gas to produce electricity. Most of the CO_2 would be sequestered into rock formations deep underground (Daily Breeze, 2006).

Cumulatively, FutureGen and these other projects would advance the future commercialization of coal gasification power plants with carbon capture and geologic sequestration. The advancement of near-zero-emissions power plants could have a beneficial cumulative impact by reducing GHG emissions related to coal-fueled energy production.

3.3.1.3 Summary of the Cumulative Impacts of FutureGen Technology

Collectively, the research, development, and operational experience gained through the FutureGen Project, other current and planned coal gasification plants, and geologic sequestration projects could foster increasing numbers of new IGCC power plants with sequestration components, and the retro-fitting of existing power plants with sequestration components. This reduction in anthropogenic GHG emissions that may otherwise be emitted by traditional coal-fueled power plants would be a beneficial cumulative impact.

The ability to effectively and economically capture CO_2 emissions from existing power plants could spur the construction of new CO_2 pipelines across the country to suitable geologic formations. In the near term, it is likely that the most economical geologic sequestration projects would support EOR or ECBM operations. However, if CO_2 becomes a regulated air pollutant in the U.S., sequestration in deep saline aquifers (which are generally more geographically dispersed throughout the U.S. than oil and gas reservoirs) may become more likely targets for carbon sequestration.

3.3.2 RELEVANT PAST AND ONGOING ACTIVITIES

This section describes the past and ongoing activities and plans implemented at the state or local level that are relevant to aspects of the FutureGen Project.

3.3.2.1 Relevant Past and Ongoing Activities in Illinois

The Illinois coal industry began to decline in the 1990s after the federal government established stricter sulfur emission standards. However, a resurgence in the coal industry resulted from advances in clean-coal technology that made it possible to use Illinois coal and still meet the strictest air quality standards in the nation (State of Illinois, 2006). In July 2003, the Governor of Illinois signed a law that added $300 million in general obligation bonds to the Coal Revival Initiative (Illinois Resource Development and Energy Security Act, P.A. 92-12), which provides major tax and financing incentives to large, clean, coal-fueled projects. Since then, the state has invested $64.7 million in coal development projects, including the Peabody Energy Electric Prairie State project in Washington County and the Taylorville Energy Center coal gasification project in Christian County. Also included is more than $45 million in grants to Illinois coal operators who upgrade their facilities to make their product more competitive, as well as more than $11 million for advanced research through the Illinois Clean Coal Institute. In addition, three new coal mines were announced in April 2006, although none are currently planned within 50 miles (80.5 kilometers) of either the Mattoon or Tuscola candidate sites.

The existing oil production industry in Illinois could provide an opportunity for EOR. During the 2004 reporting period, at least 3,700 oil wells across 48 individual oil fields produced 649,000 barrels of oil within 50 miles (80.5 kilometers) of Mattoon or Tuscola. In Mattoon, 212 oil wells at two fields produced over 39,000 barrels of oil in 2004 (ISGS, 2004). These statistics do not include inactive oil fields (as of 2004). There are also good opportunities for ECBM recovery throughout the region. Figure 3-1 depicts oil wells and coalbed methane areas within a 50-mile (80.5-kilometer) radius of both Mattoon and Tuscola.

In November 2006, the Governor of Illinois announced an initiative to build a 140-mile (225.3-kilometer) CO_2 pipeline that would stretch from coal gasification plants planned for central and southern Illinois to the Illinois Basin oil field in southeastern Illinois. The pipeline supports Illinois' Climate Change Initiative, which included an EO that created the Illinois Climate Change Advisory Group. The Group will consider a full range of policies and strategies to reduce GHG emissions in Illinois. The pipeline also would reduce Illinois' dependence on foreign oil, a key part of the Governor's Energy Independence Plan released in early 2006 (IGNN, 2006a).

In November 2006, Illinois adopted a Hg-reduction regulatory plan that will reduce emissions from coal-fueled power plants. Under the new rules, these power plants would be required to install modern pollution control equipment designed to reduce Hg pollution by 90 percent or more by June 30, 2009. While achieving the Hg standard, the utilities will also significantly reduce emissions of SO_2 and NO_x (IGNN, 2006b).

3.3.2.2 Relevant Past and Ongoing Activities in Texas

Two initiatives are underway in Texas to promote clean energy and reduce air emissions. The first is the Texas Emissions Reduction Plan, which aims to reduce NO_x emissions. The program offers state funds to replace older engines in vehicles with cleaner-burning models that produce less pollution and strives to reduce NO_x emissions by 13,000 tons (11,793 metric tons) per year (Texas Office of the Governor, 2004a). The goal of the second law, signed in 2005, is to increase the production of clean energy (such as wind, biomass, and solar power) in Texas. The law requires that about 5 percent of the state's energy comes from renewable sources by 2015 and sets a goal of 10 percent by 2015. It also helps diversify the state's energy sources by requiring that 500 MW be produced by renewable sources other than wind, such as biomass and solar power (Texas Office of the Governor, 2005a). However, a number of traditional coal-fueled power plants are currently proposed in Texas. The proposed power plants within 50 miles (80.5 kilometers) of Jewett are listed in Section 3.3.3.2.

The Industry Cluster Initiative, announced in 2004, concentrates businesses and industries within a geographic region. The initiative allows Texas to direct infrastructure funding to regions and locations where weaknesses exist and assist long-range planning efforts. In particular, the energy cluster category (which includes oil and gas production, power generation and transmission, and manufactured energy systems) is potentially relevant to the FutureGen Project in terms of synergies that could be created through co-location of other industries nearby in the future (Texas Office of the Governor, 2004b). As both Texas sites are not covered by zoning plans, this initiative could be a driving force for future development around the sites.

With regard to water resources in the Jewett ROI, more than $500,000 were made available to the Trinity River Basin Environmental Restoration Project in 2006. The state funds will be used for stormwater control, irrigation programs, and education. These funds, plus additional private dollars, could leverage as much as $30 million over 5 years to develop a comprehensive water flow model with the U.S. Army Corps of Engineers (USACE), improve water quality, enhance wildlife habitat, and expand ecotourism opportunities in the Trinity River Basin. The Trinity River has a long history of water quality problems dating back to the early 1900s, but over the past several decades, water quality has improved and the river's fisheries are returning to a much healthier state (Texas Office of the Governor, 2006a).

Water availability is an important issue in Texas. Texas' rapidly growing population and history of severe droughts could easily result in severe water shortages in the future. Without water management strategies and projects, about 85 percent of the state's projected population would not have enough water by 2060 in drought conditions. In 2002, the State Water Plan incorporated approved regional water plans and provided for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions. The plan was revised and adopted on November 14, 2006. Although conservation is a key component, some initiatives aim to increase the water supply through desalination, rainwater harvesting, and reuse of wastewater (TWDB, 2006).

The state has approximately 150 inland desalination units that produce 40 to 50 million gallons (151.4 to 189.3 million liters) of fresh water from brackish groundwater and surface water each day. In 2006, guidelines for the potential harvesting of rainwater in Texas were developed. A number of communities and water providers in Texas treat wastewater for direct and indirect reuse. Although wastewater can be treated to achieve compliance with federal and state drinking water standards, no entity in Texas currently distributes treated wastewater for drinking water purposes.

In 2005, Texas and Union Pacific developed a partnership to move freight lines away from densely populated urban areas across the state (Texas Office of the Governor, 2005b). Funding and specific projects have not been determined. The movement of rail lines would lead to safer crossings, less hazardous cargo carried through populated areas, and greater freight movement efficiency.

There are five coal mines within 50 miles (80.5 kilometers) of the Jewett Site: Big Brown in Freestone County, Twin Oak in Robertson County, Calvert in Robertson County, Gibbons Creek in Grimes County, and the adjacent Jewett Mine. No new coal mines are currently planned within a 50-mile (80.5-kilometer) radius of the site (TRRC, 2006). The FutureGen Project, if located in Jewett, could potentially use coals from these existing mines. Existing coal mining operations at the Jewett Surface Lignite Mine would continue at least through 2015. The Jewett Mine produced 7 million tons (6.4 metric tons) of lignite in 2005. The company estimates that there are 75 million tons (68.0 MMT) of lignite coal reserves and deposits currently at the mine. At the current rate of production, it is possible that the mine's coal reserves would be consumed almost entirely by the end of their contract period in 2015.

Texas has numerous opportunities for EOR. The Bureau of Economic Geology (BEG) at the University of Texas estimates that Texas has more than 1.4 billion tons (1.3 billion metric tons) of sequestration capacity (Holtz et al., 2005). Furthermore, BEG estimates that, in the Gulf Coast (outside of the traditional area of CO_2 EOR in the Permian Basin), an additional 4.5 billion barrels of oil could be produced by using miscible CO_2. Figure 3-2 shows Texas oil reservoirs that could potentially receive CO_2 from the FutureGen Project. The closest of these reservoirs to the Jewett Site, and most probable targets for EOR, are on the western ends of the Travis Peak (Hosston) and Cotton Valley-Smackover oil plays. Figure 3-3 depicts oil wells and coalbed methane resource areas within 50 miles (80.5 kilometers) of the Jewett Site.

Near the Odessa candidate site, an existing CO_2 pipeline may be the most likely avenue to deliver FutureGen CO_2 to any number of local oil fields. Figure 3-4 depicts oil wells within a 50-mile (80.5-kilometer) radius of the Odessa Site. Comparatively, much greater opportunities exist for EOR than ECBM recovery near the Odessa Site.

3.3.3 REASONABLY FORESEEABLE FUTURE ACTIONS NEAR ALTERNATIVE SITES

This section discusses relevant and reasonably foreseeable future actions within 50 miles (80.5 kilometers) of each candidate site. These actions, when considered in context with impacts expected for each alternative site, would have the potential to result in cumulative impacts, as discussed in Section 3.3.4. These major actions generally fall into the categories of other planned conventional power plants, alternative energy projects, sequestration projects, coal mining, and transportation projects. Because the Mattoon and Tuscola candidate sites are within approximately 25 miles (40.2 kilometers) of one another, many of the reasonably foreseeable actions are common to their respective ROIs and are discussed together.

3.3.3.1 Mattoon and Tuscola

Table 3-6 summarizes reasonably foreseeable projects identified within 50 miles (80.5 kilometers) of the Mattoon and Tuscola candidate sites.

Table 3-6. Reasonably Foreseeable Projects within the Mattoon and Tuscola, Illinois ROIs

Project	Description
Fossil Fuel Power Plants	
The Taylorville Energy Center (TEC)	The TEC, a 660-MW IGCC power plant, is planned for a 329-acre (133-hectare) site situated northeast of Taylorville in Christian County. Approximately 150 acres (61 hectares) would be used for the plant and equipment with the balance serving as raw material storage and as a buffer area. The property is located immediately north of the planned Christian Coal mine site.
Alternative Energy Projects	
Biofuels Company of America, LLC	Biofuels Company of America, LLC, has proposed to construct a bio-diesel production facility in Danville capable of producing 45 million gallons (170.3 million liters) of fuel per year using the equivalent of 30 million bushels of soybeans. The facility would be located approximately 45 miles (72.4 kilometers) northeast of Tuscola and over 50 miles (80.5 kilometers) northeast of Mattoon (Illinois Office of the Governor, 2006).
Illinois Clean Fuels	Illinois Clean Fuels has proposed to construct a coal-to-bio-diesel fuel plant that would use coal gasification technology similar to that proposed for the FutureGen Project. The plant would convert 4.3 million tons (3.9 MMT) of coal from a new mine into 385 million gallons (1.5 million liters) of fuel per year. Although a specific site has not yet been chosen for the facility, it would be located in the Oakland area in Coles County, which is approximately 20 miles (32.2 kilometers) northeast of Mattoon and approximately 15 miles (24.1 kilometers) southeast of Tuscola. Illinois Clean Fuels expects the plant to be operational by 2012 and create 600 jobs (Mitchell, 2006).
Diamond Ethanol Plant	The Diamond Ethanol Plant is proposed to be constructed in Charleston in Coles County and would produce 60 million gallons (227.1 million liters) of ethanol from 21 million bushels of corn a year using natural gas as fuel. The plant would be located approximately 12 miles (19.3 kilometers) east of Mattoon and 20 miles (32.2 kilometers) south of Tuscola (Stroud, 2006). The plant would include a new rail siding.
Illini Ethanol, LLC	Illini Ethanol, LLC, has proposed to construct an ethanol manufacturing plant near Royal, in Champaign County. The plant would produce up to 110 million gallons (416.4 million liters) of ethanol per year and would use natural gas as fuel. The plant would be approximately 30 miles (48.3 kilometers) northeast of Tuscola and 40 miles (64.4 kilometers) northeast of Mattoon.

Table 3-6. Reasonably Foreseeable Projects within the Mattoon and Tuscola, Illinois ROIs

Project	Description
Andersons Champaign Ethanol	The Andersons Champaign Ethanol is a proposed natural-gas-fueled ethanol plant in Champaign, which would be capable of producing up to 125 million gallons (473 million liters) of ethanol per year (IEPA, 2006a). The plant would be located approximately 30 miles (48.3 kilometers) north of Tuscola and 45 miles (72.4 kilometers) north of Mattoon in the City of Champaign. Local residents have raised environmental concerns about the proposed project, particularly with respect to the proposed plant drawing approximately 1 million gallons (3.8 million liters) of water per day from the Mahomet Aquifer. However, because no scientific surveys have been performed on the aquifer, no local entities are capable of regulating it (Carter, 2006).
Danville Renewable Energy, LLC	Danville Renewable Energy, LLC, has proposed to construct a natural-gas-fueled ethanol plant in Danville, Vermilion County. The plant would be located approximately 45 miles (72.4 kilometers) northeast of Tuscola and over 50 miles (80.5 kilometers) northeast of Mattoon (IEPA, 2006b). The plant would turn 40 million bushels of corn into 200 million gallons (757 million liters) of ethanol per year (Binder, 2006).
Twin Groves Wind Farm	Twin Groves Wind Farm, which is expected to become operational in 2007, will offer 396 MW of energy produced from 240 wind turbine generators. The site for the facility is in McLean County just east of Bloomington, which is approximately 45 miles (72 kilometers) northwest of Tuscola and approximately 60 miles (97 kilometers) northwest of Mattoon. It would install 240 turbines over approximately 21,000 acres (8,500 hectares) of leased land. The wind farm is expected to remove 150 to 200 acres (61 to 81 hectares) of land from crop production (Horizon Wind Energy, 2005).
Emerald Renewable Energy –Tuscola, LLC	An ethanol plant is being planned near the Tuscola Site. Although an air permit was submitted to IEPA on December 22, 2006, there is currently no construction schedule. This proposed plant would use corn as feedstock and would produce 100 million gallons (378 million liters) of ethanol per year. Along with the Douglas County Farm Bureau, Tuscola Economic Development is promoting its city as a site for an ethanol plant. It received a $25,000 AgriFrst grant from the State of Illinois in March 2006 to help develop the facility, according to the Illinois Farm Bureau website. It is possible that the plant could receive its energy from the existing Synergy plant. The plant would generate 35 jobs and corn would be supplied from within a 50-mile (80.5-kilometer) radius. A spokesman for Illinois Prairie Ethanol estimated that based on the capacity of the facility there would be an estimated 10 to 70 trucks unloading at the facility daily (JG-TC Online, 2006). The facility would use natural gas boilers.
Geologic Sequestration Projects	
Midwest Geological Sequestration Consortium (MGSC) CO_2 Sequestration Projects	In the Illinois Basin, the MGSC will determine the ability, safety, and capacity of geological reservoirs to store CO_2 in deep coal seams, mature oil fields, and deep saline reservoir formations. Each of these projects will obtain CO_2 from ethanol plants or refineries in Illinois and Indiana. Deep coal seam sequestration tests will involve injecting approximately 100 tons (90.7 metric tons) of CO_2 into coal seams at two test sites: the Newton Plant in Jasper County, Illinois and a site in Hutsonville, Crawford County, Illinois. The Newton Plant site is approximately 30 miles (48.3 kilometers) south of Mattoon and approximately 50 miles (80.5 kilometers) south of Tuscola. Hutsonville is approximately 35 miles (56 kilometers) southeast of Mattoon and approximately 45 miles (72.4 kilometers) southeast of Tuscola. Mature oil field tests will involve injecting between 1,000 and 2,500 tons (907 and 2,268 metric tons) of CO_2 at two sites that will be selected from potential locations in Indiana, Illinois, and Kentucky. Saline reservoir formation tests will also involve the injection of between 1,000 and 2,500 tons (907 and 2,268 metric tons) of CO_2 into two of three saline formations: the St. Peter sandstone formation, the Mt. Simon sandstone formation, and the Ironton-Galesville formation. One of the five potential sites for the field testing is Mattoon Field in Coles County, Illinois, which is located within 10 miles (16.1 kilometers) of Mattoon and is within 25 miles (40.2 kilometers) of Tuscola (NETL, 2006a).

Table 3-6. Reasonably Foreseeable Projects within the Mattoon and Tuscola, Illinois ROIs

Project	Description
CO_2 Pipeline	As part of the State of Illinois' Governor's Energy Independence Plan, a 140-mile (225-kilometer) CO_2 pipeline would connect planned coal gasification plants to EOR and ECBM areas in southeastern Illinois. A route and timeline have not been determined.
Transportation Projects	
IDOT Proposed Highway Improvement Plan (IDOT, 2006).	There are numerous IDOT projects planned in the ROI for both the Mattoon and Tuscola sites. Most of these projects are roadway and bridge maintenance including resurfacing, shoulder reconstruction, and rail crossing improvements. More substantive projects include a bridge replacement on I-130 in Olney, for US 40 over the Union Pacific Railroad, and at the CSX Railroad and US 36.
CR 1000N proposed upgrade between Charleston and Mattoon	A proposed upgrade to CR 1000N between Charleston and Mattoon would interchange with I-57. It is expected that the new interchange of I-57/CR 1000N would result in immediate development pressures nearby and eventual development along other portions. CR 1000N connects the industrial developments north of Charleston and north of Mattoon with I-57.
Proposed improvement of CH 13 to a Class II truck route from CH 18 to the entrance of the proposed Mattoon Power Plant Site, including the intersection with SR 121	The IDOT has scheduled future construction to improve CH 13 to a Class II truck route from CH 18 to the entrance of the proposed Mattoon Power Plant Site, including the intersection with SR 121. This construction is already being planned and is not related to the Proposed Action. This new construction would consist of 1.25 miles (2.0 kilometers) of roadway widening and resurfacing with new shoulders and ditches. The intersection of SR 121 and CH 13 would be rebuilt so CH 13 approaches at right angles. A turn lane would also be built on SR 121.

3.3.3.2 Jewett

Table 3-7 summarizes reasonably foreseeable projects identified within 50 miles (80.5 kilometers) of the Jewett candidate site.

Table 3-7. Reasonably Foreseeable Projects within the Jewett, Texas ROI

Project	Description
Fossil Fuel Power Plants[1]	
NRG Limestone Electric Generating Station	800-MW lignite coal-fueled boiler (Unit 3) at the existing plant in Jewett, Texas, adjacent to the Jewett Site. Expected operation date is 2012.
Oak Grove Mgmt. Co., LP (TWU)	1600-MW lignite coal-fueled power plant located in Robertson County. Site would be 12 miles (19.3 kilometers) north of Franklin, Texas, and 12 miles (19.3 kilometers) southwest of the Jewett Site. Expected operation date is 2009. This project would be near the existing Calvert coal mine.
Sandow 5 (replaces ALCOA units)	434-MW lignite coal-fueled power plant located in Rockdale, Milan County, Texas. Proposed plant would be 50 miles (80.5 kilometers) southwest of the Jewett Site. Expected operation date is 2007.
Sandy Creek En. Assocs., LP	600-MW coal-fueled power plant that would use PRB coal. Plant location would be 31 miles (49.9 kilometers) northwest of the Jewett Site on Rattlesnake Road in Riesel, McLennan County, Texas. Expected operation date is 2008.
Twin Oaks Power III, LP (Sempra)	600-MW lignite coal-fueled power plant that would be located in Robertson County, Texas, 8 miles (12.9 kilometers) north of Calvert and 31 miles (49.9 kilometers) north of the Jewett Site. Expected operation date is 2010. This project would be near the existing Twin Oaks coal mine.
Big Brown 3	800-MW coal-fueled power plant that would use PRB coal. Plant would be located in Fairfield, Freestone County, Texas, approximately 20 miles (32.2 kilometers) northeast of the Jewett Site. Expected operation date is 2009.

Table 3-7. Reasonably Foreseeable Projects within the Jewett, Texas ROI

Project	Description
Lake Creek 3	800-MW coal-fueled power plant that would use PRB coal. Plant would be located in Riesel, McClennan County, Texas, approximately 40 miles (64.4 kilometers) west of the Jewett Site. Expected operation date is 2009.
Tradinghouse 3 and 4	1600-MW coal-fueled power plant that would use PRB coal. Plant would be located in Waco, McClennan County, Texas, approximately 40 miles (64.4 kilometers) northwest of the Jewett Site. Expected operation date is 2009.
Alternative Energy Projects	
No projects identified	
Geologic Sequestration Projects	
Gulf Coast Basin, Southeast Regional Carbon Sequestration Partnership	In the Gulf Coast Basin, the Southeast Regional Carbon Sequestration Partnership will build upon the Frio Basin Project by testing a model for early CO_2 injection into an oil reservoir, followed by long-term, large-volume storage in underlying brine formations. A total of 15,000 tons (13,608 metric tons) of CO_2 is expected to be injected. Fifteen potential sites for the project have been identified and the selected site has yet to be determined (NETL, 2006b).
Transportation Projects	
FM 39 Relocation	The Texas Westmoreland Coal Company plans to relocate a section of FM 39 and the current train overpass to reclaimed land to facilitate the continuation of mining operations. This relocation is scheduled to begin in 2007 and be completed in approximately 1 year (FG Alliance, 2006c).
Texas Department of Transportation (TxDOT) roadway improvements (widening or new roads)	There are numerous TxDOT projects planned in the ROI, including improvements to FM 60 from FM 50 to Snook, FM 2154 from FM 2818 to SH 40, SH 21 from Kurten to the Navasota River, SH 6 from Hearne to Calvert, FM 60 from SH 6 to FM 158, US 79 Rockdale Relief Route, and SH 249 from Montgomery County to SH 6 (FG Alliance, 2006c).
Trans-Texas Corridor (TTC-35)	TxDOT is evaluating a TTC-35 that would parallel the existing I-35 from the Oklahoma border through Central Texas to the border with Mexico. If developed, this corridor would run north-south approximately 40 miles (64.4 kilometers) west of the Jewett Site. Construction could begin in 2011 pending environmental clearance to determine the corridor's ultimate alignment. A tier-one EIS for the project was issued in April 2006 (TxDOT, 2006a).

[1] Source: Alamo Area Council of Governments, 2006.

The planned coal-fueled power plants listed in Table 3-7 are within 50 miles (80.5 kilometers) of the proposed Jewett Power Plant Site. However, there are several similar power plants currently proposed in the northeastern portion of Texas. There have been concerns raised by the public and environmental organizations regarding cumulative impacts to air quality of all these proposed coal-fueled power plants.

In addition to the projects listed in Table 3-7, the existing NRG Limestone Electric Generating Station in Jewett will be the site of a DOE Clean Coal Power Initiative (CCPI) project, "Mercury Species and Multi-Pollutant Control," under a cooperative agreement signed in April 2006 with DOE. Performance testing of the project is expected to begin in October 2008 and last 38 months. The project will demonstrate advanced sensors and neural network-based optimization and control technologies for enhanced Hg and multi-pollutant control on its existing 890-MW boiler. The technology, once demonstrated, should have broad application to existing coal-fueled boilers and provide positive impacts on the quality of saleable byproducts, such as fly ash (NETL, 2006c).

3.3.3.3 Odessa

Table 3-8 summarizes reasonably foreseeable projects identified within 50 miles (80.5 kilometers) of the Odessa candidate site.

Table 3-8. Reasonably Foreseeable Projects within the Odessa, Texas ROI

Project	Description
Fossil Fuel Power Plants	
Navasota Energy's Quail Run Energy Center	550-MW natural-gas-fired power plant currently under construction in the Odessa Business Park, approximately 19 miles (30.6 kilometers) to the northeast of the Odessa Site. Expected completion date is 2008 (Reuters, 2006). The plant would be able to transport power to Houston or Dallas markets on existing grids.
Alternative Energy Projects	
Forest Creek Wind Farm	125-MW wind farm located on remote ranchland approximately 50 miles (80.5 kilometers) east of the Odessa Site. Expected operation date is the end of 2006 (Wells Fargo, 2006).
Major Energy Diversification Plan	On October 2, 2006, the Governor of Texas announced a Major Energy Diversification Plan that would invest $10 billion in capital through a public-private initiative that would invest in wind energy projects (Texas Office of the Governor, 2006b). This initiative could promote additional wind farms to be built in west Texas.
Geologic Sequestration Projects	
Southwest Regional Partnership for Carbon Sequestration (SACROC)	Southwest Regional Partnership for Carbon Sequestration will perform post-audit modeling analysis of injected CO_2 for EOR at the SACROC Unit over the last 30 years to define a working model of the nearby Claytonville field with similar geology that has never been subject to CO_2 injection. The SACROC-Claytonville pilot will be an initial analysis of the potential for CO_2 storage in the "Horseshoe Atoll" system, a huge system with potentially enormous CO_2 capacity. A total of 300,000 tons (272,155 metric tons) of CO_2 would be injected at the SACROC-Claytonville Fields near Snyder, Scurry County, Texas, which is approximately 80 miles (128 kilometers) northeast of Odessa (NETL, 2006b).
Transportation Projects	
La Entrada al Pacifico Rail Corridor	There is a proposal for a new rail corridor between the U.S. and Mexico that would connect the Midland-Odessa area of west Texas to the South Orient rail line. This line would be part of the La Entrada al Pacifico (Entrance to the Pacific) trade corridor. This proposed rail corridor would connect the South Orient between Rankin and McCamey, and would enable freight to travel from northwest Texas and the Panhandle to the border at Presidio (TxDOT, 2005). No approvals or timeline for this project have been set.

According to the 2006 to 2008 Statewide Transportation Improvement Program, there are no programmed major roadway improvements for the Midland-Odessa metropolitan area that would occur after 2009. However, the current program period does not extend past 2009 (TxDOT, 2006b).

3.3.4 POTENTIAL CUMULATIVE IMPACTS FOR ALTERNATIVE SITES

The following sections describe potential cumulative impacts that could occur at each of the candidate sites. These impacts are principally related to the potential for additional air emissions, increases in traffic and noise along transportation corridors that are common to the FutureGen Project, and the consumption of local resources within the ROIs.

3.3.4.1 Mattoon and Tuscola

One new coal IGCC plant is proposed within 50 miles (80.5 kilometers) of Mattoon, as well as several alternative energy projects (e.g., bio-diesel and ethanol plants). The primary concern regarding these projects is the potential for cumulative air emissions. The proposed Taylorville Energy Center (IGCC power plant) would be a large-quantity generator of air pollution subject to PSD requirements. Table 3-9 lists the allowable emissions in tons per year as cited in the draft construction permit for the project (IEPA, 2006a). These criteria pollutant emission levels are similar to the maximum emissions predicted for the FutureGen Project during the DOE-sponsored phase.

Table 3-9. Draft Air Permit Emissions for the Taylorville Energy Center

Project	MW	NO_X (tpy [mtpy])	CO (tpy [mtpy])	VOC (tpy [mtpy])	PM/PM_{10} (tpy [mtpy])	SO_2 (tpy [mtpy])
Taylorville Energy Center	600	629 (570.6)	920 (834.6)	28 (25.4)	412 (373.8)	299 (271.2)

MW = megawatts; tpy = tons per year; mtpy = metric tons per year.

Although the Taylorville IGCC power plant could be converted for carbon capture and sequestration in the future, without sequestration, it would emit approximately 7.3 million tons (6.6 MMT) of CO_2 annually (scaled in terms of MW output from the FutureGen Power Plant).

The Taylorville Energy Center would require over 4,900 gallons (18,549 liters) per minute of water. The City of Taylorville would provide water to the power plant through a 25-year agreement. The source of the water would be the Sangamon River or associated well fields. There is also an alternative for "grey water" to be used. Subsequently, the Taylorville Energy Center would use different water sources than those proposed for the Illinois FutureGen site alternatives. The proposed Taylorville Energy Center would be co-located at the Christian Coal Mine, which would supply the coal for the plant. Subsequently, the Taylorville Energy Center is not expected to increase regional train shipments of coal, although it could still receive materials and chemical shipments and ship its byproducts, such as slag and sulfur, by rail.

The proposed ethanol and bio-diesel plants in the ROI would also emit large quantities of criteria pollutants and HAPs (Table 3-10). Three of the ethanol projects (Andersons Champaign, Illini, and Danville Renewable) have received construction permits with specified air emission limits. The average ratio of these emission limits per million gallons of ethanol produced was used to develop emission estimates for the other four ethanol and bio-diesel plants.

According to a study conducted by Frontline BioEnergy in 2005, a coal-powered ethanol plant producing 50 million gallons (189 million liters) of ethanol a year would release as much as 207,000 tons (187,787 metric tons) of CO_2 per year, while a natural gas-powered plant would emit 108,000 tons (97,976 metric tons) (Quad-City Times, 2005). All five of the planned ethanol plants (shown in Table 3-10) would use natural gas as a fuel. Based on the finding of the Frontline BioEnergy study, these ethanol plants could collectively emit almost 1 million tons (907,185 metric tons) of CO_2 annually. It is unknown if any of these projects would sell the CO_2 for other beneficial uses (e.g., utilized for EOR or ECBM projects) or sequester it underground. However, the ethanol produced could be used as an additive to, or replacement for, conventional gasoline in automobiles. The Pew Center estimates that corn-based ethanol reduces full fuel-cycle GHG emissions by slightly more than 30 percent in comparison with gasoline (Pew Center, 2003).

Table 3-10. Permitted and Estimated Air Emissions from Proposed Ethanol and Bio-Diesel Plants near Mattoon and Tuscola

Project or Category	Grain Processed (tpy [mtpy]) max	Ethanol/ Bio-diesel Produced (million gallons [million liters]) per year max	Natural Gas Usage (cubic feet [cubic meters]) per month max	NO_2, (tpy [mtpy]) max	CO (tpy [mtpy]) max	VOCs (tpy [mtpy]) max	PM/ PM_{10}, (tpy [mtpy]) max	SO_2, (tpy [mtpy]) max	Acetalde -hyde, (tpy [mtpy]) max	Total HAPs, (tpy [mtpy]) max
Andersons Champaign Ethanol[1]	1,450,000 (1,315,418)	125 (473.2)	3,760 (3,411)	96.75 (87.8)	98 (88.9)	88.64 (80.4)	97.99 (88.9)	93.31 (84.6)	9.8 (8.9)	22.21 (20.1)
Illini Ethanol[2]	1,100,000 (997,903)	110 (416.4)	4,575 (4,150)	97.9 (88.8)	93.8 (85.1)	91.9 (83.4)	96.5 (87.5)	53.5 (48.5)	2.8 (2.5)	21.8 (19.8)
Danville Renewable (Ethanol)[3]	1,128,360 (1,023,631)	113.7 (430.4)	5,200 (4,717)	96.29 (87.4)	93.77 (85.1)	97.77 (88.7)	96.35 (87.4)	61.45 (55.7)	9.39 (8.5)	19.19 (17.4)
Subtotal of Draft Permit Values	3,678,360 (3,336952)	349 (1,321)	13,535 (12,279)	291 (264.0)	286 (259.5)	278 (252.2)	291 (264.0)	208 (188.7)	22 (20.0)	63 (57.2)
Average per million gallons of ethanol produced	10,549 (9,570)	1 (3.8)	38.816 (1.1)	0.834 (0.8)	0.819 (0.7)	0.798 (0.7)	0.834 (0.8)	0.597 (0.5)	0.063 (0.06)	0.181 (0.2)
Biofuels Company of America[4]	474,695 (430,636)	45 (170.3)	1,746.7 (49.5)	37.5 (34.0)	36.9 (33.5)	35.9 (32.6)	37.5 (34.0)	26.9 (24.4)	2.8 (2.5)	8.2 (7.4)
Diamond Ethanol[4]	632,927 (574,182)	60 (227.1)	2,328.9 (65.9)	50.1 (45.4)	49.1 (44.5)	47.9 (43.5)	50.0 (45.4)	35.8 (32.5)	3.8 (3.4)	10.9 (9.9)
Emerald Renewable Energy Ethanol Plant at Tuscola[4]	527,439 (478,485)	100 (378.5)	1,940.8 (55.0)	41.7 (37.8)	40.9 (37.1)	39.9 (36.2)	41.7 (37.8)	29.9 (27.1)	3.2 (2.9)	9.1 (8.3)
Illinois Clean Fuels (bio-diesel)[4]	4,061,281 (3,684,332)	385 (1,457)	14,944 (423.2)	321.2 (291.4)	315.3 (286.0)	307.3 (278.8)	321.1 (291.3)	229.9 (208.6)	24.3 (22.0)	69.8 (63.3)
Subtotal of Estimated Values	5,706,891 (5,177,204)	591.0 (2,237)	20,999 (594.6)	451.3 (409.4)	443.0 (401.9)	431.8 (391.7)	451.1 (409.2)	323.1 (293.1)	34.2 (31.0)	98.2 (89.1)
Ethanol and Bio-diesel Total	**9,385,251 (8,514,157)**	**940 (3,558)**	**34,534 (977.9)**	**742.3 (673.4)**	**729 (661.3)**	**709.8 (643.9)**	**742.1 (673.2)**	**531.1 (481.8)**	**56.2 (51.0)**	**161.2 (146.2)**

[1] IEPA, 2006b.
[2] IEPA, 2006c.
[3] IEPA, 2006d.
[4] Emissions and grain estimates were scaled from the projects with construction permits.
tpy = tons per year; mtpy = metric tons per year; max = maximum; HAPs = hazardous air pollutants.

Table 3-11 compares the maximum estimated emissions from proposed sources (Taylorville Energy Center, ethanol and bio-diesel plants, and the FutureGen Project). Based on the maximum emission case, the largest contribution of air pollutants related to the FutureGen Project would be NO_2, SO_2, and CO. The FutureGen Project would contribute up to 36 percent and 40 percent of the cumulative NO_x and SO_x emissions, respectively, and up to 27 percent of cumulative CO emissions. The Mattoon and Tuscola power plant sites are in attainment areas and are substantially below the NAAQS for these pollutants (see Sections 4.2 and 5.2, respectively). Therefore, the cumulative impact from NO_2, SO_2, and CO emissions from the FutureGen Project would not be expected to cause exceedance of NAAQS. Ambient concentrations of $PM_{2.5}$ are much closer to the NAAQS, and cumulative air emissions from proposed facilities in the region would likely cause the $PM_{2.5}$ concentrations to increase. Detailed modeling of all the proposed sources, along with the existing sources and local air quality data, would be required to estimate more accurately whether the cumulative impact of the proposed sources could result in the $PM_{2.5}$ standard being exceeded. However, the FutureGen Project would represent less than 10 percent of the estimated future emissions of PM for the maximum case, and approximately three percent for the target case (See Section 2.5.6.1).

Table 3-11. Comparison of All Proposed Emission Sources within the Mattoon and Tuscola ROIs

Project or Category	NO_2 (tpy [metric tpy]) max	CO (tpy [metric tpy]) max	VOCs (tpy [metric tpy]) max	PM/PM_{10} (tpy [metric tpy]) max	SO_2 (tpy [metric tpy]) max	CO_2 (million tpy [million metric tpy]) emitted
Taylorville Energy Center	629 (570.6)	920 (834.6)	28 (25.4)	412 (373.8)	299 (271.2)	7.3 (6.6)
Ethanol and Bio-Diesel Plants	742 (673.1)	728 (661.3)	710 (643.2)	742 (673.1)	531 (481)	1.1 (1.0)
FutureGen - --maximum case	758 (687.6)	611 (554.3)	30 (27.2)	111 (100.7)	543 (492)	0.17 to 0.41 (0.15 to 0.28)
--target case	326 (295.7)	n/a[1]	n/a[1]	33 (29.9)	212 (192)	0.11 to 0.25 (0.10 to 0.23)
Total --maximum case	2,129 (1,931)	2,260 (2,050)	768 (697)	1,264 (1,147)	1,372 (1,245)	9.6 (8.7)
--target case	1,697 (1,539)	n/a[1]	n/a[1]	1,187 (1,077)	1,041 (944)	7.85 (7.1)
FutureGen Percent of Total --maximum case	36 percent	27 percent	4 percent	9 percent	40 percent	5 percent
--target case	19 percent	n/a[1]	n/a[1]	3 percent	20 percent	5 percent

[1] n/a indicates that emission targets for these pollutants have not been established.
tpy = tons per year; max = maximum.

Although water needs for all of the proposed ethanol plants are not published, the Andersons Champaign plant would use approximately 1 million gallons (3.8 million liters) of groundwater a day. Local residents expressed concerns about the ability of the aquifer to sustain this withdrawal. Therefore, it is reasonably foreseeable that water withdrawals from the Mahomet Aquifer may constrain these types of projects in the future. Based on the ratio of water use to ethanol production for the Andersons Champaign ethanol plant, the five proposed ethanol plants could collectively require 1.3 million gallons (5.1 million liters) of water annually. However, processing may consume only 30 percent of the water and the remaining 70 percent (in the form of wastewater) could be filtered and either reused by the plant or returned to the aquifer.

In comparison, the FutureGen Project (running at 85 percent capacity) could use up to 1.3 million gallons (5.1 million liters) of water annually, which is nearly equal to the combined operation of these five ethanol plants, although the FutureGen Project would completely consume (i.e., evaporate) its water intake. Because the primary water sources proposed in either Mattoon or Tuscola would come from the effluent of existing wastewater treatment facilities (municipal or industrial) and not groundwater, no cumulative impacts to the sustainability of groundwater withdrawals are expected to result from the FutureGen Project. Process water for the Tuscola Site would be supplied by Kaskaskia River through an existing intake structure, and during certain low flow periods the Kaskaskia River source could be supplemented by groundwater withdrawals from wells owned by the Lyondell-Equistar Chemical Company. These groundwater withdrawals, if needed, would be temporary and are not expected to have any cumulative impact to the sustainability of groundwater withdrawals within the region.

Although the construction of most of these plants (Taylorville Energy Center and ethanol/bio-diesel plants) would be completed by the time the FutureGen Project would begin construction, it is possible that, in the short term, these projects may compete with the FutureGen Project for resources such as construction labor and local construction supplies. Collectively, they may increase short-term construction road traffic impacts in terms of truck deliveries and commuter vehicles. Over the long term, these projects would collectively increase both rail shipments and truck shipments on local highways.

For example, if all the grain and produced fuel from the proposed ethanol and bio-diesel plants were transported by train, this could require up to 246 10-car train shipments (one-way) each week in the region surrounding the Tuscola and Mattoon sites (see Table 3-12). The number of units on the train greatly influences the rail traffic calculation and this would be determined based on the site conditions at those plants and how many cars they could accommodate at a time. Much longer 100-car trains would reduce the number to 25 (one-way) train shipments a week. The FutureGen Project would require approximately five 100-car trains each week. Collectively, these projects would increase train shipments in the area to a large degree, although the contribution from the FutureGen Project would be minor in comparison to the other planned projects. The increase in rail and truck shipments for these projects could result in increases in noise along their respective rail and road corridors.

Coal accounts for 40 percent of the 2 billion tons (1.8 billion metric tons) of freight train shipments in the U.S. The proposed FutureGen Project coal shipments would account for less than 0.1 percent of the 816 million tons (740.3 MMT) of coal-related train shipments annually (AAR, 2006). Therefore, the FutureGen Project would have minimal impact on the national railroad system.

As presented in Table 3-6, a number of transportation projects would occur in the ROI. However, these projects are primarily for roadway improvements and maintenance activities that would be expected to improve roadway conditions over time. Although traffic from the FutureGen Project could exacerbate short-term impacts from roadway construction activities and associated detours, the impacts are expected to be minor and short term.

In addition, as with many development activities in this region, more prime farmland may be converted and lost due to land disturbance and construction activities. As discussed in the Land Use resource sections for Mattoon and Tuscola (Sections 4.11 and 5.11, respectively), approximately 27,060 acres (10,951 hectares) of prime farmland are lost per year in Illinois. The projects listed in Table 3-6 may lead to loss of prime farmland depending on their location. The FutureGen Project would cause the additional loss of up to 200 acres (81 hectares) of prime farmland.

With the initiatives currently in place to promote use of Illinois Basin Coal and the advancement of clean coal technologies that make the use of this coal feasible, coal mining within the region could increase over time. As a potential consumer of Illinois Basin coal, the FutureGen Project could provide additional incentive for certain coal mining activities in the region. However, this potential would largely be based on future decisions of the Alliance on the degree to which it chooses to use a particular coal or coal source.

As indicated in Section 3.3.3.1, there are numerous opportunities for EOR in the Mattoon ROI. There are also opportunities for ECBM recovery throughout the region. Over time, it is possible that new EOR or ECBM projects could emerge as a result of new CO_2 streams in the region, including those from the proposed ethanol plants and possibly the FutureGen Project. This is evidenced by the proposed 140-mile (225-kilometer) CO_2 pipeline discussed in Section 3.3.2.1. The potential cumulative impacts resulting from these undertakings would principally be related to construction of the necessary infrastructure to transport the CO_2 to the injection location, as well as the activities that would occur at injection and recovery sites. The types of impacts that could occur with new EOR or ECBM projects are described in 3.3.1.1.

Additional geologic sequestration research activities within the Illinois Basin are being undertaken by the MGSC that would inject CO_2 in deep coal seams, mature oil fields, and deep saline formations. The MGSC estimates that there are over 45 billion tons (40.8 billion metric tons) of CO_2 storage capacity within the Illinois Basin. Of this capacity, 8.6 billion tons (7.8 billion metric tons) lie within deep saline formations (e.g., Mt. Simon and St. Peter formations) (MGSC, 2005). The FutureGen Project would use 0.64 percent of this saline formation capacity. Thus, while the FutureGen Project would subtract from available capacity, it would have a negligible impact on the ability for other sequestration projects to occur within the region.

The FutureGen Project could result in the future clustering of other industries on or around the selected site. At the Mattoon Site, this would cause further alteration of the character of the landscape. At the Tuscola Site, where there are existing and planned chemical plants nearby, this change would be less intrusive, although at both sites this would possibly displace additional prime farmland. The clustering of industry would introduce new air emission sources, truck and rail traffic, and noise that would degrade the environment to some degree.

3.3.4.2 Jewett

As listed in Table 3-7, there are eight new coal-fueled power plants within a 50-mile (80.5-kilometer) radius of the proposed Jewett Power Plant Site in various stages of planning and permitting. In addition, the NRG Limestone Electric Generating Station plans to add a lignite-fired boiler and 800-MW electric generating unit. Based on planning data, all of these plants are expected to begin operation before the completion of the FutureGen Project.

Cumulative air quality impacts within the ROI for the Jewett Site would largely be driven by the combined emissions of these proposed facilities, which would be expected to be substantially greater than the emission potential for the FutureGen Project. Table 3-12 summarizes the air emissions estimated for these proposed power plants. Should the projects go forward, they would release tens of thousands of tons of criteria pollutants into the atmosphere, which could adversely affect air quality, though the extent is unknown. The FutureGen Project would contribute up to 3.3 percent and 1.1 percent of the cumulative NO_2 and SO_2 emissions, respectively, and up to 1 percent of cumulative CO emissions. Because the Jewett Site is in an attainment area that is substantially below the NAAQS for these pollutants (see Section 6.2), the cumulative impact from NO_2, SO_2, and CO emissions from the FutureGen Project would not be expected to cause exceedance of NAAQS. Ambient concentrations of $PM_{2.5}$ are much closer to the NAAQS, and cumulative air emission from proposed facilities in the region would likely cause the $PM_{2.5}$ concentrations to increase. Detailed modeling of all the proposed sources, along with the existing sources and local air quality data, would be required to estimate more accurately whether the cumulative impact of the proposed sources could result in the $PM_{2.5}$ standard being exceeded. However, the FutureGen Project would represent less than 1 percent of the estimated future emissions of PM within 50 miles (80.5 kilometers) of Jewett.

While the FutureGen Project would emit pollutants, the levels would be very small, and future air quality degradation in the region would be dominated by the other proposed power plants. As new sources, these proposed facilities would be expected to consume PSD increments and may affect emission levels allowed from other new sources, including the FutureGen Project. These conditions would need to be thoroughly considered in the permitting process for the FutureGen Project and other future facilities that may be sited in the area.

Table 3-12. Air Emissions Expected for Proposed Coal-Fueled Power Plants near Jewett

Project	MW	NO_2 (tpy [mtpy])	CO (tpy [mtpy])	VOC (tpy [mtpy])	PM/PM_{10} (tpy [mtpy])	SO_2 (tpy [mtpy])
Big Brown, PRB[1]	800	1,950 (1,769)	5,701 (5,172)	139 (126.1)	1,604 (1,455)	3,789 (3,437)
Oak Grove, Lignite[2]	1,600	6,320 (5,733)	26,790 (24,303)	352 (319.3)	3,171 (2,877)	15,079 (13,679)
Lake Creek, PRB[3]	800	1,950 (1,769)	5,701 (5,172)	139 (126.1)	1,606 (1,457)	3,788 (3,436)
Tradinghouse Units 3 and 4, PRB[4]	1,600	3,889 (3,528)	11,393 (10,336)	276 (250.4)	3,209 (2,911)	7,577 (6,874)
Limestone 3, Lignite[5]	800	1,752 (1,589)	13,395 (12,152)	176 (159.7)	1,402 (1,272)	2,103 (1,908)
Sandow 5, Lignite[5]	434	2,593 (2,352)	7,267 (6,593)	95 (86.2)	1,037 (940.8)	5,186 (4,705)
Sandy Creek, PRB[5]	600	1,793 (1,627)	4,276 (3,879)	104 (94.3)	1,434 (1,301)	3,585 (3,252)
Twin Oaks Power 3, Lignite[5]	600	2,037 (1,848)	4,276 (3,879)	104 (94.3)	1,018 (923.5)	5,818 (5,278)
Total – Planned Power Plants	**7,234**	**22,284 (20,216)**	**78,798 (71,484)**	**1,386 (1,257)**	**14,481 (13,137)**	**46,925 (42,570)**
FutureGen - max case	275	758 (687.6)	611 (554.3)	30 (27.2)	111 (100.7)	543 (492.6)
- target case		326 (295.7)	n/a[6]	n/a[6]	33 (29.9)	212 (192.3)
Total - max case		23,042 (20,903)	79,409 (72,039)	1,416 (1,285)	14,592 (13,238)	47,468 (43,062)

Table 3-12. Air Emissions Expected for Proposed Coal-Fueled Power Plants near Jewett

Project	MW	NO_2 (tpy [mtpy])	CO (tpy [mtpy])	VOC (tpy [mtpy])	PM/PM_{10} (tpy [mtpy])	SO_2 (tpy [mtpy])
- target case		22,610 (20,511)	n/a[6]	n/a[6]	14,514 (13,167)	47,137 (42,762)
FutureGen Percent of Total - max case		3.3 percent	0.8 percent	2.09 percent	0.8 percent	1.1 percent
- target case		1.4 percent	n/a[6]	n/a[6]	0.2 percent	0.4 percent

[1] TXU, 2007a.
[2] TXU, 2007b.
[3] TXU, 2007c.
[4] TXU, 2007d.
[5] PCTO and SEED, 2006. CO and VOCs were estimated based on TXU project values, scaled by MW size and type of coal.
[6] n/a indicates that emission targets for these pollutants have not been established.
MW = megawatts; tpy = tons per year; mtpy = metric tons per year.

Based on a nominal rate of 2 pounds (0.9 kilograms) of CO_2 generated for each kilowatt-hour for a pulverized coal power plant (EPA, 2006), power plants listed in Table 3-12 would emit approximately 63 million tons (57.2 MMT) of CO_2 annually.

In addition to the potential for cumulative air quality impacts, activities associated with the construction and operation of a new 800-MW unit at the adjacent NRG Limestone Electric Generating Station could result in additional traffic and noise in the immediate vicinity of the Jewett Site. However, it is expected that these increases would be localized, and because there are few receptors in this area and traffic conditions are generally acceptable, these impacts are not expected to be severe.

There are several transportation projects in the area of the Jewett Site. Most notably, the Texas Westmoreland Coal Company plans to relocate a section of FM 39 and the current train overpass to reclaimed land to facilitate the continuation of mining operations. This relocation is scheduled to begin in 2007 and be completed in approximately one year (FG Alliance, 2006c). Therefore, the FutureGen Project would have minimal impact on the relocation of FM 39.

The Trans-Texas Corridor 35 could cause impacts during its construction in the form of regional traffic delays and detours. However, after its completion, this corridor would alleviate traffic and have a net positive impact on transportation in the region. The initiative to move freight lines away from heavily populated areas (discussed in Section 3.3.2.2), such as Dallas to the north, Houston to the south, and Austin to the southwest, may cause temporary rail delays during construction, but would have long-term positive impacts on rail shipments in the region.

As indicated in Section 3.3.2.2, there are numerous opportunities for EOR in the Jewett ROI. Over time, it is possible that projects could emerge as a result of new CO_2 streams in the region. The potential cumulative impacts resulting from any EOR undertakings would principally be related to construction of the necessary infrastructure to transport the CO_2 to the injection location, as well as the activities that would occur at injection and recovery sites.

Water availability in Texas is an overall concern in terms of cumulative impacts of new projects. The water required by other projects in the ROI (such as the proposed power plants) and their sources are unknown, but could reduce water availability in the region to some extent. The withdrawal of 3,000 gallons (11,356 liters) per minute for the FutureGen Project could also affect groundwater supplies in the future. The Jewett Site would have an on-site wastewater treatment facility and it is probable that the effluent would be recycled into the power plant. This would be consistent with the recommendations of the 2007 State Water Plan. Consistent with the state's effort to restore the Trinity River, the FutureGen Project would use BMPs during construction of the CO_2 pipeline and sequestration facilities to minimize degradation of the river's water quality.

The FutureGen Project could result in the future clustering of other industries on or around the selected site. For the Jewett Site, surrounded by existing industry with few residences nearby, this change would not be considered intrusive. The clustering of industry would introduce new air emission sources, truck and rail traffic, and noise that would degrade the environment to some degree. However, such development would be consistent with the Texas Industry Cluster Initiative (Texas Office of the Governor, 2004b).

3.3.4.3 Odessa

There is only one major fossil fuel energy project planned within the ROI for the Odessa Site, and there are few other projects in the vicinity that have the potential to result in cumulative impacts. The natural gas-fired power plant currently under construction is 19 miles (30.6 kilometers) from the Odessa Site, and no cumulative air quality impacts are expected from this project and the FutureGen Project.

In general, west Texas has favorable conditions for wind energy. A wind farm is proposed approximately 50 miles (80.5 kilometers) east of the site and wind farms are located within a few miles of the Odessa Sequestration Site. Based on the state's Energy Diversification Plan and clean energy law, future wind farms near the Odessa Site are highly likely. These projects would provide clean, renewable energy that could possibly replace the energy provided by aging fossil fuel power plants in the future.

A proposal for a new rail corridor between the U.S. and Mexico would connect the Midland-Odessa area of west Texas to the South Orient rail line. Should this project go forward, it may expand freight routes in the area around the proposed Odessa Site, allowing for greater flexibility and lower cost of deliveries to and from the plant site.

As indicated in Section 3.3.2.2, there are numerous opportunities for EOR in the Odessa ROI. Over time, it is possible that projects could emerge as a result of new CO_2 streams in the region. The potential cumulative impacts resulting from any EOR undertakings would principally be related to construction of the necessary infrastructure to transport the CO_2 to the injection location, as well as the activities that would occur at injection and recovery sites. It is expected that geologic sequestration research and projects would also continue in the ROI, including those under DOE's Carbon Sequestration Program. Due to the abundant land area and suitable geologic conditions, the FutureGen Project would not limit future sequestration activities in the region.

Water availability in west Texas is a chief concern in terms of cumulative impacts of new projects. Although there are not many large projects proposed within the ROI that would consume water, the withdrawal of 3,000 gallons (11,356 liters) per minute for the FutureGen Project could affect future groundwater supplies. While the Texas Water Development Board has indicated that a number of existing well fields provide sufficient water for the FutureGen Project, regional population and industry growth over time may strain water supplies in the future.

The FutureGen Project could result in the future clustering of other industries on or around the selected site. For the Odessa Site, which is surrounded by existing industry and oil and gas fields, this change would not be considered intrusive. The clustering of industry would introduce new air emission sources, truck and rail traffic, and noise that would degrade the environment to some degree. However, such development would be consistent with the Texas Industry Cluster Initiative (Texas Office of the Governor, 2004b).

3.4 UNAVOIDABLE ADVERSE IMPACTS, MITIGATION MEASURES, AND BEST MANAGEMENT PRACTICES

For all environmental resources, the mitigation of potential adverse impacts from project activities would be achieved through various mitigation measures and the implementation of BMPs that are generally required by permitting processes and other federal, state, or municipal regulations and ordinances. Table 3-13 outlines specific mitigation measures that the Alliance may use to offset potential adverse impacts from the FutureGen Project. Table 3-14 describes BMPs that the Alliance could implement to avoid reasonably foreseeable adverse impacts to each resource area.

3.5 COMMITMENTS, USES, AND PRODUCTIVITY

3.5.1 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

> A resource commitment is **irreversible** when primary or secondary impacts from its use limit future use options and is **irretrievable** when its use or consumption is neither renewable nor recoverable for use by future generations.

This section describes the amounts and types of resources that would be irreversibly and irretrievably committed for the proposed FutureGen Project. A resource commitment is considered *irreversible* when primary or secondary impacts from its use limit future use options. Irreversible commitment applies primarily to nonrenewable resources such as minerals or cultural resources, and to those resources that are renewable only over long time spans, such as soil productivity. A resource commitment is considered *irretrievable* when the use or consumption of the resource is neither renewable nor recoverable for use by future generations. Irretrievable commitment applies to the loss of production, harvest, or natural resources.

The principal resources that would be committed are the lands required for the construction of the proposed FutureGen Project, the proposed utility and transportation corridors requiring new construction and other utility ROWs, and the target formation for permanent CO_2 sequestration. Considerable amounts of water used to operate the FutureGen Power Plant would also be lost (i.e., evaporated rather than discharged back to surface or groundwater). Other resources that would be committed to the proposed project include construction materials (e.g., steel, concrete) and energy (e.g., coal, natural gas) used for construction and operation.

The amount of land that would be committed during construction of the proposed project would include land used for the power plant construction, rail loop, possible on-site landfill, storage piles, pipeline and power line construction ROWs, CO_2 injection site equipment and wells, and, to a lesser extent, access road construction. Although not all of the acreage at the power plant site would actually be developed, it is possible that the entire site would be off limits to other uses. For the Illinois sites, the use of land for the proposed power plant and injection infrastructure would preclude farming in the developed areas, although it is possible that, after the project is concluded, some of the land could revert back to agricultural use.

Temporary easements would be required during pipeline and power line construction, and permanent easements would be maintained for the pipeline ROWs. Temporary and permanent easement lands would not ordinarily be considered as irretrievable resources.

Injection of CO_2 into the subsurface would require gaining permanent mineral rights to the affected area at a defined depth interval. Because sequestration of the CO_2 is intended to be permanent, the use of this portion of the subsurface would be irreversibly committed to CO_2 storage. Once CO_2 injection is completed, some wells and equipment at the injection site could still be used for long-term monitoring purposes, but when the surface facilities are removed, the land could return to other uses.

The FutureGen Project would use up to 3,000 gallons (11,356 liters) of water per minute or 1.6 billion gallons (5.9 billion liters) of water annually that would be irretrievably committed. This water would be used primarily as process water in the cooling towers, which would convert the water to the vapor phase. Because the project would not discharge any of the water directly back to groundwater or surface water, much of this water may be lost to the local area and downstream users.

Material and energy resources committed for the FutureGen Project would include construction materials (e.g., steel, concrete), electricity, and fuel (e.g., coal, diesel, gasoline). All energy used during construction and operation would be irretrievable. During operation, the FutureGen Project would use up to 1.9 million tons (1.7 MMT) of coal annually. The coal source would vary, based on test plans during the 4-year research and testing phase of the project, and afterward could be based on the site location and market forces. Regardless of the source of the coal, these resources would be irretrievably committed. Based on 2005 U.S. coal production statistics, the FutureGen Project would use only 0.17 percent of the coal produced annually. The power plant would also use natural gas during startup and unplanned restart events. Although the amount of natural gas used would be negligible in relation to local capacity, it would be irretrievably committed.

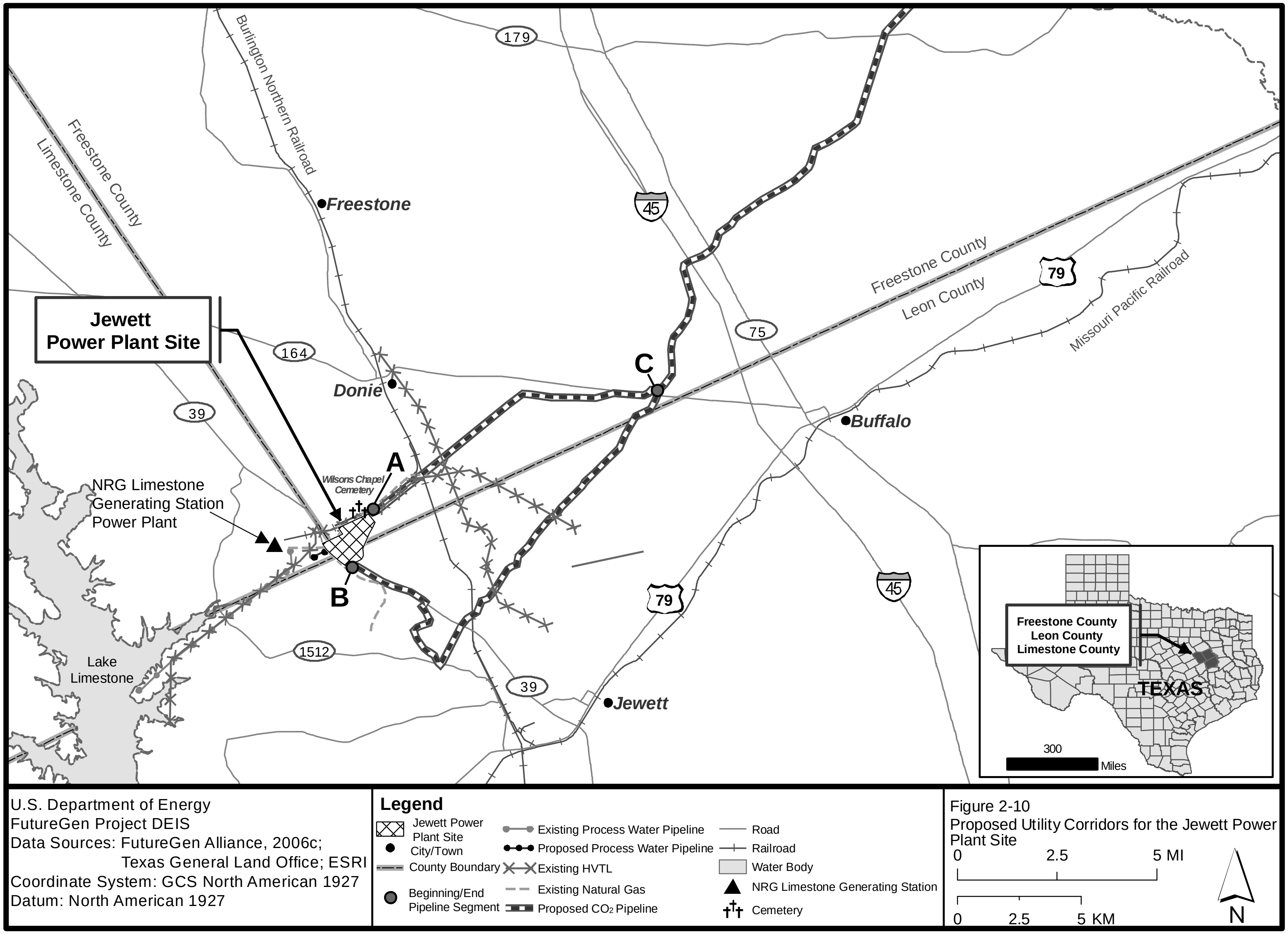
The construction and operation of the proposed FutureGen Project would require the obligation of human resources that would not be available for other activities during the commitment period, but this requirement would not be irreversible.

Finally, the construction and operation of the FutureGen Project would require the commitment of fiscal resources by the Alliance and DOE. However, DOE believes these commitments would help to solve the environmental constraints of using fossil energy resources and to fulfill a Presidential Initiative and national need.

3.5.2 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

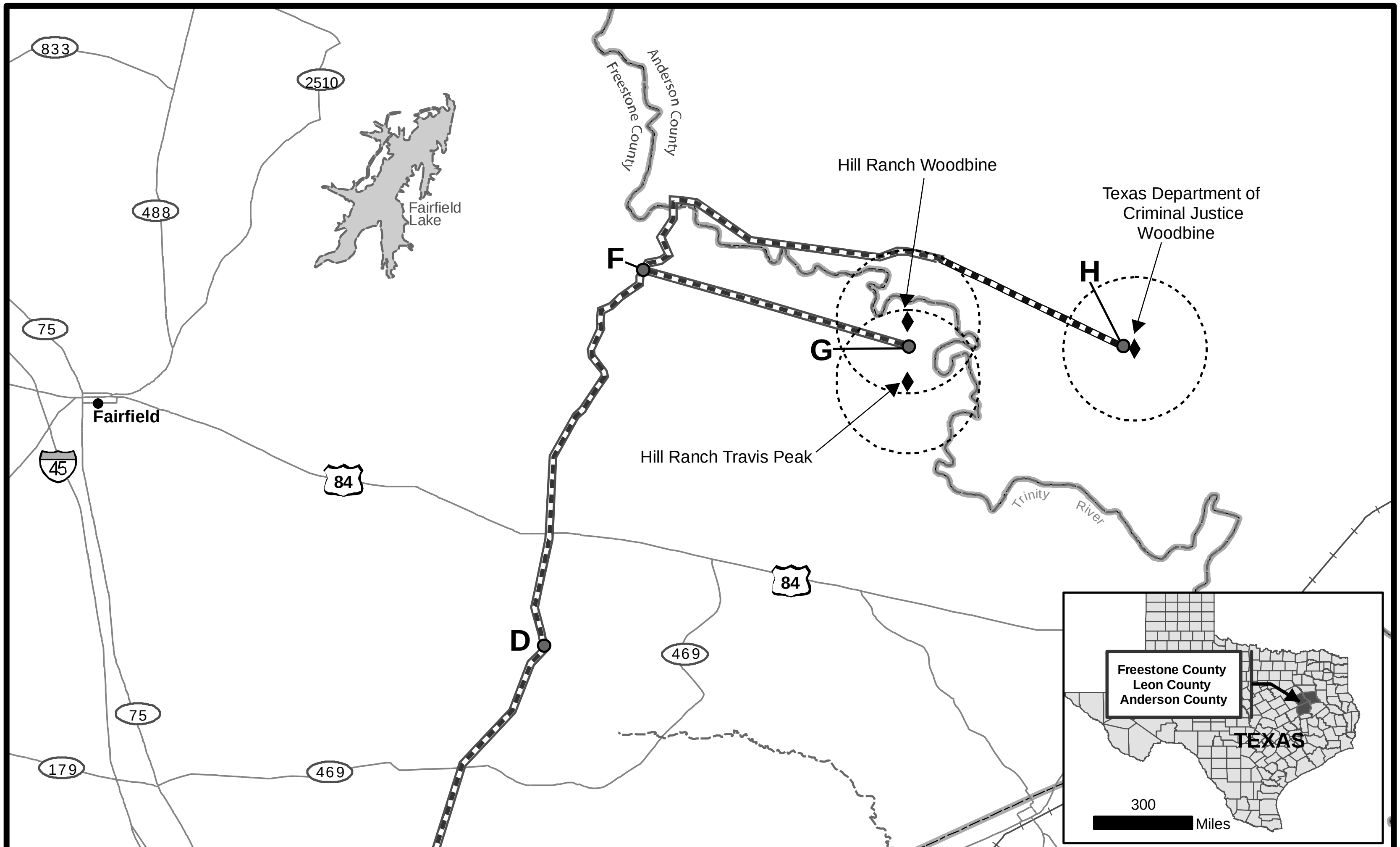
The proposed power plant site would occupy up to 200 acres (81 hectares) and the injection site would occupy up to 10 acres (4 hectares) of land. Easements would be required for pipelines and power lines. The power plant would consume resources, including coal; natural gas; water; and small quantities of process chemicals, paints, degreasers, and lubricants. Slag from the gasification process would be used beneficially to the extent possible or would be properly disposed of at an off-site landfill if no beneficial use can be identified. Sulfur byproducts would be recovered and marketed. The long-term benefit of the proposed project would be to test advanced power generation systems using IGCC technology at a sufficiently large scale to allow industries and utilities to assess the project's potential for commercial application. The proposed project would also achieve low air emissions of GHGs by capturing and permanently sequestering CO_2 in a deep saline aquifer. This technology would foster the overall long-term reduction in the rate of CO_2 emissions from coal-fueled power plants.

The ability to successfully research and test advanced coal gasification on a variety of coal types, hydrogen turbines, or fuel cells, as well as carbon capture and sequestration, at an operating facility would provide incentive for energy providers in the U.S. and abroad to pursue these types of technologies for future power plants. The successful demonstration of near-zero-emissions electricity production from coal, an abundant worldwide energy source, could foster similar power plants. These technological advancements would further the goal of reducing anthropogenic emissions of GHG that lead to global warming. If the FutureGen Project is successful, the short-term use of land, materials, water, energy, and labor to construct and operate the project would have long-term positive impacts on reducing GHG emissions both in the U.S. and abroad.



U.S. Department of Energy
FutureGen Project DEIS
Data Sources: FutureGen Alliance, 2006c; Texas General Land Office; ESRI
Coordinate System: GCS North American 1927
Datum: North American 1927

Figure 2-10
Proposed Utility Corridors for the Jewett Power Plant Site



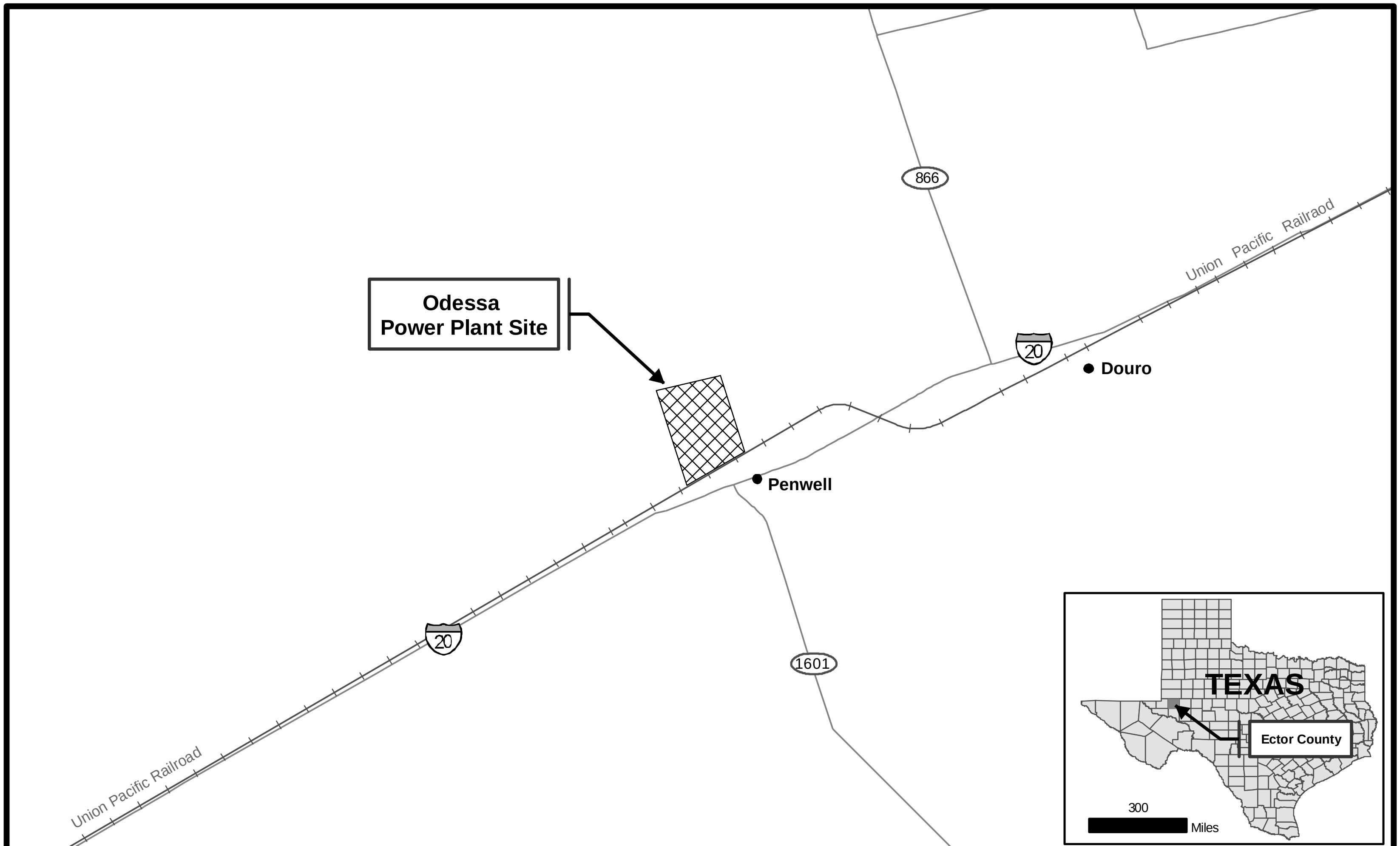
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESIR; FutureGen Alliance, 2006c; Texas General Land Office
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

- Jewett Sequestration Site
- City/Town
- County Boundary
- Beginning/End Pipeline Segment
- CO_2 Plume Radius
- Proposed CO_2 Pipeline
- Road
- Railroad
- Water Body

Figure 2-11
Proposed Jewett Sequestration Site

0 2.5 5 MI
0 2.5 5 KM
N



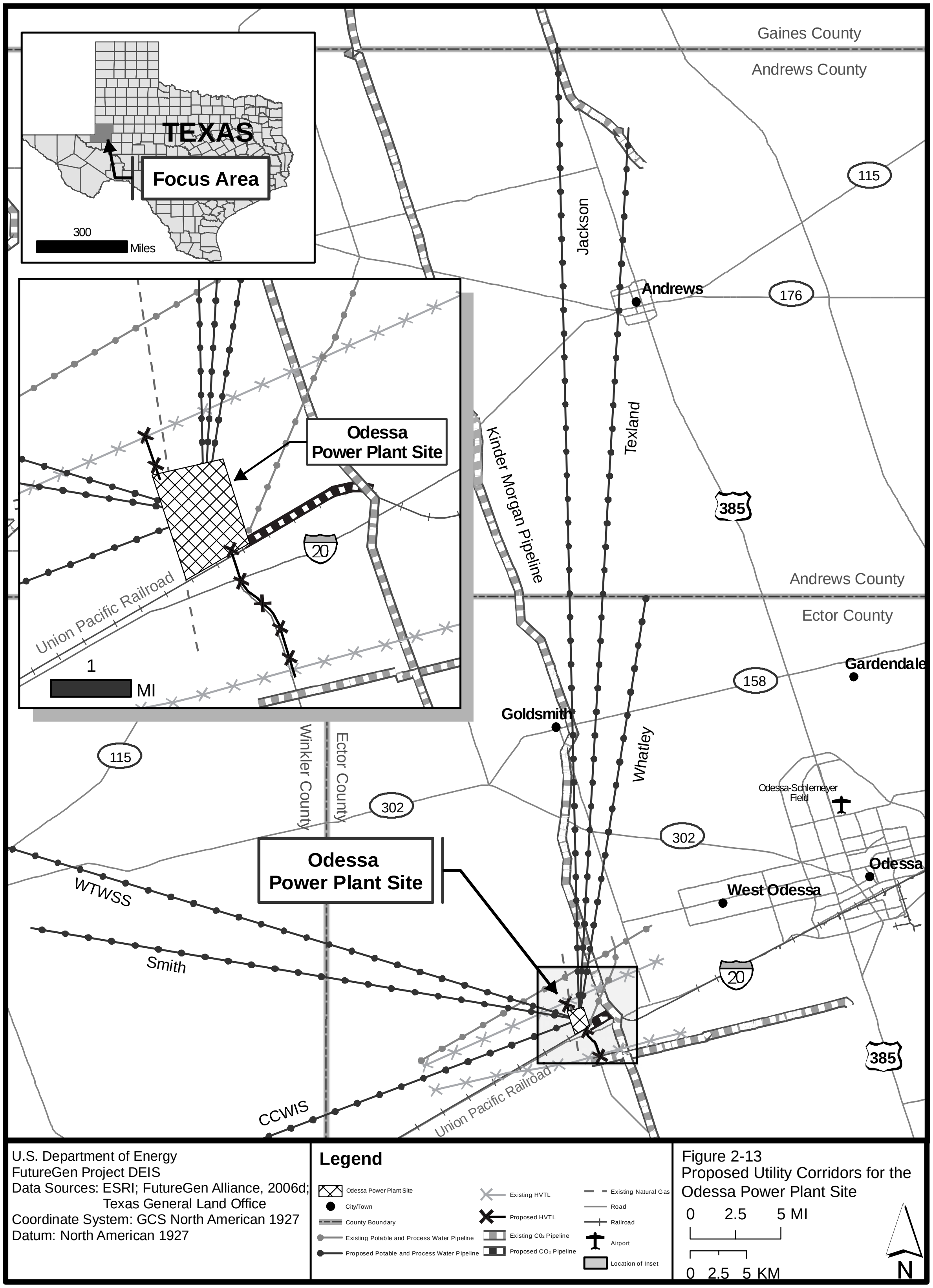
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006d; Texas General Land Office
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

Odessa Power Plant Site
City/Town
Road
Railroad

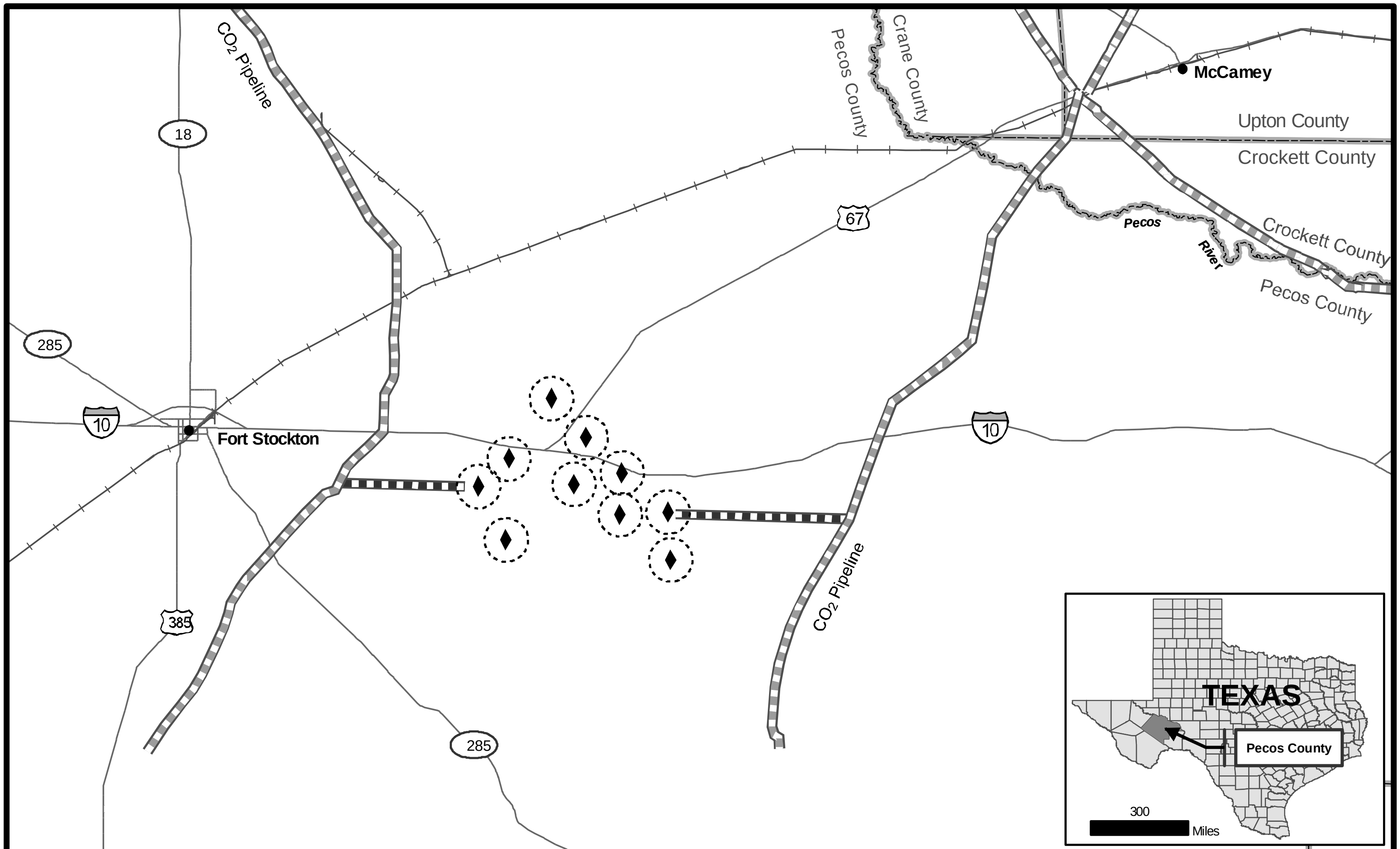
Figure 2-12
Proposed Odessa Power Plant Site

0 1 2 MI
0 1 2 KM
N



U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006d; Texas General Land Office
Coordinate System: GCS North American 1927
Datum: North American 1927

Figure 2-13
Proposed Utility Corridors for the Odessa Power Plant Site



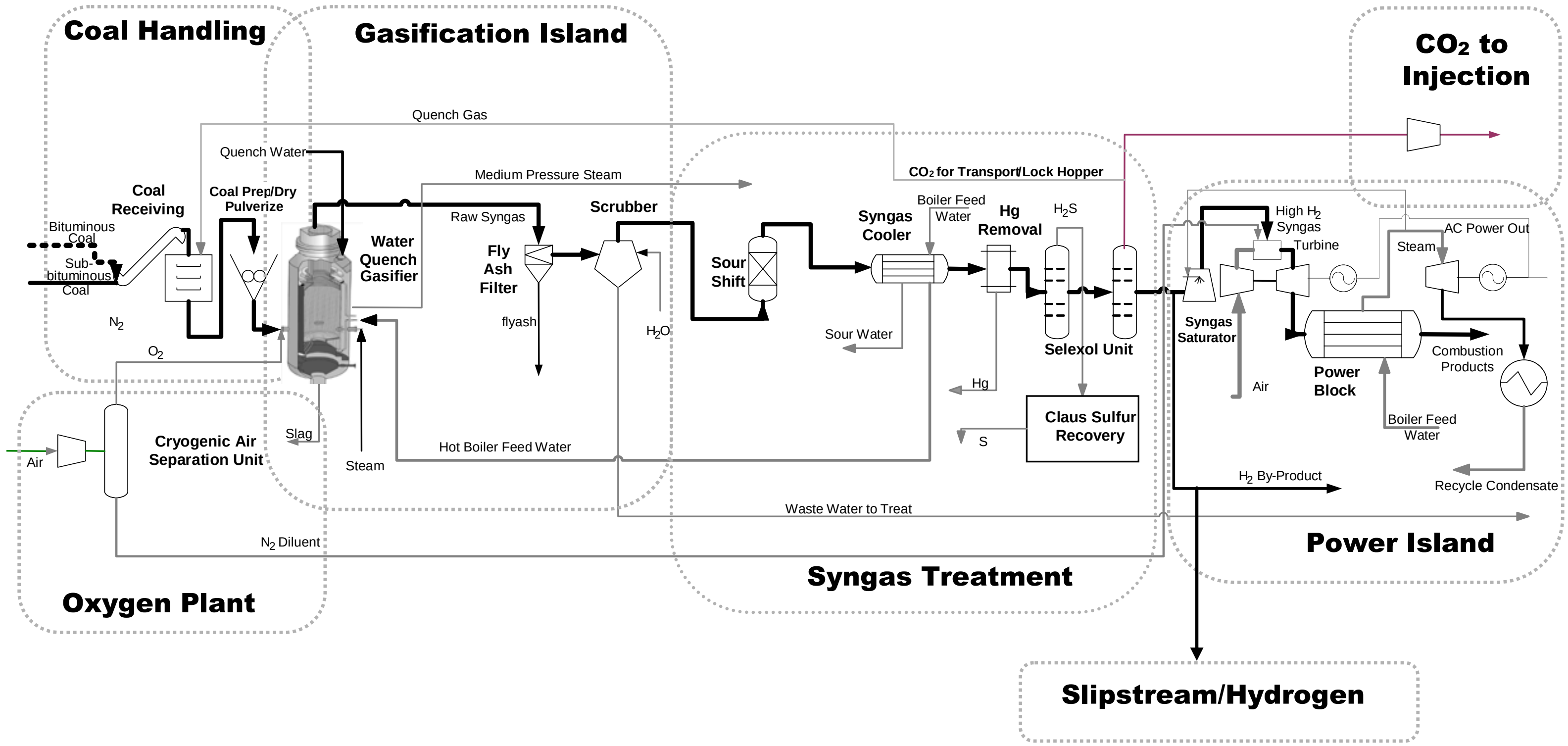
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006d; Texas General Land Office
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

- Odessa Sequestration Site
- City/Town
- County Boundary
- CO_2 Plume Radius
- Existing CO_2 Pipeline
- Proposed CO_2 Pipeline
- Road
- Railroad

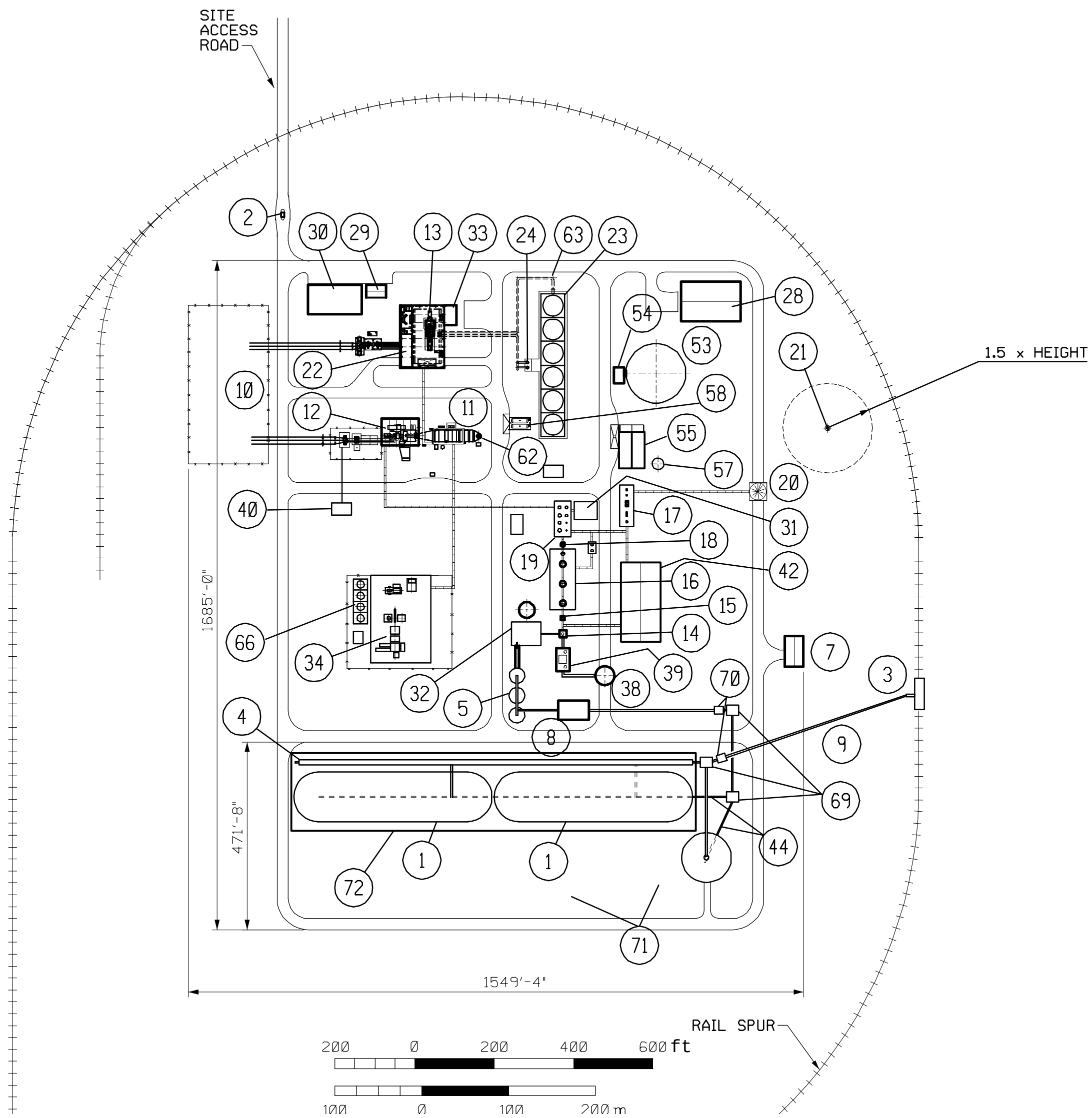
Figure 2-14
Proposed Odessa Sequestration Site

0 5 10 MI
0 5 10 KM
N



AC = Alternating current
Source: Adapted from FG Alliance, 2007

Figure 2-17. Block Diagram of and Example Design for the FutureGen Power Plant



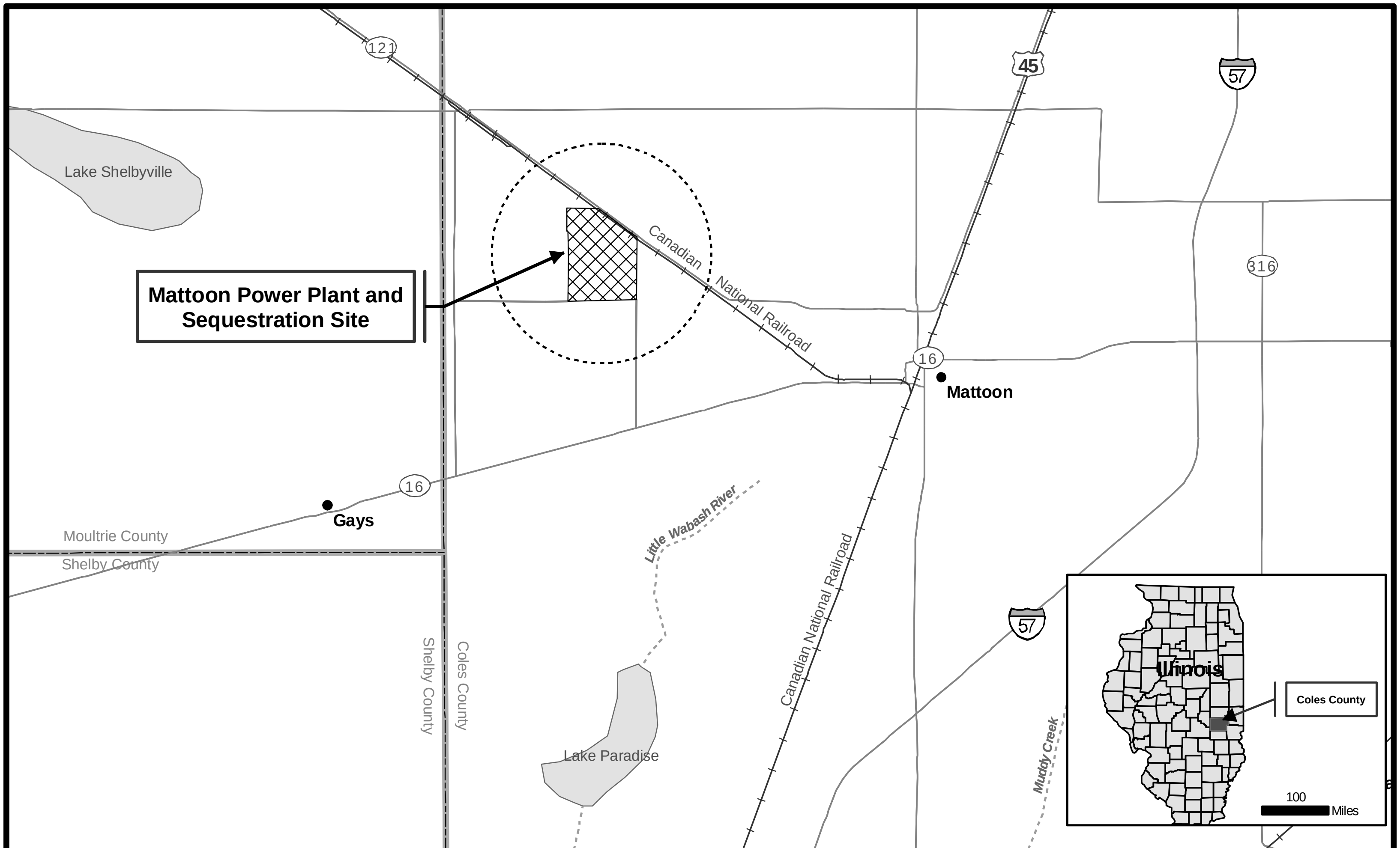
1. COAL STORAGE
2. GUARD HOUSE
3. COAL RECEIVING
4. COAL TRAVELING STACKER
5. COAL STORAGE BINS
6. UTILITY BRIDGE*
7. VEHICLE MAINTENANCE GARAGE
8. CRUSHER BUILDING
9. BELT CONVEYORS
10. SWITCHYARD
11. HEAT RECOVERY STEAM GENERATOR
12. COMBUSTION TURBINE
13. STEAM TURBINE GENERATOR
14. GASIFIER
15. GAS SCRUBBER
16. SHIFT REACTION SECTION
17. CLAUS PLANT
18. MERCURY REMOVAL
19. ACID GAS REMOVAL
20. SULFUR STORAGE
21. FLARE STACK
22. ELECTRICAL ROOM
23. COOLING TOWER
24. CIRCULATING WATER PUMPS
28. WAREHOUSE
29. ADMINISTRATION BUILDING
30. VISITORS CENTER
31. CO_2 COMPRESSION
32. SLURRY PREPARATION
33. WORKSHOP AND STORES
34. AIR SEPARATION UNIT
38. SLAG SILO
39. SLAG PROCESSING AREA AND WATER HANDLING
40. ASU ELECTRICAL BUILDING
41. COAL ELECTRICAL BUILDING*
42. RESEARCH AND DEVELOPMENT FACILITY
43. SOUR WATER STRIPPERS*
44. RECLAIM CONVEYORS
46. EMERGENCY DIESEL GENERATOR*
47. CONTINUOUS EMISSIONS MONITORING SYSTEM ENCLOSURE*
48. CONTROL ROOM*
49. AUXILIARY TRANSFORMERS*
50. STEAM TURBINE GENERATOR STEP UP TRANSFORMER*
51. GENERATOR CIRCUIT BREAKER*
52. COMBUSTION TURBINE GENERATOR STEP UP TRANSFORMER*
53. FIRE SERVICE WATER TANK
54. FIRE SERVICE WATER PUMP HOUSE
55. WATER TREATMENT FACILITY
56. CHEMICAL TRUCK UNLOADING*
57. DEMINERALIZED WATER TANK
58. AMMONIA STORAGE TANKS AND PUMPS
59. AMMONIA UNLOADING AREA*
60. SELECTIVE CATALYTIC REDUCTION SKID*
61. AIR INLET FILTER*
62. STACK
63. CIRCULATING WATER PIPING
64. SLURRY STORAGE TANK*
65. CHEMICAL TREATMENT SKID*
66. ASU COOLING TOWER
69. TRANSFER BUILDING
70. SAMPLE SYSTEM
71. EMERGENCY COAL PILE
72. COAL PILE ENCLOSURE

* = Not shown in figure

Note: Figure is an example of a typical power plant configuration; however, all components of the typical configuration would not be included in the proposed FutureGen facility. Consecutive numbers missing from the legend result from this difference.

Source: FG Alliance, 2007

Figure 2-18. Example FutureGen Project Configuration



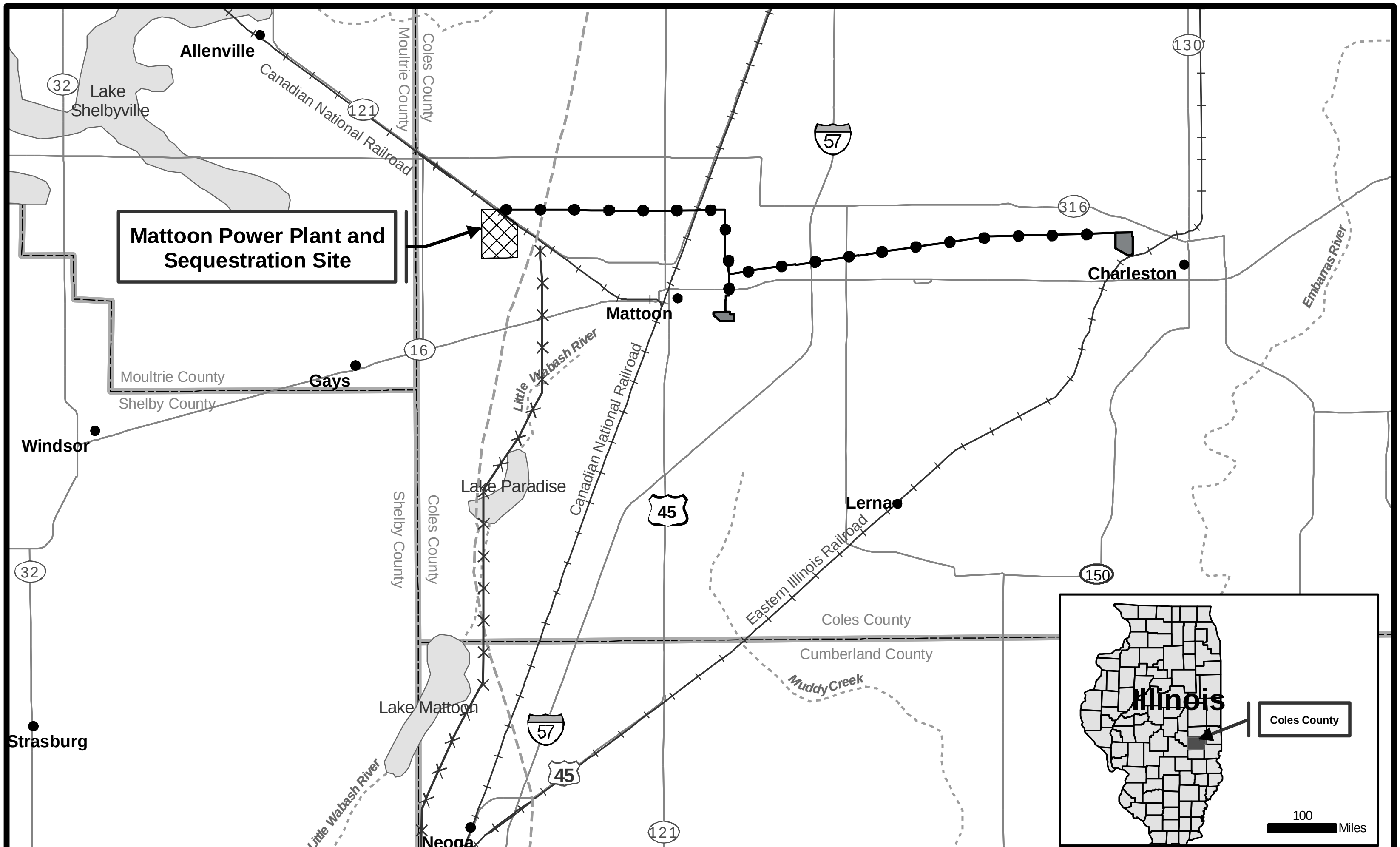
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006a
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

Mattoon Power Plant and Sequestration Site
City/Town
County Boundary
CO_2 Plume Radius
Road
Railroad
Water Body
River or Stream

Figure 2-4
Proposed Mattoon Power Plant and Sequestration Site

0 1 2 MI
0 1 2 KM
N



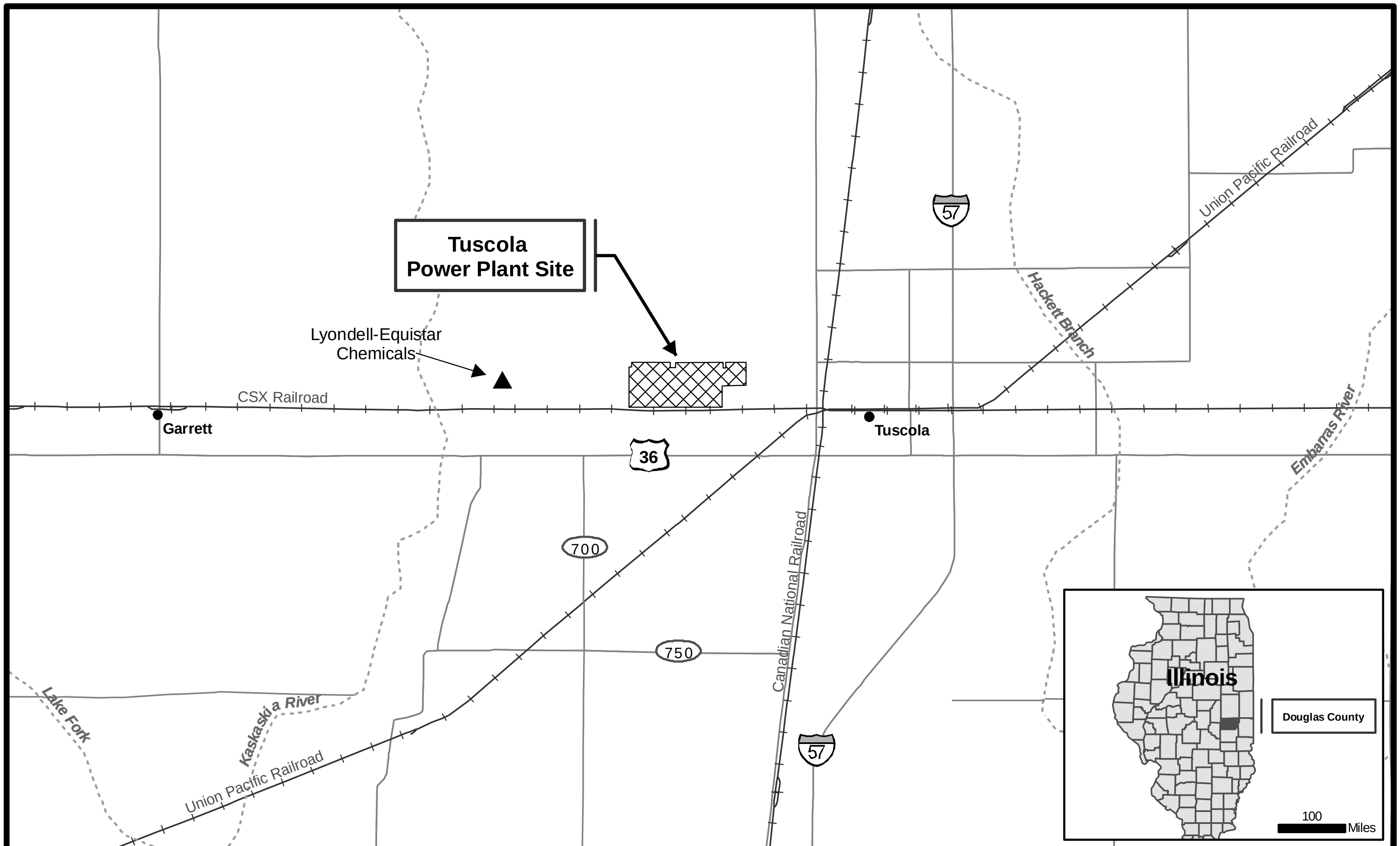
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006a
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

Mattoon Power Plant and Sequestration Site
City/Town
County Boundary
Proposed Process Water Pipeline
Existing HVTL
Existing Natural Gas
Wastewater Treatment Plant
Road
Railroad
Water Body
River or Stream

Figure 2-5
Proposed Utility Corridors for the Mattoon Power Plant and Sequestration Site

0 2 4 MI
0 2 4 KM
N



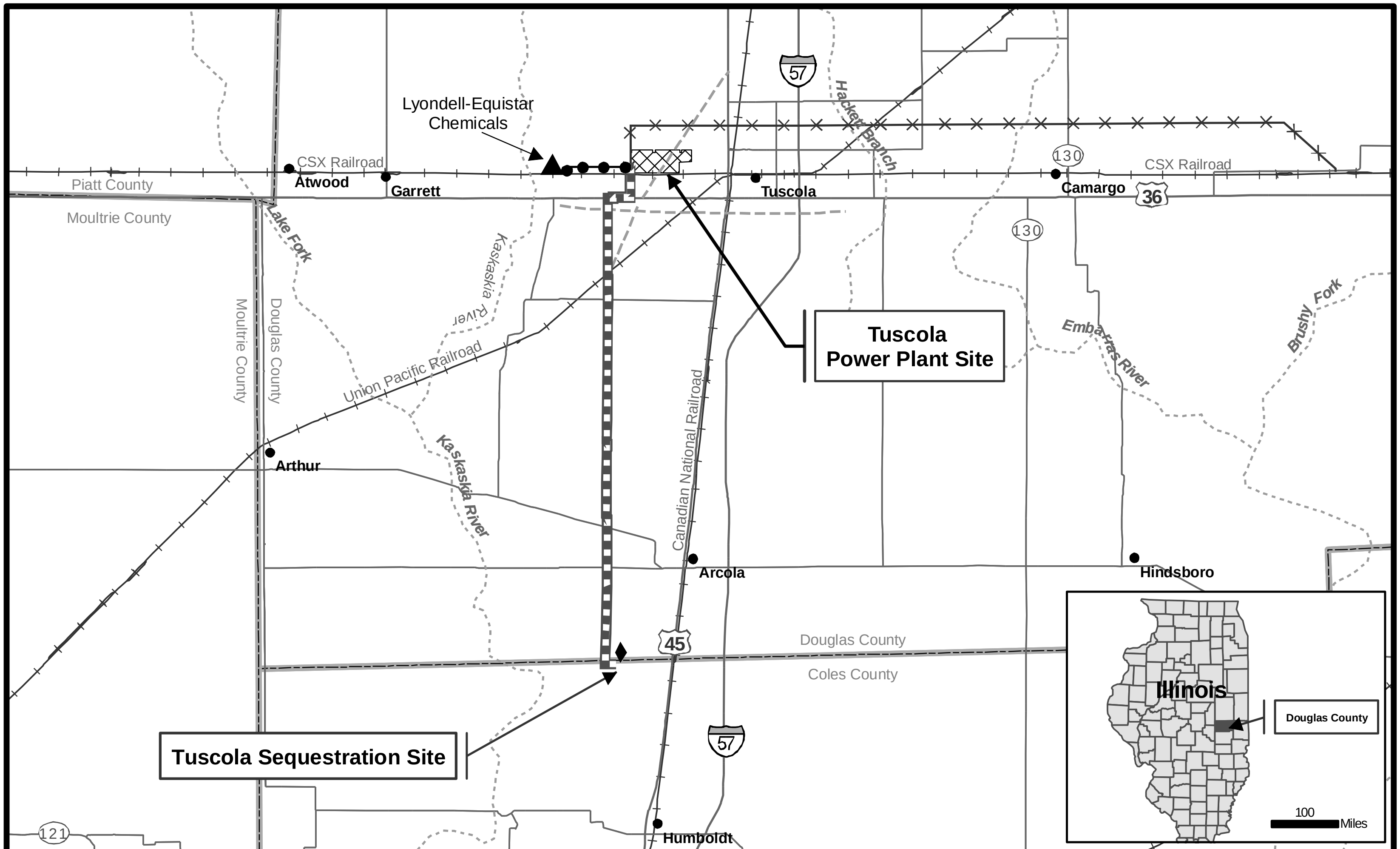
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006b
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

Tuscola Power Plant Site — Road — River or Stream
City/Town — Railroad — Lyondell-Equistar Chemicals

Figure 2-6
Proposed Tuscola Power Plant Site

0 1 2 MI
0 1 2 KM
N



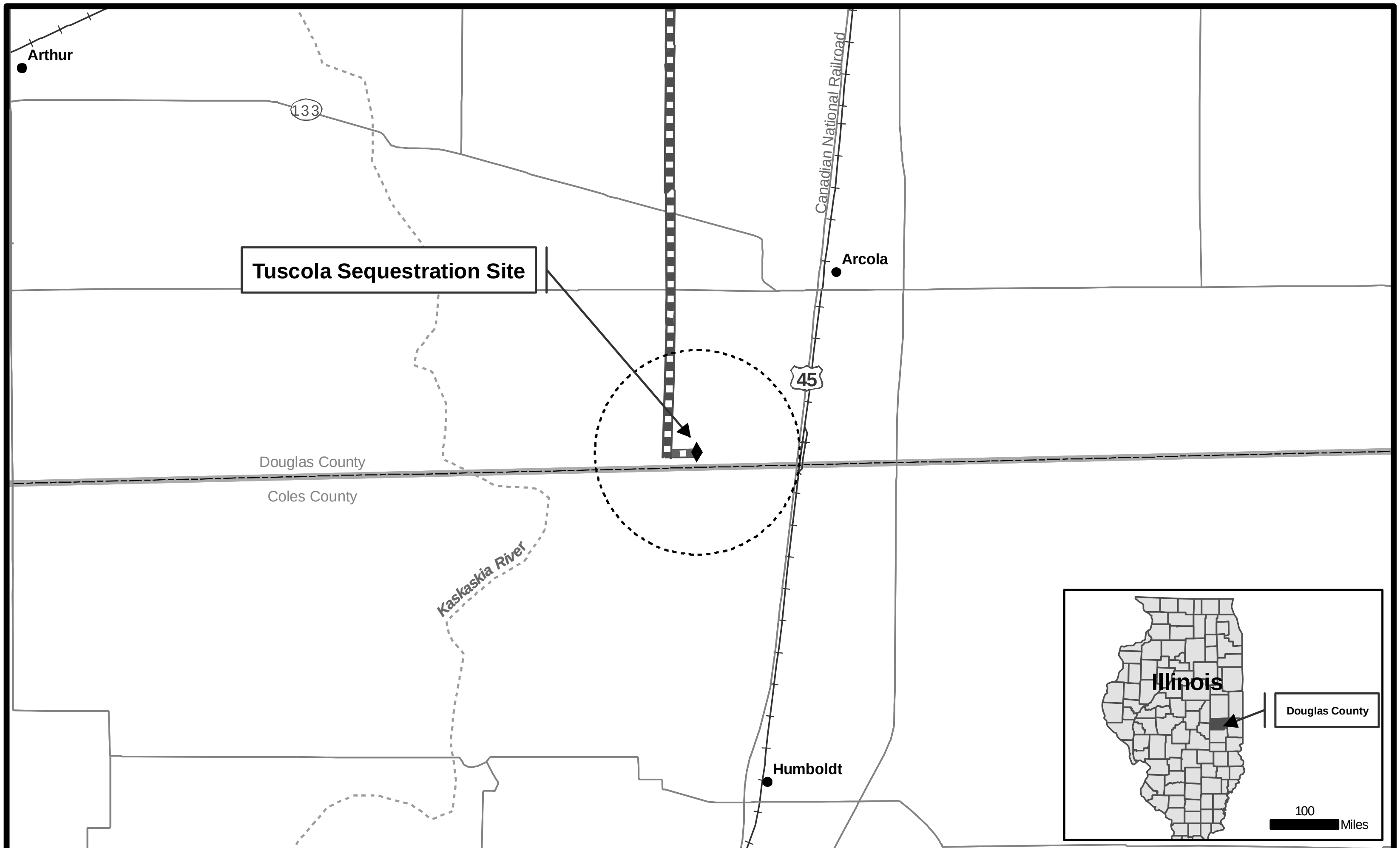
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006b
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

- Tuscola Power Plant Site
- Tuscola Sequestration Site
- City/Town
- County Boundary
- Proposed Process and Potable Water Pipeline
- Proposed HVTL
- Existing Natural Gas
- Proposed CO_2 Pipeline
- Road
- Railroad
- River or Stream
- Lyondell-Equistar Chemicals

Figure 2-7
Proposed Utility Corridors for the Tuscola Power Plant Site

0 2.5 5 MI
0 2.5 5 KM
N



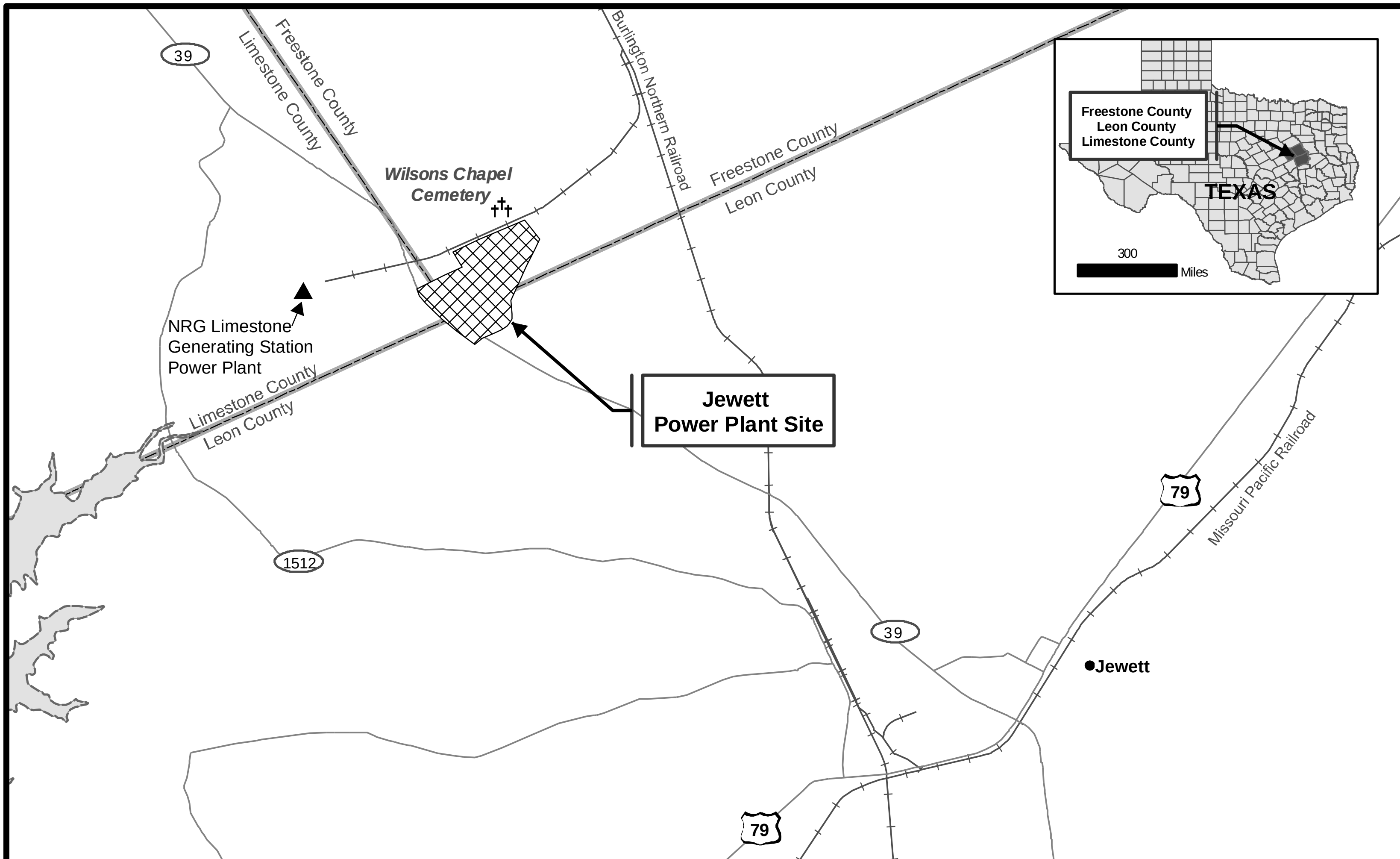
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006b
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

- Tuscola Sequestration Site
- City/Town
- County Boundary
- CO_2 Plume Radius
- Proposed CO_2 Pipeline
- Road
- Railroad
- River or Stream

Figure 2-8
Proposed Tuscola Sequestration Site

0 1 2 MI
0 1 2 KM
N



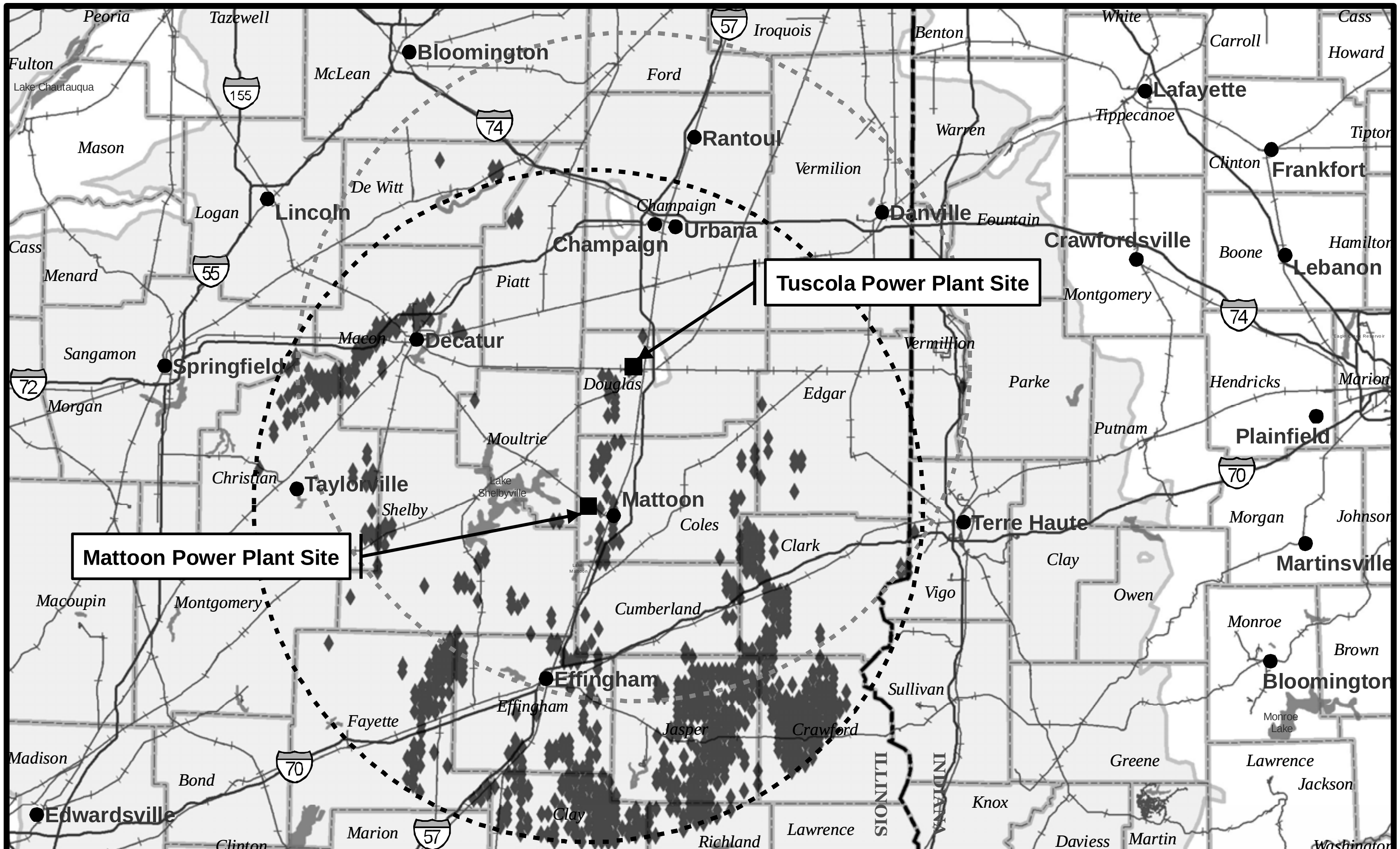
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006c; Texas General Land Office
Coordinate System: GCS North American 1927
Datum: North American 1927

Legend

Jewett Power Plant Site
City/Town
County Boundary
Road
Railroad
Water Body
NRG Limestone Generating Station
Cemetery

Figure 2-9
Proposed Jewett Power Plant Site

0 1 2 MI
0 1 2 KM
N



U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006a, 2006b; NATCARB; USGS
Coordinate System: NAD 1983 UTM Zone 16N
Datum: North American

Legend

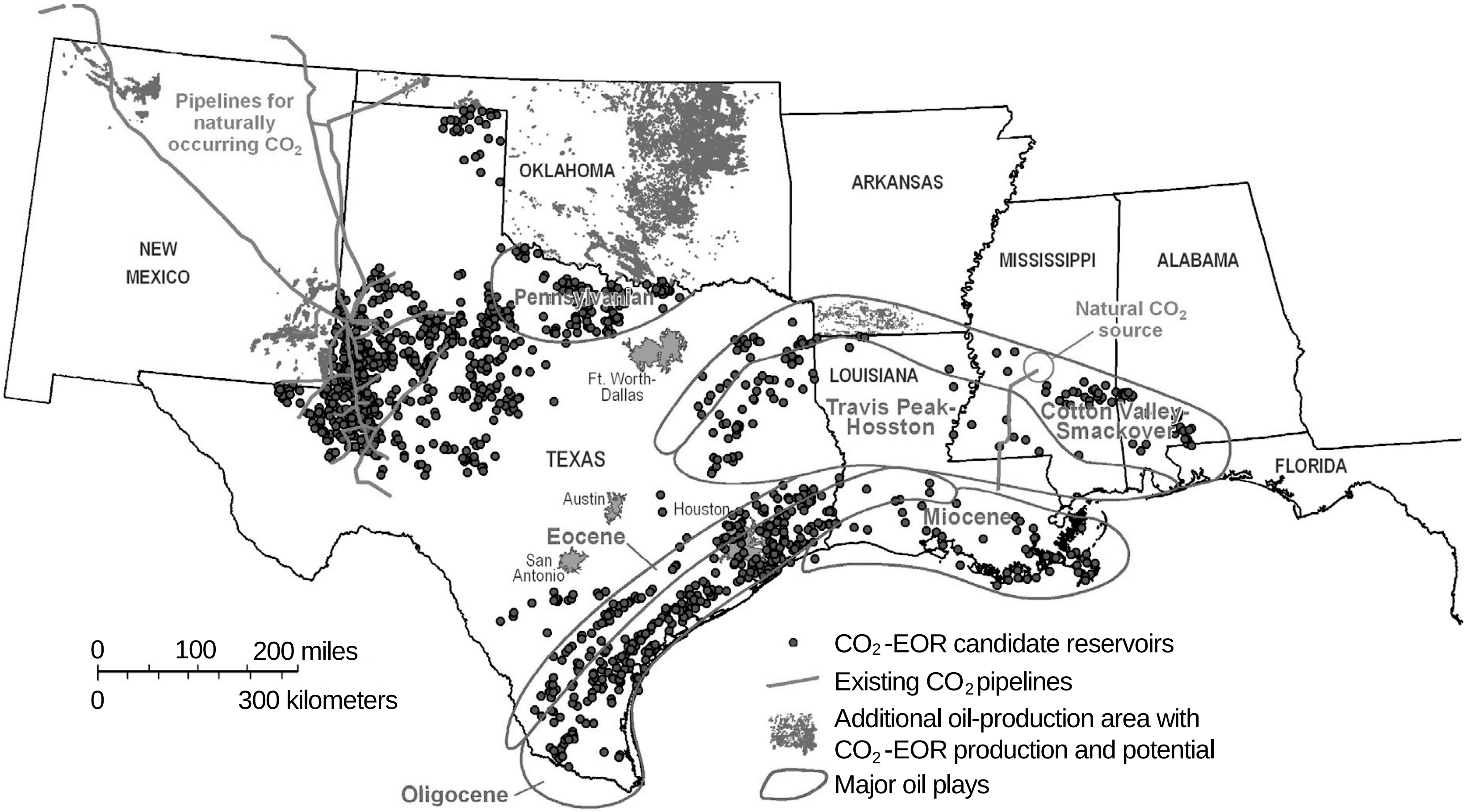
- Power Plant Site
- 50-Mile Buffer of Mattoon Site
- 50-Mile Buffer of Tuscola Site
- Coalbed Methane Resource (TCF 3.9)
- Oil Well
- City/Town
- County Boundary
- State Boundary
- Highway
- Railroad
- Water Body

Figure 3-1
Potential Areas Suitable for EOR or ECBM near Mattoon and Tuscola

0 10 20 MI

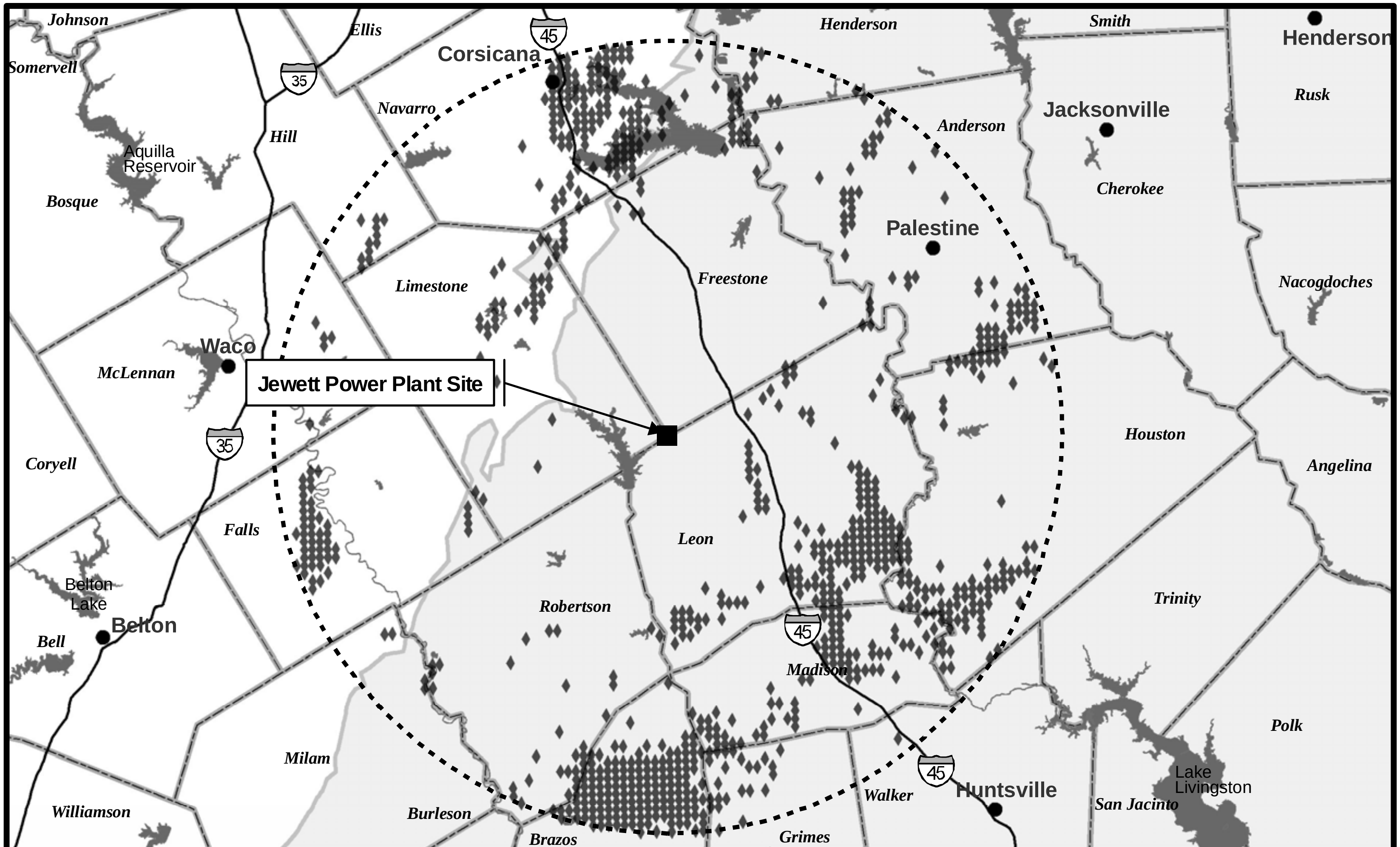
0 10 20 KM

N



Source: Holtz et al., 2005

Figure 3-2. Map of Candidate Oil Reservoirs for EOR in Texas



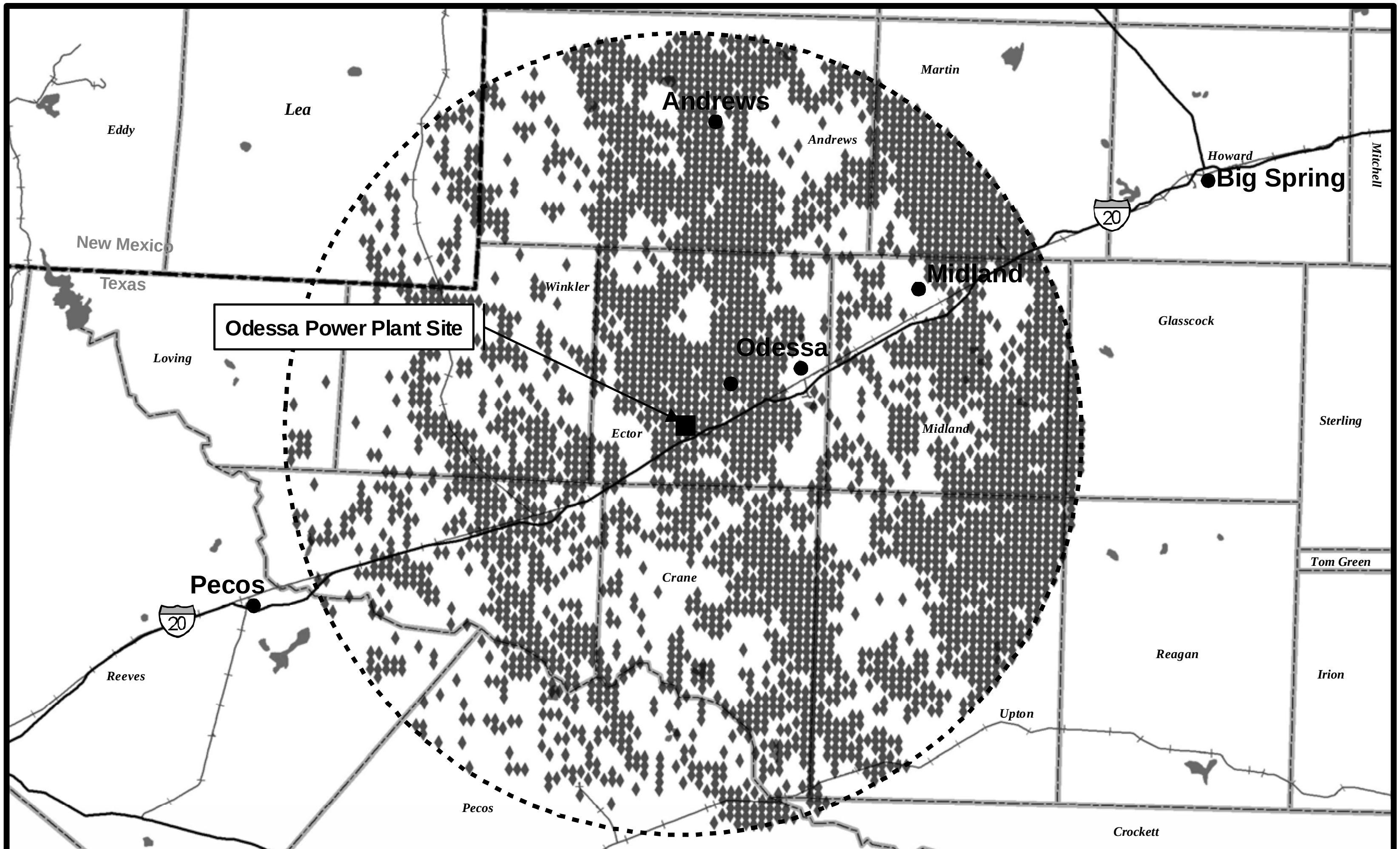
U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006c; NATCARB; USGS
Coordinate System: NAD 1983 UTM Zone 14N
Datum: North American

Legend

- Jewett Power Plant Site
- 50-Mile Buffer of Jewett Site
- Coalbed Methane Resources (TCF = 3.4)
- Oil Well
- City/Town
- County Boundary
- Water Body
- Highway
- Railroad
- River

Figure 3-3
Potential Areas Suitable for EOR or ECBM near Jewett

0 10 20 MI
0 10 20 KM
N



U.S. Department of Energy
FutureGen Project DEIS
Data Sources: ESRI; FutureGen Alliance, 2006d; USGS
Coordinate System: NAD 1983 UTM Zone 14N
Datum: North American

Legend

- Odessa Power Plant Site
- 50-Mile Buffer of Odessa Site
- Oil Well
- City/Town
- County Boundary
- State Boundary
- Water Body
- Highway
- Railroad

Figure 3-4
Potential Areas Suitable for EOR or ECBM near Odessa

0 10 20 MI
0 10 20 KM
N

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M.S., GIS
B.S., English
Provided GIS support for Proposed Action and Alternatives, Land Use, Surface Water, Utilities and Socioeconomics.
3 years of experience in GIS related work, and 5 years of experience in technical writing.

Catherine E. Wade – Environmental Scientist
B.S., Environmental Science and Policy
Assisted with research and populated tables for Socioeconomics sections; peer reviewer for various sections; contributed to preparation of Appendix A.
1 year of research experience in marine science and field biology.

The Louis Berger Group

Ellen Hall, Ph.D. – Resource Lead
Ph.D., Natural Resource Economics
M.Ag., Agricultural Economics
B.A., History
Lead author for Aesthetics; group lead for sections on Land Use, Aesthetics and Light, Noise and Vibration, Traffic and Transportation, and Utility Systems; peer reviewer of Socioeconomics, Community Services, and Environmental Justice.
34 years of experience with NEPA documentation and analysis, with particular focus on electrical generation and transmission facilities.

Leslie Smythe – Resource Lead
M.S., Aquatic Ecology
B.S., Biology
Technical Group Lead for Natural and Cultural Resources. Peer reviewer of Biological Resources, Wetlands and Cultural Resources.
35 years of experience with NEPA documentation and analysis, 20 years of which were for federal agencies.

Marc Blute, CHMM – Principal Environmental Scientist
B.S., Atmospheric Sciences
Provided emission estimates and assisted in the preparation of Air Quality sections.
8 years of experience in air quality permitting, compliance, monitoring and control equipment design.

Tom Chadderdon – Senior Archaeologist
M.A., Anthropology
B.A., Anthropology and Geography
Lead Author for Cultural Resources.
25 years of experience in Cultural Resources Management, 10 years of experience with Cultural Resource documentation and analysis for federal projects.

Susan Davis – Terrestrial Biologist
B.S., Wildlife Management
Lead author for Biological Resources.
10 years of experience with NEPA documentation and analysis for federal agencies.

Steve Eget, P.E. – Director
M.S., Environmental Engineering
B.S., Civil and Environmental Engineering
Peer reviewer for air quality and climate; provided senior technical support for air quality section.
13 years of experience specializing in air quality and environmental engineering for utilities, independent power producers, and cogeneration plants.

Alynda E. Foreman – Ecologist
M.S., Multi-disciplinary Studies - Environmental Research and Education
B.A., Biology; Minor in Environmental Science
Lead author for Floodplains and Wetlands.
10 years of experience with NEPA documentation and analysis on projects for federal agencies.

Thierry Garcy – Principal Engineer
B.S., Engineering
Lead author for Noise and Vibration.
More than 15 years experience providing noise impact evaluation and monitoring support for environmental reviews, permit acquisition/compliance projects, construction management programs, and other specialty projects.

Jack Halpern – Senior Consultant
Ph.D. (ABT), Geotechnical Engineering
M.S., Geotechnical Engineering
B.S., Mining Engineering
Lead author of sections on Utility Systems, and Security/Terrorism; Peer reviewer for Materials and Waste Management, Human Health and Safety.
40 years of experience with siting, permitting and constructing fossil- and nuclear-fueled generation facilities and transmission lines.

Mark W. Killgore, P.E., D. WRE – Principal Engineer
B.S. Civil Engineering
M.S. Civil Engineering
Provided senior technical support for Utilities section.
28 years of experience, including 25 years on energy projects and need for power analyses.

Gary Michalski – Peer Reviewer
M.A., Business Administration
B.S., Industrial Management
Peer reviewer for Utility Systems and Risk Assessment.
More than 35 years experience in industrial development, particularly natural gas, including the supply, transportation, storage, and market sectors. His experience in project development includes regulatory permitting and environmental feasibility analysis.

Michael Mujadin – Consultant
B.S.E., Chemical Engineering
Consultant on technical and operations matters concerning the IGCC design, construction and operating plans, emissions, and air and water quality.
40 years of experience in all phases of gas and oil production, processing, transmission and storage and coal gasification development, construction and operation.

Neeharika Naik-Dhungel – Environmental Manager
M.S., Energy Management and Policy
M.Sc., Theoretical Nuclear Physics
B.Sc., Physics, Chemistry and Mathematics, minor
Author for air quality.
11 years of experience in power plant siting, auditing, and developing air quality compliance programs.

Joseph Ofungwu, Ph.D., P.E. – Principal Engineer
Ph.D., Civil and Environmental Engineering
M.S., Hydraulics and Water Resources Engineering
B.S., Civil Engineering
Prepared air dispersion modeling for air quality analysis.
8 years of experience in air dispersion modeling and human health risk assessments.

Jean Potvin – Senior Planner
B.S., Recreation and Park Management
Lead author for Land Use for proposed Illinois sites.
18 years of federal government experience in regulatory compliance and NEPA documentation and analysis, with particular focus on hydroelectric projects.

James Purdy, AICP – Principal Transportation Planner
M.C.P., City Planning
B.S., Physics
Assisted in preparing Traffic and Transportation.
32 years experience preparing NEPA and other environmental impact studies for transportation projects and planning studies for states and municipalities, with emphasis on transportation.

Keri Pyke, P.E., PTOE – Principal Traffic Engineer
B.S., Civil Engineering
Lead author for Traffic and Transportation.
13 years of experience in preparing transportation impact studies for federal and state agencies and municipalities.

Dan Ramage – Manager of Multimedia Services
A.A., Art
Provided GIS oversight.
20 years of experience as a highway designer and 16 years of experience as IT manager and multimedia visualization manager.

Peter Sparhawk, AICP – Principal Planner
B.A., History
Lead author for Land Use for proposed Texas sites.
17 years of experience with NEPA and state environmental documentation and analysis, project management, land use and environmental planning, power plant siting and licensing, and environmental permitting.

Michael Whims – Peer Reviewer
B.S., Geological Engineering
Peer reviewer for Draft Work Plans for Risk Assessment and Draft Final Risk Assessment Report.
32 years of experience in the design, construction, and operation of underground natural gas storage facilities.

Randy Winslow – Graphics Technician
B.F.A. – in process
Provided photography and GIS maps.
12 years of experience in graphic design, including 5 years in providing graphics for environmental reports.

Kevin Young – Corporate Lead
M.S., Zoology
B.S., Biology
Louis Berger corporate lead and peer reviewer.

Tetra Tech

Sergio Rivera – Deputy Project Manager
B.S. Geology
M.A. Project Management
Deputy Project Manager/secondary author for Groundwater and Soils.
16 years of experience in diverse geological and environmental projects.

Lawson Bailey – Senior Health Physicist/Program Manager
B.S., Biology
Co-author for Human Health and Safety.
27 years of professional experience in operations, construction, engineering, management, scientific, and consulting disciplines.

Misty Bernot – Environmental Scientist
B.A., Environmental Studies
Lead author for soils.
1 year of experience with NEPA projects.

Jackie Boltz – Public Outreach Lead
M.B.A, General Business
B.A, French Language and Literature
Served as Public Outreach Lead.
14 years of experience in planning and implementing public outreach activities for NEPA compliance for multiple federal agencies.

Karen Browne – Environmental Scientist
B.S., Environmental Science
M.S., Environmental Policy and Management
Lead author for Surface Water.
6 years of experience in NEPA and water resources assessments.

Delight Buenaflor – GIS Specialist
M.S., Environmental Science and Policy
B.A., Biology
Served as GIS specialist for Groundwater, Surface Water, Geology, Physiography and Soils, Human Health, and Risk Assessment.
10 years of experience in environmental impact analysis, permitting, NEPA document preparation, and environmental compliance for federal agencies.

Rhonda Carlisle – Contract Specialist
B.A. Business Management
Cost tracking and budgeting.
16 years of experience in contracting and budgeting

Chih-fang Chung – GIS Analyst
M.S. Geography
B.S. Geography
Compiled GIS data, performed analyses, and prepared maps.
8 years of GIS experience.

Amber Genteman – Graphic Artist
B.A. Technical and Professional Writing
Technical editor, formatting and graphic illustration
3 years of experience in technical writing, formatting and graphic illustration.

Steven Gherini – Vice President
M.S. Civil Engineering
M.S. Environmental Chemistry
B.S. Civil Engineering
Obtained information on the design of the FutureGen plant, pipeline, and injection system from meetings with Future project managers, conference calls, and literature.
30 years of experience with NEPA documentation and analysis on projects for federal agencies.

Thomas Grieb – Chief Scientist, Vice President
Ph.D. Environmental Health Science
M.S. Biostatistics
M.A. Marine Biology
A.B. Zoology
Resource Lead for the Risk Assessment and Peer Reviewer for Soils, Groundwater, Surface Water, Geology and Health, Safety and Accidents.

Mary Hoganson – Environmental Scientist
M.S., Biology
B.S., Biology
Co-Author for Materials and Waste Management.
17 years of federal government and commercial experience in waste management and regulatory compliance, and NEPA documentation and analysis.

Maher Itani – QA Reviewer
M.E.A., Engineering Administration
B.S., Civil Engineering
Served as QA Reviewer for Groundwater, Surface Water, Geology, Physiography and Soils, Human Health, and Risk Assessment.
19 years of experience in project management, NEPA document preparation, and environmental compliance for federal agencies.

Robert Johns – Principal Scientist
Ph.D. Environmental Engineering
M.S. Petroleum Engineering
B.S. Mechanical Engineering
Developed analog site database and conducted post-injection sequestered gas leakage analyses.
20 years of experience with NEPA documentation and analysis on projects for federal agencies.

Kay Johnson – Principal Scientist
Ph.D. Environmental Health Science
M.S. Biology
A.B. Zoology
Conducted an assessment of the toxic effects and health risks of the gases potentially released during the pre- and post-injection phases of the project.
28 years of experience with NEPA documentation and analysis on projects for federal agencies.

Lisa Matis – Environmental Engineer
M.S., Mechanical Engineering
B.S., Chemical Engineering
Lead author of Materials and Waste Management; peer reviewer of Utilities, Regulatory Compliance, and Appendix D.
17 years of federal government and commercial experience in waste management and regulatory compliance, and NEPA documentation and analysis.

Erin McMahan – Environmental Scientist
B.A., Environmental Studies
M.S., Environmental Science and Policy
Secondary author for Surface Water
3 years of experience in NEPA related projects.

Bill Mills – Director
M.S. Environmental Engineering
B.S. Environmental Engineering
B.S. Aerospace Engineering
Developed a conceptual model for post-sequestration risk assessment analysis.
30 years of experience with NEPA documentation and analysis on projects for federal agencies.

Wilma Perry – Administrative Assistant
25 years of clerical experience.

John Radde – Scientist
M.S. Watershed Science
B.S. Fisheries Biology
Obtained detailed meteorological data for the proposed sites and prepared input needed by the various air models used for the project.
16 years of experience with NEPA documentation and analysis on projects for federal agencies.

Mark Rigby – Scientist
Ph.D. Natural Science
M.S. Environmental Science and Ecology
B.A. Aquatic Biology
Co-authored the post-injection risk assessment, calculated risks, developed toxicity criteria and developed the risk assessment report outline.
8 years of experience with NEPA documentation and analysis on projects for federal agencies.

Kateryna Sayenko – IT Programmer
M.S. Computer Science
Performed slab model runs with pre- and post-processing of data.
6 years of IT experience.

Roy Sujoy – Environmental Engineer
Ph.D. Civil and Environmental Engineering
M.S. Civil and Environmental Engineering
B.S. Tech Civil Engineering
Assisted with the preliminary and final risk assessment work plan.

Karen Summers – Director
M.S. Geology
B.A. Geology
Reviewed information on the plant and pipeline, develop approach for the pre-injection risk assessment, and worked on evaluating the results of the modeling of the pre-injection release.
30 years of experience with NEPA documentation and analysis on projects for federal agencies.

Daniel Theisen – Senior Engineer
B.S., Mechanical Engineering
Lead author for Climate and Meteorology; peer reviewer for Utility Systems, Noise and Vibration, and Air Quality
16 years of professional experience, including NEPA document preparation, safety analysis, and dispersion modeling.

Scott Truesdale – Environmental Scientist
B.A., Environmental Science/Geology
Lead author for Geology and Groundwater.
20 years of experience in NEPA projects and assessing impacts to geologic and water resources.

Michael Ungs – Principal Scientist
Ph.D. Forest Science
M.S. Mechanical and Aerospace Engineering
B.S. Aeronautical and Astronautical Engineering
Conducted air model simulations of catastrophic pipeline and well failures.
25 years of modeling experience

David Wertz – Environmental Scientist
B.S., Environmental Science
M.Sc., Geophysics
Secondary author for Geology.
7 years of experience in NEPA and other environmental assessments.

Ken Wilkinson – Principal Engineer and Programmer
B.S. Mechanical Engineering
IT support, ftp, and Sharepoint creation and maintenance.
22 years of engineering and IT experience.

Phil Young, CHP – Health Physicist
M.S., Health Physics
B.S., Radiation Health
Co-author of Human Health, Safety, and Accidents.
17 years of professional experience in environmental radiological programs and nuclear engineering for government and utility clients.

Independent Consultants

Kevin L. Johnson – Vice-President, CO_2 Solutions
B.S., Chemical Engineering
Peer reviewer of Risk Assessments, Geology, and Human Health, and Safety.
Over 25 years of experience with environmental assessments, with particular focus on energy industry facilities and carbon sequestration technologies.

Dwight F. Rychel, Ph.D. – Consultant
Ph.D., Operations Research (Environmental Minor)
M.B.A., Business Administration
B.S., Mechanical Engineering
Peer reviewer for Human Health, Safety and Accidents, and Waste Materials and Waste Management.
30+ years in business and technical aspects of the energy industry, including petroleum reservoir engineering and modeling, natural gas storage design and operation, pipeline operations, power plant construction, and enhanced oil recovery (EOR). Published in several areas including CO_2 EOR.
Registered Professional Engineer, Oklahoma.

12.1 CONFLICT OF INTEREST AND DISCLOSURE FORMS

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Disclosure Statement

Environmental Impact Statement
FutureGen Project
DE-AT26-06NT42921

DEAR 952.209-8 ORGANIZATIONAL CONFLICTS OF INTEREST DISCLOSURE requires an offeror to provide a statement of any past (within the past twelve months), present, or currently planned financial, contractual, organizational, or other interests relating to the performance of the statement of work. The offeror is to provide a statement that no actual or potential conflict of interest or unfair competitive advantage exists with respect to the advisory and assistance services to be provided in connection with the instant contract or that any actual or potential conflict of interest or unfair competitive advantage that does or may exist with respect to the contract in question has been communicated as part of the statement.

"Financial interest or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)". See 46 FR 18026-18031.

In accordance with these requirements, the entity signing below hereby certify as follows: (check either (a) or (b) and list items being disclosed if (b) is checked).

Financial Interest:

(a)	X	Has no past, present, or currently planned financial interest in the outcome of the project.
(b)		Has the following financial interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Contractual Interest:

(a)	X	Has no past, present, or currently planned contractual interest in the outcome of the project.
(b)		Has the following contractual interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Organizational Interest:

(a)	X	Has no past, present, or currently planned organizational interest in the outcome of the project.
(b)		Has the following organizational interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Other Interest:

(a)	X	Has no past, present, or currently planned other interest in the outcome of the project.
(b)		Has the following other interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Unfair Competitive Advantage:

To the best of my knowledge and belief, no unfair competitive advantage exists with regard to Potomac-Hudson Engineering, Inc.'s participation on the instant contract.

Certified by:

05/22/06

Signature Date

Frederick J. Carey, Principal
Name & Title (Printed)

Potomac-Hudson Engineering, Inc.
Company

Disclosure Statement

Environmental Impact Statement
FutureGen Project
DE-AT26-06NT42921

DEAR 952.209-8 ORGANIZATIONAL CONFLICTS OF INTEREST DISCLOSURE requires an offeror to provide a statement of any past (within the past twelve months), present, or currently planned financial, contractual, organizational, or other interests relating to the performance of the statement of work. The offeror is to provide a statement that no actual or potential conflict of interest or unfair competitive advantage exists with respect to the advisory and assistance services to be provided in connection with the instant contract or that any actual or potential conflict of interest or unfair competitive advantage that does or may exist with respect to the contract in question has been communicated as part of the statement.

"Financial interest or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)". See 46 FR 18026-18031.

In accordance with these requirements, the entity signing below hereby certify as follows: (check either (a) or (b) and list items being disclosed if (b) is checked).

Financial Interest:

(a)	X	Has no past, present, or currently planned financial interest in the outcome of the project.
(b)		Has the following financial interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Contractual Interest:

(a)	X	Has no past, present, or currently planned contractual interest in the outcome of the project.
(b)		Has the following contractual interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Organizational Interest:

(a)	X	Has no past, present, or currently planned organizational interest in the outcome of the project.
(b)		Has the following organizational interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Other Interest:

(a)	X	Has no past, present, or currently planned other interest in the outcome of the project.
(b)		Has the following other interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Unfair Competitive Advantage:

To the best of my knowledge and belief, no unfair competitive advantage exists with regard to Tetra Tech, Inc.'s participation FutureGen Project.

Certified by:

Signature May 16, 2006
Date

Mark E. Smith, Vice President

Name & Title (Printed)

Tetra Tech, Inc.

Company

Disclosure Statement

Environmental Impact Statement
FutureGen Project
DE-AT26-06NT42921

DEAR 952.209-8 ORGANIZATIONAL CONFLICTS OF INTEREST DISCLOSURE requires an offeror to provide a statement of any past (within the past twelve months), present, or currently planned financial, contractual, organizational, or other interests relating to the performance of the statement of work. The offeror is to provide a statement that no actual or potential conflict of interest or unfair competitive advantage exists with respect to the advisory and assistance services to be provided in connection with the instant contract or that any actual or potential conflict of interest or unfair competitive advantage that does or may exist with respect to the contract in question has been communicated as part of the statement.

"Financial interest or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)". See 46 FR 18026-18031.

In accordance with these requirements, the entity signing below hereby certify as follows: (check either (a) or (b) and list items being disclosed if (b) is checked).

Financial Interest:

(a)	X	Has no past, present, or currently planned financial interest in the outcome of the project.
(b)		Has the following financial interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Contractual Interest:

(a)	X	Has no past, present, or currently planned contractual interest in the outcome of the project.
(b)		Has the following contractual interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Organizational Interest:

(a)	X	Has no past, present, or currently planned organizational interest in the outcome of the project.
(b)		Has the following organizational interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Other Interest:

(a)	X	Has no past, present, or currently planned other interest in the outcome of the project.
(b)		Has the following other interest in the outcome of the project and hereby agree to mitigate to the extent necessary to preclude a conflict prior to award of this contract:
		1.
		2.
		3.

Unfair Competitive Advantage:

To the best of my knowledge and belief, no unfair competitive advantage exists with regard to Potomac-Hudson Engineering, Inc.'s participation on the instant contract.

Certified by:

Kevin Young 5/12/06

Signature Date

Kevin Young, Senior Vice President

Name & Title (Printed)

The Louis Berger Group, Inc.

Company

Table 3-1. Project Features for Alternative Sites

ROW	Mattoon		Tuscola		Jewett		Odessa	
Estimated Lengths of Potable Water Pipeline (miles [kilometers])								
New ROW	—		<1 (<1.6)[1]		<1 (<1.6)[2]		—[3]	
Existing ROW	1 (1.6)		—		—		—[3]	
Total	1 (1.6)		<1 (<1.6)		<1 (<1.6)		—[3]	
Estimated Lengths of Process Water Pipeline (miles [kilometers])								
	Mattoon[4]	Charleston[4]						
New ROW	2 (3.2)	—	1.5 (2.4)		<1 (<1.6)[2]		24 – 54 (38.6 – 86.9)	
Existing ROW	4.2 (6.8)	8.1 (13.0)	—		—		—	
Total	6.2 (10)	8.1 (13.0)	1.5 (2.4)		<1 (<1.6)		24 – 54 (38.6 – 86.9)	
Estimated Lengths of Sanitary Wastewater Pipeline (miles [kilometers])								
	Mattoon WWTP		On-site Option	WWTP Option[5]	On-Site		On-site	
New ROW	—		—	0.9 (1.4)	—		—	
Existing ROW	1.25 (2.0)		—	—	—		—	
Total	1.25 (2.0)		—	0.9 (1.4)	—		—	
Estimated Lengths of Electrical Grid Interconnection Power Line (miles [kilometers])								
	Option 1 (138-kV)	Option 2 (345-kV)	Option 1 (138-kV)	Option 2 (345-kV)	Option 1[6] (345-kV)	Option 2 (138-kV)	N Option (138-kV)	S Option (138-kV)
New ROW	0.5 (0.8)	16 (25.7)	0.5 (0.8)	3 (4.8)	—	2 (3.2)	0.7 (1.1)	—
Existing ROW	0 – 2 (3.2)	—	—	14 (22.5)	—	—	—	1.8 (2.9)
Total	0.5 (0.8) – 2.5 (4)	16 (25.7)	0.5 (0.8)	17(27.4)	—	2 (3.2)	0.7 (1.1)	1.8 (2.9)
Estimated Lengths of Natural Gas Supply Pipeline (miles [kilometers])								
New ROW	0.25 (0.4)[7]		—[8]		—[8]		—[8]	
Existing ROW	—		—[8]		—[8]		—[8]	
Total	0.25 (0.4)		—[8]		—[8]		—[8]	
Estimated Lengths of CO_2 Pipeline (miles [kilometers])								
	On-site CO_2 pipeline		Crossing existing ROWs where applicable[9]		Using A-H Segment[10]	Using B-H Segment[10]		
New ROW	—		11 (17.7)		9 (14.5)	6 (9.7)	2 (3.2) to 14 (22.5)[11]	
Existing ROW	—		Not determined		43 (69.2)	53 (85.3)	58 (93.3)[12]	
Total	—		11 (17.7)		52 (83.7)[13]	59 (95.0)[13]	72[13] (111)	

[1] Potable water supply would tap into an existing line operated by the Illinois American Water Company.
[2] Wells would be located either on or near the plant site.
[3] Potable water would be obtained through the same pipeline as the process water supply.
[4] Mattoon would obtain process water from the combined effluents of the municipal WWTP for the cities of Mattoon and Charleston via separate pipelines.
[5] Discharge to Lyondell-Equistar Chemical Company WWTP.
[6] Would connect to a 345-kilovolt (kV) line bordering the site.
[7] The Site Proponent has obtained an option for additional land for the pipeline ROW that would give flexibility to connect to a natural gas mainline located 0.25 mile (0.4 kilometer) east of the proposed site.
[8] Existing natural gas pipeline traverses site or borders site boundary.
[9] Pipeline would be constructed parallel to Country Road (CR) 750E and 700E; cross existing state, county, and municipal ROWs; and occupy new ROW where needed.
[10] Corridor would be the same except for initial alignments (A-C or B-C) connecting to plant site.
[11] If existing Kinder Morgan pipeline cannot be used, new pipeline would be constructed (assumes new ROW).
[12] If existing Kinder Morgan pipeline can be used.
[13] Total ROW is not actual distance between the power plant site and the sequestration site.

Table 3-13. Possible Mitigation Measures for the FutureGen Project

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Air Quality	**Construction/Operations:** • The FutureGen Project would result in emissions of criteria and hazardous air pollutants, including those from unplanned restarts and flaring events. During these events, intermittent increases of steady-state emissions would occur when process gases are flared for a short period of time to restart the operations. It is not possible to predict the number and nature of unplanned restarts due to plant upsets that could occur. There would be concentrations of pollutants resulting in short-term impacts; however, the peak concentration of pollutants emitted would be within a 2-mile (3.2-kilometer) radius at any of the proposed sites. Residences within that radius would be most affected during unplanned restart and flaring events.	**Operations:** • The FutureGen Project would employ the most advanced particulate control technologies available. Concentration of particulates in the cleaned syngas would be about 0.1 to 1 parts per million by weight, far lower than current environmental standards. • The project would use the most advanced combustion control technologies for NO_X available when the turbine would be put into service. SCR is considered a possible option if suitable conditions exist to minimize potential interference by sulfur species. • The project would include a water-gas-shift reactor, plus an AGR system which would capture and remove acidic gases such as CO and H_2S.
Climate and Meteorology	**Construction/Operations:** • Construction and operation of the proposed facility would not cause any unavoidable adverse impacts relevant to climate and meteorology.	**Construction/Operations:** • No mitigation measures warranted.
Geology	**Construction/Operations:** • No unavoidable adverse impacts would occur to geological resources. Reservoir space would be used to store the injected CO_2. • May cause local adverse impacts to and loss of microbial communities that live in rock where CO_2 would be injected.	**Construction/Operations:** • No mitigation measures warranted.
Physiography and Soils	**Construction:** • Unavoidable soil disturbance at the proposed power plant site would result in permanent removal or displacement of soils on up to 200 acres (81 hectares); this includes prime farmland soils (Mattoon and Tuscola). Temporary disturbances to soil would occur along proposed utility corridors. BMPs would prevent any additional adverse impacts. **Operations:** • No unavoidable adverse impacts would occur to physiography and soils. BMPs would be used to minimize impacts.	**Construction:** • Prime farmland soils (Mattoon and Tuscola) could be stockpiled and hauled off site during construction for other agricultural uses. **Operations:** • No mitigation measures warranted.

Table 3-13. Possible Mitigation Measures for the FutureGen Project

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Groundwater	**Construction/Operations**: • No unavoidable adverse impacts would occur to groundwater resources. BMPs would be used to minimize impacts. • Some groundwater use would occur in Tuscola, Jewett, and Odessa. Impacts of water use are likely to be more important for the Odessa site.	**Construction/Operations**: • No mitigation measures warranted.
Surface Water	**Construction/Operations**: • No unavoidable adverse impacts would occur to surface water resources. BMPs would be used to minimize impacts. • Some surface water use would occur in Odessa, Jewett, and Tuscola. Impacts of water use are likely to be more important for the Odessa Site.	**Construction/Operations**: • No mitigation measures warranted.
Wetlands and Floodplains	**Construction:** • Construction of the proposed facility could result in unavoidable temporary impacts to wetlands along utility corridors. BMPs should prevent any adverse impacts from construction and operation of the FutureGen Project. **Operations**: • No unavoidable adverse impacts would occur to wetlands or floodplains. BMPs would be used to minimize impacts.	**Construction**: • Site design could avoid impacts to wetlands. New utility corridors could be located to avoid some wetlands. • Section 404 permits would be obtained for jurisdictional water-body and wetland alternations. As a permit condition, mitigation of wetland impacts would be in the form of direct replacement or other approved U.S. Army Corps of Engineers (USACE) and state mitigation requirements. Typical mitigation ratios for unavoidable impacts to wetlands would be 1:1 for open water and emergent wetlands, 1.5:1 for shrub wetlands, and up to 2:1 for forested wetlands. • Directional drilling of utilities in areas where mitigation is not required by the USACE would further reduce impacts to wetland resources. **Operations**: • No mitigation measures warranted.

Table 3-13. Possible Mitigation Measures for the FutureGen Project		
Resource Area	**Unavoidable Adverse Impacts**	**Possible Mitigation Measures**
Biological Resources	**<u>Construction</u>:** • Permanent unavoidable land disturbance at the proposed power plant site would result in permanent habitat loss of up to 200 acres (81 hectares). Temporary disturbances to additional aquatic and terrestrial habitats would occur along proposed utility corridors. BMPs should prevent any adverse impacts to these terrestrial and aquatic habitats. • No known occurrences of threatened and endangered species; however, the potential exists for an adverse impact to threatened or endangered species within each of the proposed FutureGen Project sites. Surveys for these species before construction would determine if they occur in the area. BMPs and coordination with state and federal agencies should prevent any adverse impacts. **<u>Operations</u>:** • No unavoidable adverse impacts would occur to biological resources. BMPs would be used to minimize impacts.	**<u>Construction</u>:** • Mitigation for federal endangered species, if necessary, would be defined during consultation with the U.S. Fish and Wildlife Service and could include passive measures such as construction timing outside of critical breeding periods, or more aggressive measures such as complete avoidance of impacts. **<u>Operations</u>:** • No mitigation measures warranted.
Cultural Resources	**<u>Construction</u>:** • Although there are no known areas of cultural significance, the potential exists for an adverse impact to cultural resources (Jewett and Odessa CO_2 corridors, Tuscola electrical transmission corridor). Archaeological surveys would determine location of any cultural resources and the possible extent of impact. Construction of the proposed facility is not anticipated to have any unavoidable adverse impacts relevant to cultural resources. • Consultation with Native American tribes was initiated; no tribes have requested involvement, however, coordination is ongoing. The potential of unavoidable adverse impacts would be resolved once consultation is complete. • **<u>Operations</u>:** • No unavoidable adverse impacts would occur to cultural resources. BMPs would be used to minimize impacts.	**<u>Construction</u>:** • Consultation with the State Historic Preservation Officer (SHPO) for any new unforeseen areas of construction or ground disturbance not included within the EIS would be completed before construction to determine the need for cultural resource investigations and any appropriate mitigation measures. • Required management and mitigation measures regarding traditional cultural properties are unknown until consultation with Native American tribes is complete. **<u>Operations</u>:** • No mitigation measures warranted.

Table 3-13. Possible Mitigation Measures for the FutureGen Project

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Land Use	**<u>Construction</u>:** • Direct unavoidable impact due to displacement of oil and gas wells (Odessa and Jewett). • Direct impact to any residential property and prime farmland (Mattoon and Tuscola) located adjacent to the power plant site; introduces industrial construction adjacent to residential property. BMPs used for aesthetics, noise, and traffic should minimize any adverse impacts on adjacent land use resulting from project construction. • <u>Operations</u>: • No unavoidable adverse impacts would occur to land use. BMPs would be used to minimize impacts.	**<u>Construction</u>:** • Displaced oil and gas wells could be relocated. **<u>Operations</u>:** • No mitigation measures warranted. • FutureGen Project land that is not used for project purposes could be leased for agricultural use.
Aesthetics	**<u>Construction/Operations</u>:** • The proposed power plant (Mattoon and Tuscola) would cause a major unavoidable visual intrusion to residences within a 1-mile (1.6-kilometer) radius of the site. • Moderate unavoidable visual intrusion would occur for two residences near the Odessa site due to the presence of other industrial facilities that are visible in the general area and the FutureGen facility.	**<u>Construction/Operations</u>:** Potential mitigation measures that would reduce the aesthetic impacts of the facility include: • Enclosing some of the more “industrial” components of the plant in buildings. • Providing landscaping around the perimeter of the plant site to partially screen the plant from nearby residences and those passing by on the adjacent roads. • Selecting single-pole transmission towers to reduce the visual profile of the transmission towers. • Lighting design (e.g., luminaries with controlled candela distributions, well-shielded or hooded lighting, and directional lighting) could minimize potential for light pollution.
Transportation and Traffic	<u>Construction</u>: • Construction would create temporary localized adverse impacts due to the presence of additional trucks. BMPs should minimize additional impacts. • Temporary unavoidable impacts would occur to rail operations during construction of a new underpass (Odessa). <u>Operations</u>: • Changes to traffic signal timings may be required at ramp intersections to accommodate changes in the turning volumes.	<u>Construction</u>: • Truck traffic impacts would be mitigated through the use of signed truck routes to the proposed power plant site. Continued use of these routes during operations would reduce adverse impact. • At a minimum, trained rail construction flaggers would be required at all times during construction to accommodate traffic flow (Odessa). <u>Operations</u>: • No mitigation measures warranted.

Table 3-13. Possible Mitigation Measures for the FutureGen Project

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Noise and Vibration	**<u>Construction</u>:** • Construction would result in unavoidable temporary elevated noise impacts at the power plant site, increasing ambient noise levels at nearby receptors. BMPs would reduce impacts. **<u>Operations</u>:** • Operational traffic activities within the power plant site would result in unavoidable noise increases at nearby residences (Mattoon and Tuscola). BMPs would reduce impacts. • Noise and vibration from train rail car shakers could generate noise levels up to 118 dBA. • Numerous power plant components could generate increases in ambient noise levels and some could generate vibrations.	**<u>Construction</u>:** • Noise mitigation measures to limit the number of heavy trucks passing by residential receptors during construction would include diverting truck trips, scheduling more deliveries on rail, or purchasing the impacted property (Mattoon and Tuscola). **<u>Operations</u>:** • Sound enclosures or dampening devices could be used whenever possible. In addition, alternate site configurations could be considered in order to position noise-producing equipment away from the impacted receptors (Mattoon and Tuscola). • Design of coal handling equipment would be evaluated during final design to reduce noise impacts to adjacent receptors.
Utility Systems	**<u>Construction/Operations</u>:** • No unavoidable adverse impacts would occur to utility systems. BMPs would be used to minimize impacts.	**<u>Construction/Operations</u>:** • No mitigation measures warranted.
Materials and Waste Management	**<u>Construction/Operations</u>:** • No unavoidable adverse impacts would occur to materials and waste management. BMPs would be used to minimize impacts.	**<u>Construction/Operations</u>:** • No mitigation measures warranted. •

Table 3-13. Possible Mitigation Measures for the FutureGen Project		
Resource Area	**Unavoidable Adverse Impacts**	**Possible Mitigation Measures**
Human Health, Safety, and Accidents	**Construction/Operations:** • Unavoidable adverse impacts to human health and safety, although unlikely, could result from various types of accidents, sabotage and terrorism acts, ranging from small pipeline leaks to, in the worst case, a power plant explosion. Two separate risk studies were completed to identify and evaluate the risks of most importance. The results of the risk assessments would help planners and designers to reduce these risks during the planning, designing, construction, and operation of the FutureGen. • The potential for large spills of ammonia with adverse impacts to human health would be low.	**Construction/Operations:** • Design the CO_2 pipeline with automatic emergency shut-off valves spaced at 5-mile (8.0-kilometer) intervals to reduce the quantity of gases that could be released in the event of a pipeline rupture. The affected area associated with a release event would be reduced approximately linearly with the reduction in the distance between the shut-off valves. Automatic shut-off valves could be placed at 3-mile (4.8-kilometer) or 1-mile (1.6-kilometer) intervals near populated areas to further reduce the quantity of gases that could be released from a pipeline rupture or puncture. • Thicker pipe walls or armored pipe guards could be used at water body and road crossings. • The Risk Assessment associated with the preparation of the EIS delineated potential areas affected by pipeline ruptures and punctures. Set-back areas could be specified for populated areas. Pipelines could also be routed to maximize the distance to populated areas and sensitive receptors. • Well head and pipeline protective barriers could be installed (e.g., chain-link fences and posts or barricades). • The pipeline would be buried to minimize accidental damage. Deeper burial of the pipeline (deeper than 3 feet [0.9 meters]) in areas with higher population densities could reduce the risk of damage caused by digging and trenching. • Bleed valves could be added to control location and direction of releases should a puncture occur. The valves may be able to be designed to maximize the production of dry ice, snow, which reduces the peak concentrations of pipeline gases. • The use of in-line inspection vehicles or intelligence pigs can detect very early evidence of corrosion. Increased monitoring for corrosion and frequent inspections and clean-outs could be implemented in populated areas, in addition to the Supervisory Control and Data Acquisition monitoring of pipeline pressure, temperature, and flow rate. • The quantity of ammonia stored on site could be decreased from a 30-day supply to a 2-week supply using two smaller tanks. • The transfers from the tanker truck to the pipeline leading to the tank could be conducted within a portable secondary containment system. • Inspection would be conducted of the tanker truck and connecting pipe valves.

Table 3-13. Possible Mitigation Measures for the FutureGen Project		
Resource Area	**Unavoidable Adverse Impacts**	**Possible Mitigation Measures**
Community Services	**Construction/Operations:** • No unavoidable adverse impacts would occur to community services. BMPs would be used to minimize impacts.	**Construction/Operations:** • No mitigation measures warranted.
Socioeconomics	Construction: • Construction of the proposed facility would have unavoidable adverse impacts on residential properties located within, and adjacent to, the proposed power plant site property boundaries (Mattoon and Tuscola). BMPs should prevent any additional adverse impacts from construction and operations of the FutureGen Project. **Operations:** • Operation of the facility would have unavoidable adverse impacts on residents located very near the proposed power plant (Mattoon and Tuscola) through a potential unobstructed view of the facility, noise, and perhaps some dust or vibrations. The potential socioeconomic impact could be a reduction in property values for some homes very near or adjacent to the power plant.	**Construction:** • Purchase of the residences (two at Mattoon; three at Tuscola) would mitigate financial loss or other long-term impacts to residents from construction and operation of the FutureGen Project. • **Operations:** • See mitigation measures under aesthetics and noise.
Environmental Justice	**Construction/Operations:** • Construction and operation of the proposed facility are not anticipated to have any unavoidable adverse impacts related to environmental justice.	**Construction/Operations:** • No mitigation measures warranted.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Air Quality	• Water sprays from trucks could be used to control fugitive dust by wetting exposed soils during construction activities. • A phased construction period could be utilized to minimize vehicular emissions. • Plugging of identified abandoned wells within the injection area could be performed before the start of CO_2 injection operations, and plugging of injection wells at the conclusion of injection operations would be undertaken to prevent leakage of sequestered CO_2. • Trucks could be covered, equipment properly maintained, and the amount of vehicle trips and idling limited to minimize vehicular emissions.
Climate and Meteorology	• The facility would be designed to withstand high winds and extreme temperatures.
Geology	• Maintenance and monitoring of CO_2 injection wells would be performed to ensure they are operating properly. • Periodic mechanical integrity testing of injection well casings, tubing, and packers would be performed to prevent fluid movement through vertical channels adjacent to the injection well bores, and to detect any unexpected migration of CO_2 at the injection wells. • Monitoring of active or inactive wells that penetrate the primary seal within the subsurface ROI, including sealed and abandoned wells, would be conducted to detect leakage of CO_2 through these potential conduits. • Monitoring for microseismic events and increased pressures due to CO_2 injection would be performed to identify conditions that could cause fracturing of the sequestration formation and CO_2 escape. • A monitoring and tracking system for the CO_2 plume would be used to detect any unexpected migration of the CO_2 plume. • Remediation options for typical leakage scenarios at the CO_2 injection wells or abandoned wells would be developed before plant startup so that pipe ruptures, blow-outs, and leaks can be quickly identified and addressed.
Physiography and Soils	• Silt fences, sand bags, straw bales, trench plugs, and interceptor dikes would be utilized during construction to minimize soil erosion. • Soil wetting and phased construction would be utilized to reduce soil blowing. • Topsoil segregation during construction would minimize soil structure damage and allow the soil to be placed back into pre-construction uses (i.e., crop production). • Soils would be stabilized through post-construction revegetation and mulching of temporarily disturbed areas. • Permanently removed vegetation would be recycled to the extent practicable (e.g., mulch, pulp and paper products) to maximize re-utilization of these permanently lost resources. • Established Occupational Safety and Health Administration (OSHA) and EPA guidelines for labeling, segregation, and storage of hazardous materials would be used to minimize soil contamination from spills and handling.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Groundwater	• A Spill Prevention, Control, and Countermeasures Plan would be developed and implemented to minimize the potential for groundwater contamination due to uncontrolled or unmitigated releases of hazardous materials. • Monitoring systems would be installed at the sequestration site and areas within the subsurface ROI to detect CO_2 migration before it can come in contact with overlying groundwater resources. • Soil gas monitoring would be used to detect CO_2 migration into soils. • The lateral and vertical extent of the CO_2 plume would be monitored to detect any CO_2 migration beyond the sequestration reservoir.
Surface Water	• Engineering designs and construction techniques, required as part of the NPDES Permit and Stormwater Pollution Prevention Plan (SWPPP), would minimize surface water quality impacts. • Site design would incorporate stormwater treatment, effectively eliminating water quality impacts from contaminated stormwater runoff. • Silt fencing, storm sewer inlet/outlet protection, and use of sediment basins would be used to reduce the potential for sedimentation, turbidity, and runoff during construction. • Directional drilling under water bodies during underground utility pipeline construction would help reduce sedimentation, turbidity, and interruption of surface water flows. • Perpendicular crossings of streams within locations that could not be directionally drilled would reduce the linear impacts of construction. • Soils near surface water bodies would be stabilized through post-construction revegetation and mulching of temporarily disturbed areas to reduce additional sedimentation and runoff.
Wetlands and Floodplains	• Engineering designs and construction techniques, required as part of the NPDES Permit and SWPPP, would minimize surface water quality impacts. • Silt fencing, hay bales, and other sediment and erosion control mechanisms would be used to minimize sedimentation into wetlands adjacent to construction sites. • Existing ROWs would be used whenever possible to limit impacts to previously disturbed wetlands or avoid wetland impacts. • Construction activities would be scheduled to occur during drier months to minimize the potential for impacts to floodplain soils and topographical features. • Equipment movement through and near wetland areas would be minimized to reduce the magnitude of temporary impacts. • The use of herbicides within or adjacent to wetlands would be limited to those approved for use in wetland areas. • Directional drilling would be used to reduce or avoid impacts to wetlands during pipeline construction.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Biological Resources	• Existing ROWs would be used whenever possible to confine impacts to previously disturbed terrestrial and aquatic habitats. • Standard pipeline construction practices, including silt fencing, hay bales, and other sediment and erosion control mechanisms, would be used to minimize impacts to aquatic habitat and species. • A soil erosion and sedimentation control plan would be implemented as required by applicable permits. • Equipment movement through and near riparian corridors would be minimized to reduce the magnitude of temporary impacts. • Construction activities would be scheduled for drier months to minimize the potential for impacts to aquatic habitats. • Directional drilling would be used to avoid impacts to aquatic habitat during pipeline construction. • Post-construction revegetation and mulching of temporarily disturbed areas would be conducted to decrease the recovery time for disturbed habitats.
Cultural Resources	• If artifacts or other evidence of cultural resources were discovered during construction, operations in that area would cease and the area would be secured until the SHPO could be consulted regarding the discovery. • Consultation would occur with the caretakers of the cemetery located in the CO_2 pipeline corridor at the Jewett Site to determine BMPs needed to ensure that the cemetery remains undisturbed. At a minimum, the boundaries of the cemetery would be clearly marked and a buffer of 100 feet (30.5 meters) in all directions around the cemetery would be established within which no construction activity, including vehicular access or parking, would be allowed.
Land Use	• Careful selection of utility corridor routing during final design, particularly underground water and CO_2 lines, would be undertaken to minimize the potential for conflicts with the locations of existing oil, gas, and water wells. • Appropriate shoring of utility trenches and general BMPs during construction would minimize land use impacts throughout the corridors, especially in those areas where prime farmland exists. • Where utility corridors cross cropland (Mattoon and Tuscola), separation of topsoil during trenching and return of the topsoil to the top of the filled-in trench would be done to help maintain the productivity of the agricultural land following construction. • Farmland drain tiles on the Tuscola and Mattoon sites would be carefully replaced where they would be impacted by utility corridor construction.
Aesthetics	• Grading of stockpiled topsoil and reestablishment of native vegetation would be used to minimize landscape scarring after construction is complete.
Transportation and Traffic	• Traffic signal timing could be changed along designated corridors to accommodate necessary construction traffic. • Horizontal directional drilling would be utilized to run pipelines under roadways so that continued safe use of roadways could be achieved.
Noise and Vibration	• The number of heavy trucks passing by residential receptors would be regulated during construction. • Construction activities would likely occur during daytime hours and would comply with any local noise regulations related to construction.
Utility Systems	• Existing utility locations would be mapped and checked before finalizing locations of new utility construction to avoid accidental disturbance of these existing underground utilities. • Inspectors would be employed to help ensure that construction does not interfere with existing lines. • In the event of an accident that damaged or severed an existing line, standard emergency procedures would be followed to notify the affected utility so that service is restored as soon as possible.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Materials and Waste Management	• Pollution prevention, waste minimization, and recycling measures would be used to reduce the amounts of waste generated. • Excess construction materials would be stored for potential later use to reduce amount of construction waste sent to landfills. • Recycling would be incorporated into construction and operations to minimize emissions and waste products.
Human Health, Safety, and Accidents	• A site safety plan that focuses on construction activities and provides for safety meetings would be prepared and implemented to help avoid injury during construction. • An OSHA-compliant Worker Protection Program would be established to effectively implement site safety plans, maintain Material Safety Data Sheets (MSDS), track chemical inventories, provide and track worker training, and assess and enforce site safety policies and procedures (e.g., worker personal protective equipment, spill prevention and control, noise monitoring, and construction safety). • Monitoring, cleanout, and inspection procedures for the CO_2 pipelines need to be developed and followed. These plans should include use of safety valves to isolate sections of the pipeline, bleed valves, and continuous pipeline monitoring with computer models to rapidly interpret changes in fluid densities, pressures, etc. • An emergency response plan with procedures to notify the public would be developed. • An SPCC plan would be prepared to describe spill prevention and control measures for the on-site ammonia storage tank and refilling operations. Daily inspection of the valves on the ammonia tank would be conducted to make sure that no leaks have occurred. All refilling operations would be conducted within a portable secondary containment system by trained workers only.
Community Services	The following fire protection measures would eliminate fire or explosion hazards at the power plant: • Good housekeeping practices would be utilized to control the accumulation of flammable and combustible waste materials and residues. • Chemicals would be properly stored to eliminate fire and incompatibility hazards. • MSDS would be available for consultation to determine the appropriate storage of incompatible chemicals. • All state and local fire codes would be adhered to during project operations. • Engineered safeguards and automatic fire suppression systems would be installed in all high risk areas.
Socioeconomics	• There are no BMPs related to Socioeconomics.
Environmental Justice	• There are no BMPs related to Environmental Justice.

[1] BMPs apply to all four candidate sites unless otherwise noted.

Table 3-3. Summary Comparison of Impacts

<table>
<tr><th>Mattoon</th><th>Tuscola</th><th>Jewett</th><th>Odessa</th></tr>
<tr><td colspan="4">No-Action Alternative</td></tr>
<tr><td colspan="4">No impact to environmental resources; no change in existing conditions. Under the No-Action Alternative, DOE would not share in the cost for constructing and operating the FutureGen Project. Without DOE funding, it would be unlikely that the Alliance, or industry in general, would soon undertake the commercial-scale integration of CO_2 capture and geologic sequestration with a coal-fueled power plant.</td></tr>
<tr><td colspan="4">Proposed Action – Air Quality</td></tr>
<tr>
<td>Construction:
Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term impacts on local air quality.
Operations:
Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be:
Pollutant FG FG+Ambient NAAQS
Conc. During Normal Plant Operation
SO_2, 3-hr 0.717 123.75 1,300
SO_2, 24-hr 0.262 70.93 365
SO_2, Annual 0.184 10.65 80
NO_2, Annual 0.256 30.35 100
PM_{10}, 24-hr 0.524 57.86 150
PM_{10}, Annual 0.038 26.04 50
$PM_{2.5}$, 24-hr 0.524 32.46 35
$PM_{2.5}$, Annual 0.038 12.54 15
CO, 1-hr 11.333 5,622.76 40,000
CO, 8-hr 5.005 3,462.94 10,000
Conc. During Plant Upset Events[1]
SO_2, 3-hr 511.819 634.85 1,300
SO_2, 24-hr 88.000 158.67 365
Units in micrograms per cubic meter
Probability of exceeding PSD increment:
Normal plant operation: zero percent (all[2])
Plant upset events: 0.23 percent (3-hr SO_2), zero percent (24-hr SO_2)
Hg Emissions (tpy [mtpy]): 0.011 (0.010)
Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)</td>
<td>Construction:
Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term impacts on local air quality.
Operations:
Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be:
Pollutant FG FG+Ambient NAAQS
Conc. During Normal Plant Operation
SO_2, 3-hr 0.536 123.57 1,300
SO_2, 24-hr 0.197 70.87 365
SO_2, Annual 0.048 10.52 80
NO_2, Annual 0.067 30.09 100
PM_{10}, 24-hr 0.393 57.73 150
PM_{10}, Annual 0.010 26.01 50
$PM_{2.5}$, 24-hr 0.393 32.33 35
$PM_{2.5}$, Annual 0.010 12.51 15
CO, 1-hr 9.470 5,620.90 40,000
CO, 8-hr 4.729 3,462.66 10,000
Conc. During Plant Upset Events[1]
SO_2, 3-hr 511.958 634.99 1,300
SO_2, 24-hr 67.000 137.67 365
Units in micrograms per cubic meter
Probability of exceeding PSD increment:
Normal plant operation: zero percent (all[2])
Plant upset events: 0.22 percent (3-hr SO_2), zero percent (24-hr SO_2)
Hg Emissions (tpy [mtpy]): 0.011 (0.010)
Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)</td>
<td>Construction:
Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term impacts on local air quality.
Operations:
Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be:
Pollutant FG FG+Ambient NAAQS
Conc. During Normal Plant Operation
SO_2, 3-hr 0.820 34.85 1,300
SO_2, 24-hr 0.415 13.51 365
SO_2, Annual 0.483 3.10 80
NO_2, Annual 0.674 27.01 100
PM_{10}, 24-hr 0.829 55.83 150
PM_{10}, Annual 0.099 26.10 50
$PM_{2.5}$, 24-hr 0.829 30.16 35
$PM_{2.5}$, Annual 0.099 13.80 15
CO, 1-hr 10.447 4,018.62 40,000
CO, 8-hr 7.879 1,954.70 10,000
Conc. During Plant Upset Events[1]
SO_2, 3-hr 511.913 545.94 1,300
SO_2, 24-hr 89.500 102.59 365
Units in micrograms per cubic meter
Probability of exceeding PSD increment:
Normal plant operation: zero percent (all[2])
Plant upset events: 1.66 percent (3-hr SO_2), 0.24 percent (24-hr SO_2)
Hg Emissions (tpy [mtpy]): 0.011 (0.010)
Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)</td>
<td>Construction:
Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term on local air quality.
Operations:
Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be:
Pollutant FG FG+Ambient NAAQS
Conc. During Normal Plant Operation
SO_2, 3-hr 0.542 52.89 1,300
SO_2, 24-hr 0.188 13.28 365
SO_2, Annual 0.248 5.49 80
NO_2, Annual 0.346 15.40 100
PM_{10}, 24-hr 0.376 51.71 150
PM_{10}, Annual 0.051 18.05 50
$PM_{2.5}$, 24-hr 0.376 20.71 35
$PM_{2.5}$, Annual 0.051 7.75 15
CO, 1-hr 8.418 7,234.37 40,000
CO, 8-hr 4.855 3,906.86 10,000
Conc. During Plant Upset Events[1]
SO_2, 3-hr 511.979 564.33 1,300
SO_2, 24-hr 73.000 86.09 365
Units in micrograms per cubic meter
Probability of exceeding PSD increment:
Normal plant operation: zero percent (all[2])
Plant upset events: 0.09 percent (3-hr SO_2), zero percent (24-hr SO_2)
Hg Emissions (tpy [mtpy]): 0.011 (0.010)
Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)</td>
</tr>
</table>

[1] Unplanned restart emissions of PM_{10} and $PM_{2.5}$ do not occur during plant upset events. Unplanned restart emissions of NO_2 and CO_2 are lower than steady-state emissions (i.e., <2 percent and <0.2 percent, respectively), therefore impacts are lower.
[2] all = all pollutants and associated averaging period.
FG = FutureGen; tpy = tons per year; NAAQS = National Ambient Air Quality Standards; PSD = Prevention of Significant Deterioration; HAP = Hazardous Air Pollutant; Hg = mercury.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Climate and Meteorology			
Construction and Operations: No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºFahrenheit [F] [17.8ºCelsius (C)]) days (average): 7.5 Snowfall: 1 snowfall of 6 inches (15.2 centimeters) or more and one ice glaze event per year. F1 or greater tornadoes: 1 to 4 every 50 years Severe or extreme drought conditions, potential for wildfire; increased number of water trucks to reduce fugitive dust.	**Construction and Operations:** No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºF [17.8ºC]) days (average): 6 Snowfall: 1 snowfall of 6 inches (15.2 centimeters) or more and one ice glaze event per year. F1 or greater tornadoes: 1 to 4 every 50 years Same as Mattoon.	**Construction and Operations:** No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºF [17.8ºC]) days (average): rare Snowfall: Annual snowfall is less than 1.5 inches (3.8 centimeters) and ice glaze events are rare. F1 or greater tornadoes: 1 every 5 years Same as Mattoon.	**Construction and Operations:** No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºF [17.8ºC]) days (average): rare Snowfall: Annual snowfall is less than 4.5 inches (11.4 centimeters) and ice glaze events are rare. F1 or greater tornadoes: 1 every 200 years Same as Mattoon.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Geology			
Construction: **Target Formation:** Formation: Mt. Simon Injection depth: 1.3 to 1.6 miles (2.1 to 2.6 kilometers) Formation: St. Peter (Optional target reservoir) Injection depth: 0.9 mile (1.4 kilometers) Predicted CO_2 Plume Radius: 1.2 miles (1.9 kilometers) **Caprock:** Formation: Eau Claire Shale Thickness: 500 to 700 feet (152 to 213 meters) Well penetrations (ROI): No known	**Construction:** **Target Formation:** Formation: Mt. Simon Injection depth: 1.3 to 1.5 miles (2.1 to 2.4 kilometers) Formation: St. Peter (Optional target reservoir) Injection depth: 0.9 mile (1.4 kilometers) Predicted CO_2 Plume Radius: 1.1 miles (1.8 kilometers) **Caprock:** Formation: Eau Claire Shale Thickness: 500 to 700 feet (152 to 213 meters) Well penetrations (ROI): No known	**Construction:** **Target Formation:** Formation: Woodbine (Primary) Injection depth: 1 to 1.1 miles (1.6 to 1.8 kilometers) Formation: Travis Peak (Secondary) Injection Depth: 1.7 to 2.1 mile (2.7 to 3.4 kilometers) Predicted CO_2 Plume Radius: 1.7 miles (2.7 kilometers) **Caprock (Primary):** Formation: Eagle Ford Shale Thickness: 400 feet (122 meters) Well penetrations (ROI): 8 known, up to 57	**Construction:** **Target Formation:** Formation: Lower Delaware Mountain Group and upper interval of the Queen Formation Injection depth: 0.4 to 1 mile (0.6 to 1.6 kilometers) Predicted CO_2 Plume Radius: 1 mile (1.7 kilometers) **Caprock:** Formation: Queen-Seven Rivers Thickness: 700 feet (213 meters) Well penetrations (ROI): 2 known, up to 16
Operations: **Earthquake potential:** Intensity: Medium (magnitude <5) Likelihood: Possible but not common **Earthquake occurrences since 1974:** Number: 29 Magnitude: 2.7 to 5.0 Distance: Within 100 miles (161 kilometers)	**Operations:** **Earthquake potential:** Intensity: Same as Mattoon Likelihood: Same as Mattoon **Earthquake occurrences since 1974:** Number: 30 Magnitude: 2.4 to 5.1 Distance: Within 120 miles (193 kilometers)	**Operations:** **Earthquake potential:** Intensity: Medium (magnitude <4) Likelihood: Possible but not common **Earthquake occurrences since 1974:** Number: 4 Magnitude: 2.3 to 3.4 Distance: Within 100 miles (161 kilometers)	**Operations:** **Earthquake potential:** Intensity: Medium (magnitude <6) Likelihood: Possible but not common **Earthquake occurrences since 1974:** Number: 40 Magnitude: 2.3 to 5.7 Distance: Within 120 miles (193 kilometers)

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Geology (continued)			
Faults: Although no detailed mapping of faults, recent 2D seismic lines indicate no major faulting at the injection site. Possibility exists for faults associated with nearby anticline; however, these are likely sealing faults. Closest Major Fault: New Madrid 200 miles (322 kilometers) south-southwest.	**Faults:** Although no detailed mapping of faults, recent 2D seismic lines indicate no major faulting at the injection site. Strong possibility exists for faults associated with steep flank of nearby anticline; however, these are likely sealing faults. Closest Major Fault: New Madrid 230 miles (370 kilometers) south-southwest.	**Faults:** Multiple surface faults within 10 miles (16 kilometers). Closest Major Fault: Mexia-Talco 30 to 35 miles (48.2 to 56.3 kilometers) sealing fault, New Madrid 400 miles (644 kilometers) north-northeast.	**Faults:** No detailed mapping of faults. Quiescent basement fault beneath ROI. Closest Major Fault: Rio Grande Rift system 210 miles (338 kilometers); New Madrid greater than 800 miles (1,287 kilometers).
Potential for Adverse Impacts: Radon displacement: Low Induced seismicity: Low CO_2 leakage due to seal penetrations or faults: Low	**Potential for Adverse Impacts:** Same as Mattoon.	**Potential for Adverse Impacts:** Same as Mattoon.	**Potential for Adverse Impacts:** Same as Mattoon.

ROI = Region of influence.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Physiography and Soils			
Construction: Soil disturbance (including loss, change of composition and potential of spill contamination).	**Construction:** Soil disturbance (including loss, change of composition and potential of spill contamination).	**Construction:** Soil disturbance (including loss, change of composition and potential of spill contamination).	**Construction:** Soil disturbance (including loss, change of composition and potential of spill contamination).
Power Plant Site: Up to 200 acres (81 hectares) permanently lost.	**Power Plant Site:** Same as Mattoon.	**Power Plant Site:** Same as Mattoon.	**Power Plant Site:** Same as Mattoon.
Sequestration Site: Power Plant and Sequestration Site on same parcel of land.	**Sequestration Site**: Up to 10 acres (4 hectares) permanently lost.	**Sequestration Site**: Same as Tuscola.	**Sequestration Site**: Same as Tuscola.
Utility Corridors: Up to 25.6 acres (10.4 hectares) temporarily disturbed.	**Utility Corridors:** Up to 32.4 acres (13.1 hectares) temporarily disturbed.	**Utility Corridors:** Up to 358 acres (145 hectares) temporarily disturbed.	**Utility Corridors:** Up to 341 acres (138 hectares) temporarily disturbed.
Transportation Corridors: Up to 15.9 acres (6.4 hectares) disturbed through construction of infrastructure within the power plant site.	**Transportation Corridors**: Up to 6.7 acres (2.7 hectares) disturbed through construction of infrastructure within the power plant site.	**Transportation Corridors:** Up to 73 acres (29.5 hectares) disturbed through construction of infrastructure within the power plant site.	**Transportation Corridors**: Up to 1.8 acres (0.7 hectare) disturbed through construction of infrastructure within the power plant site.
Operations: Low potential for contamination due to minor spills at the power plant site and along utility corridors.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Groundwater			
Construction: No groundwater use, impacts are not anticipated.	**Construction:** No groundwater use, impacts are not anticipated.	**Construction:** No groundwater use, impacts are not anticipated.	**Construction:** No groundwater use, impacts are not anticipated.
Operations: Process water source; treated wastewater, no impacts to local aquifers anticipated.	**Operations:** Process water source; treated wastewater primary source, ultimate source is the Kaskaskia River. Short-term impacts from supplemental use of groundwater.	**Operations:** Groundwater impact due to increase in aquifer use for power plant process water. Sustainability of aquifer would be maintained.	**Operations:** Groundwater impact due to increase in aquifer use for power plant process water. Current water level declines anticipated to continue.
Aquifer: n/a	Aquifer: Mahomet (supplemental only)	Aquifer: Carrizo-Wilcox	Aquifer: Undetermined, multiple options
Aquifer capacity: n/a	Aquifer capacity: 16 to17 million gallons per day (61 to 64 million liters per day)	Aquifer capacity: 1.23×10^8 m^3/day	Aquifer capacity: 1.28×10^7 to 7.2×10^7 m^3/day
Potable groundwater use to depth: Approximately 175 feet (53.3 meters)	Potable groundwater use to depth: Approximately 100 feet (31 meters)	Potable groundwater exists to depth: Approximately 1,400 feet (427 meters)	Potable groundwater exists to depth: Approximately 1,500 feet (457 meters)
Usage of capacity: n/a	Usage of capacity: 26 percent (short-term)	Usage of capacity: 4 percent	Usage of capacity: 7 to 39 percent
Depth to CO_2 injection zone: Mt. Simon: 1.3 to 1.6 miles (2.1 to 2.6 kilometers) St Peter (optional): 0.9 mile (1.4 kilometers)	Depth to CO_2 injection zone: Mt Simon: 1.3 to 1.5 miles (2.1 to 2.4 kilometers) St Peter (optional): 0.9 mile (1.4 kilometers)	Depth to CO_2 injection zone: Woodbine: 1.0 mile (1.6 kilometers); Travis Peak: 1.7 miles (2.7 kilometers)	Depth to CO_2 injection zone: 0.4 mile (0.6 kilometer)
Impacts of CO_2 sequestration on drinking water aquifers considered unlikely. Abandoned wells penetrating primary seal would need to be assessed and closed properly.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Existing wells through Caprock: 0	Existing wells through Caprock: 0	Existing wells through Caprock: Up to 57	Existing wells through Caprock: Up to 16

n/a = not applicable.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Surface Water			
Construction: Low potential for increased sediment loads, stream channel erosion, and non-point source pollution from land disturbance and stream crossings.	**Construction:** Same as Mattoon.	**Construction:** Same as Mattoon.	**Construction:** Same as Mattoon.
Pipeline stream crossings: 5	Pipeline stream crossings: 7	Pipeline stream crossings: 30	Pipeline stream crossings: Approximately 3 to 6
Operations: Streams affected: Cassell and Kickapoo creek flows reduced by process water withdrawals (3,000 gallons per minute [gpm] [11,356 liters per minute (lpm)]) from Mattoon and possibly Charleston wastewater treatment plants.	**Operations:** Streams affected: Kaskaskia River flows reduced by process water withdrawals (3,000 gpm [11,356 lpm]) from Lyondell-Equistar reservoir.	**Operations:** Streams affected: No water withdrawals.	**Operations:** Streams affected: No water withdrawals.
Sanitary discharge from plant site: Municipal treatment, no surface water discharges or impacts anticipated.	Sanitary discharge from plant site: On-site system, effluent recycled from process water. Additional option for municipal treatment, no surface water discharges or impacts anticipated.	Sanitary discharge from plant site: On-site system, effluent recycled from process water, no surface water discharges or impacts anticipated.	Sanitary discharge from plant site: On-site system, effluent recycled from process water, no surface water discharges or impacts anticipated.
No CO_2 pipeline stream crossings.	Low potential for impacts from CO_2 pipeline leaks at stream crossings.	Same as Tuscola.	Same as Tuscola.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Wetlands and Floodplains			
Construction: **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below: Wetlands present: Low quality farm pond 0.05 acre (0.02 hectare) Floodplains present: None	**Construction:** **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below: Wetlands present: None Floodplains present: None	**Construction:** **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below: Wetlands present: Low quality up to 2 acres (0.8 hectare) Moderate quality up to 0.1 acre (0.04 hectare) Low quality ponds up to 18 acres (7.3 hectares) Floodplains present: None	**Construction:** **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below: Wetlands present: None Floodplains present: None
Sequestration Site: The sequestration site is located on the same property as the power plant site.	**Sequestration Site:** Injection wells would be placed to avoid wetlands and floodplains. Wetlands present: 4 areas up to 5 acres (2 hectares) Floodplains present: None	**Sequestration Site:** Injection wells would be placed to avoid wetlands and floodplains. Wetlands present: Over 43* ****National Wetlands Inventory (NWI) mapping indicates that over 43 forested, scrub-shrub, and emergent wetlands associated with streams and on-channel stock ponds are also located within the region of influence (ROI). Wetland delineation required for verification.*** Floodplains present: 25 percent of ROI in 100-year floodplains	**Sequestration Site:** Injection wells would be placed to avoid wetlands and floodplains. Wetlands present: None mapped* ****Indicated by NWI mapping. Wetland delineation would be required for verification.*** Floodplains present: Currently unmapped* ****Natural Resources Conservation Service (NRCS) soils data indicate that there are areas within the sequestration site that range from "none" to "rare" to "frequent."***

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Wetlands and Floodplains (continued)			
Utility and Transportation Corridors: Directional drilling and site planning would be used to avoid these features.	**Utility and Transportation Corridors:** Directional drilling and site planning would be used to avoid these features.	**Utility and Transportation Corridors:** Directional drilling and site planning would be used to avoid these features.	**Utility and Transportation Corridors:** Directional drilling and site planning would be used to avoid these features.
Wetlands: up to 29.2 acres (11.8 hectares)	Wetlands: up to 4.2 acres (1.7 hectares)	Wetlands: Over 90* ****NWI mapping indicates that over 90 forested, scrub-shrub, and emergent wetlands associated with streams and on-channel stock ponds are also located within the ROI. Wetland delineation required for verification.***	Wetlands: None mapped* ****Indicated by NWI mapping. Wetland delineation would be required for verification.***
Floodplains: In certain segments	Floodplains: In certain segments	Floodplains: Portions of all seven segments of CO_2 pipeline	Floodplains: In certain segments of CO_2 pipeline
Temporary impacts from placement of construction equipment and trenching for underground utilities.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Operations: No impacts to wetlands or floodplains are anticipated.	**Operations:** Water levels in process water reservoir would fluctuate due to water uptakes. Minimal impact anticipated because pond currently experiences these types of fluctuations and the wetland is low value.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Biological Resources			
Construction: **Power Plant Site:** Up to 200 acres (81 hectares) row crops would be lost. 1 farm pond could be impacted, resulting in a permanent loss of aquatic habitat. **Sequestration Site:** Same footprint as power plant site, no additional loss. Potential threatened and endangered (T&E) species present include the Indiana Bat. Surveys may be required.	**Construction:** **Power Plant Site:** Same as Mattoon. No aquatic habitat present. **Sequestration Site:** Up to 10 acres (4 hectares) row crops would be lost. Consultation with Illinois Department of Natural Resources, no threatened or endangered species are expected to occur within the sequestration site.	**Construction:** **Power Plant Site:** Up to 200 acres (81 hectares) of mixed oak/grassland would be lost. 3 intermittent tributary streams; 3 man-made impoundments could be impacted, resulting in permanent loss of aquatic habitat. Potential T&E species present include the Navasota ladies'-tresses. Surveys may be required. **Sequestration Site:** Up to 10 acres (4 hectares) mixed oak/grassland would be lost. Potential T&E species present include the interior least tern, Houston toad, Bachman's sparrow, white-fared Ibis and state rare invertebrates. Surveys may be required.	**Construction:** **Power Plant Site:** Up to 200 acres (81 hectares) of mesquite lotebush-brush and mesquite-juniper brush would be lost. No aquatic habitat present. Potential T&E species present at the sequestration site includes the Texas Horned Lizard. Surveys may be required. **Sequestration Site:** Up to 10 acres (4 hectares) mesquite-juniper brush would be lost. Potential T&E species present include the Texas horned lizard. Surveys may be required.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Biological Resources (continued)			
Utility Corridors: Up to 35.3 miles (56.8 kilometers) total, of which 18.8 miles (30.3 kilometers) within new ROW, primarily agricultural row crops would be lost. Aquatic habitat of 5 perennial streams could be temporarily impacted by trenching. Potential T&E species present include the Indiana Bat, Kirkland's snake, and Eastern sand darter. Surveys may be required.	**Utility Corridors:** Up to 31.9 miles (51.3 kilometers) total, of which 16.9 miles (27.2 kilometers) within new ROW, primarily agricultural row crops would be lost. Aquatic habit limited, intermittent streams. Potential T&E species present include Kirkland's snake. Surveys may be required.	**Utility Corridors:** Up to 63 miles (101 kilometers) total, of which 13 miles (20.9 kilometers) within new ROW, primarily oak/grassland (high quality deer and turkey hunting ground) would be lost. Aquatic habitat of 14 perennial and 39 intermittent streams could be temporarily impacted by trenching. Potential T&E species present include interior least tern, Houston toad, Bachman's sparrow, white-fared Ibis and state rare invertebrates. Surveys may be required.	**Utility Corridors:** Up to 128.5 miles (207 kilometers) total, of which 68.7 miles (111 kilometers) within new ROW, primarily row crops would be lost. Intermittent/ephemeral streams only, limited aquatic habitat. Potential T&E species present include the Texas horned lizard. Surveys may be required.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Cultural Resources			
Construction: No known cultural resources at the power plant or sequestration site, no impacts anticipated. Phase I survey may be needed for certain utility corridor segments.	**Construction:** Same as Mattoon. Same as Mattoon.	**Construction:** No known cultural resources at the power plant site, no impacts anticipated. Known cultural sites along CO_2 pipeline corridor segments: A-C; 3 B-C; 15 C-D; 13 D-F; 1 F-H; 3 33 recorded sites within region of influence of sequestration site. Phase I surveys and consultation would be needed for these CO_2 pipeline segments.	**Construction:** Same as Jewett. Phase I survey needed for all water, CO_2 pipeline, and transmission line corridors. Consultation needed for potential cultural resources at the sequestration site. Fossil bearing rock formations are extensive in the region of the sequestration site; however, no impacts to unique or irreplaceable invertebrate paleontological resources anticipated. Vertebrate paleontological resources could be impacted.
Operations: Impacts would only occur during construction.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Land Use			
Construction: **Power Plant Site:** Land conversion, acres affected: Up to 200 acres (81 hectares)	**Construction:** **Power Plant Site:** Land conversion, acres affected: Same as Mattoon.	**Construction:** **Power Plant Site:** Land conversion, acres affected: Same as Mattoon.	**Construction:** **Power Plant Site:** Land conversion, acres affected: Same as Mattoon.
Change of land use: Farmland to industrial.	Change of land use: Same as Mattoon.	Change of land use: Industrial storage and pasture to industrial.	Change of land use: Ranch, oil and gas to industrial.
Oil or gas wells displaced: 0	Oil or gas wells displaced: 0	Oil or gas wells displaced: Up to 3	Oil or gas wells displaced: Up to 2
Prime farmland converted: Up to 200 acres (81 hectares), Land Evaluation and Site Assessment (LESA) points = 255 which exceeds the 225 threshold. Site would be reevaluated for change in land use.	Prime farmland converted: Up to 200 acres (81 hectares), LESA points = 239. Site would be reevaluated for change in land use.	Prime farmland converted: Up to 5 acres (2 hectares)	Prime farmland converted: None
Surrounding land uses: 2 residences (directly adjacent) 2 residences (within 0.25 mile [0.4 kilometer]) 20 residences (within 1 mile [1.6 kilometers])	Surrounding land uses: 3 residences (adjacent) 7 residences (within 0.5 mile [0.8 kilometer]); several dozen (within one mile [1.6 kilometers])	Surrounding land uses: 1 small chapel and cemetery (within 1 mile [1.6 kilometers]) no residences.	Surrounding land uses: 3 habitable residences (within 1 mile [1.6 kilometers]
Airspace and Federal Aviation Administration (FAA) conformance: Stacks would be lighted; FAA notification not required.	Airspace and FAA conformance: Stacks would be lighted; FAA notification required.	Airspace and FAA conformance: Same as Mattoon.	Airspace and FAA conformance: Same as Mattoon.
Conforming with zoning requirements: No conflict.	Conforming with zoning requirements: Same as Mattoon.	Conforming with zoning requirements: Same as Mattoon.	Conforming with zoning requirements: Same as Mattoon.
Current zoning: Enterprise Zone: industrial.	Current zoning: Industrial.	Current zoning: None; surrounded by industrial properties.	Current zoning: None; industrial facilities in the vicinity.
Sequestration Site: Land use acres changed: Same as Power Plant Site.	**Sequestration Site:** Land use acres changed: Up to 10 acres (4 hectares) farmland to industrial.	**Sequestration Site:** Land use acres changed: Up to 10 acres (4 hectares) ranch and state land to industrial.	**Sequestration Site:** Land use acres changed: Up to 10 acres (4 hectares) grazing and oil and gas production to industrial.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Land Use (continued)			
Mineral Rights: Option contract includes mineral rights for 444 acres (180 hectares). May require purchase of additional rights to include 0.25 mile (0.4 kilometer) buffer.	**Mineral Rights:** Option to 10 acres (4 hectares). Title searches for remainder of site are underway.	**Mineral Rights:** 50-year lease option with a waiver for mineral rights for at least three injection sites; however, title searches would need to be conducted.	**Mineral Rights:** University of Texas controls land and historically provide subsurface access through easements. Title searches would need to be conducted. The University has indicated it would grant a 50-year lease.
Utility Corridors: Approximate new ROW 18.8 miles (30.3 kilometers) (approximate): 11 to 27 miles (17.7 to 43.5 kilometers) variable width.	**Utility Corridors:** Approximate new ROW up to 16.9 miles (27.2 kilometers) variable width.	**Utility Corridors:** Approximate new ROWs between 10 miles (16.1 kilometers) and 13 miles (20.9 kilometers) variable width.	**Utility Corridors:** Approximate new ROW 68.7 miles (111 kilometers) variable width.
Impacts of new ROW: Temporary disruption of existing use, existing uses could continue after construction.	Impacts of new ROW: If the 3-mile (4.8-kilometer) ROW for the transmission line is selected, nine landowners would be temporarily impacted; existing uses could continue after construction.	Impacts of new ROW: Same as Mattoon.	Impacts of new ROW: Same as Mattoon.
Temporary impact to the use of Lincoln Prairie Grass Bike Trail during construction of process water pipeline from City of Charleston.			
Operations: **Power Plant Site:** Site is approximately 444 acres (180 hectares), with 200 acres (81 hectares) permanently converted; remaining 244 acres (99 hectares) could be leased for continued agricultural use.	**Operations:** **Power Plant Site:** Site is approximately 345 acres (140 hectares), with 200 acres (81 hectares) permanently converted; remaining 145 acres (59 hectares) could be leased for continued agricultural use.	**Operations:** **Power Plant Site:** Site is approximately 400 acres (162 hectares), with 200 acres (81 hectares) permanently converted; remaining 200 acres (81 hectares) could continue as pasture.	**Operations:** **Power Plant Site:** Site is approximately 600 acres (243 hectares), with 200 acres (81 hectares) permanently converted; remaining 400 acres (162 hectares) could continue as ranch land.
Sequestration Site: Same as power plant site.	**Sequestration Site:** 10 acres (4 hectares) permanently converted; remaining land could remain in agricultural use.	**Sequestration Site:** 10 acres (4 hectares) permanently converted; remaining land could remain as ranch land.	**Sequestration Site:** 10 acres (4 hectares) permanently converted; remaining land could continue as ranch land and oil and gas activities.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Aesthetics			
Power Plant Site: **Construction**: Visual intrusion, traffic and noise to nearby residences.	**Power Plant Site:** **Construction**: Same as Mattoon.	**Power Plant Site:** **Construction**: There are no nearby residences; thus, no visual intrusion, traffic or noise impacts.	**Power Plant Site:** **Construction**: Same as Mattoon.
Operations: Visual intrusion, traffic and noise to nearby residences.	**Operations**: Same as Mattoon.	**Operations**: Same as Mattoon.	**Operations**: Same as Mattoon.
Nearby receptors: 2 residences (adjacent to site) 2 residences (within 0.25 mile [0.4 kilometer) 20 residences (within 1 mile [1.6 kilometers])	Nearby receptors: 3 residences (adjacent to site) 7 residences (within 0.5 mile [0.8 kilometer]) Several dozen residences (within 1 mile [1.6 kilometers])	Nearby receptors: No residences (adjacent to or within 1 mile [1.6 kilometers] of site)	Nearby receptors: No residences (adjacent to site) 4 residences (within 0.5 mile [0.8 kilometer])
Daytime visibility: Downtown Mattoon, motorists, and communities within 7 to 8 miles (11.3 to 13 kilometers).	Daytime visibility: Downtown Tuscola, motorists, and communities within 7 to 8 miles (11.3 to 13 kilometers).	Daytime visibility: 0.5 to 1 miles (0.8 to 1.6 kilometers).	Daytime visibility: Motorists within 7 to 8 miles (11.3 to 13 kilometers).
Visibility from public areas: Lake Mattoon and Paradise Lake.	Visibility from public areas: Ervin Park	Visibility from public areas: None	Visibility from public areas: None
Nighttime visibility: Downtown Mattoon, travelers on roadways, and communities within 7 to 8 miles (11.3 to 12.9 kilometers).	Nighttime visibility: Downtown Tuscola, travelers on roadways, and communities within 7 to 8 miles (11.3 to 12.9 kilometers).	Nighttime visibility: minimal	Nighttime visibility: Travelers on roadways and a few residences within 7 to 8 miles (11.3 to 12.9 kilometers).
Sequestration Site: Nearby receptors: Same as power plant site.	**Sequestration Site:** Nearby receptors: Up to 10 residential properties.	**Sequestration Site:** Nearby receptors: Minimal, travelers on adjacent county roads.	**Sequestration Site:** Nearby receptors: Up to 3 residential properties and travelers along I-10.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Aesthetics (continued)			
Utility Corridors: Temporary receptor impacts (buried utilities): The use of Prairie Grass Bike Trail and 1st and 2nd streets and Lafayette Avenue would be temporarily interrupted during construction of utilities. Permanent receptor impacts (High Voltage Transmission Line [HVTL] utilities): Residential properties within 0.25 mile (0.4 kilometer) would have view of HVTL.	**Utility Corridors:** Temporary receptor impacts (buried utilities): 12 residences within 0.25 mile (0.4 kilometer) of proposed CO_2 pipeline may experience visual impacts during construction layout. Permanent receptor impacts (HVTL utilities): 150 residential properties within 0.25 mile (0.4 kilometer) would have view of HVTL.	**Utility Corridors:** Temporary receptor impacts (buried utilities): Receptors adjacent to up to 45 miles (72.4 kilometers) of CO_2 pipeline. Permanent receptor impacts (HVTL utilities): Minimal receptors along up to 2 miles (3.2 kilometers) of new transmission line would have view of HVTL.	**Utility Corridors:** Temporary receptor impacts (buried utilities): Receptors adjacent to up to 54 miles (86.9 kilometers) of water pipeline and 6 miles (9.7 kilometers) of CO_2 pipeline. Permanent receptor impacts (HVTL utilities): Up to 4 residences and travelers along I-20 for up to 2 miles (3.2 kilometers) of new transmission line would have view of HVTL.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Transportation and Traffic			
Construction: **Power Plant Site:** SR 121 would temporarily degrade from Level of Service (LOS) C to D, which represents traffic conditions approaching unstable flow; however, this is typically considered acceptable for a temporary condition (44 months). CR 13 (between SR 121 and CH 18) would temporarily degrade from LOS A to C, which represents stable flow. Truck routes may be designated to include I-57, CH 18, and CR 13 to reduce traffic through Mattoon.	**Construction:** **Power Plant Site:** CR 1050N and CR 750E would temporarily (44 months) degrade from LOS A to C, which represents stable traffic flow. Truck routes may be designated to include I-57, US 36, CR 1050N and CR 750E to reduce traffic through Tuscola.	**Construction:** **Power Plant Site**: FM 39 would temporarily degrade from LOS B to D, which represents traffic conditions approaching unstable flow; however, this is typically considered acceptable for a temporary condition. SH 164 would temporarily (44 months) degrade from LOS B to C, which represents stable flow.	**Construction:** **Power Plant Site**: FM 1601 would temporarily degrade from LOS A to D, which represents traffic conditions approaching unstable flow; however, this is typically considered acceptable for a temporary (44 months) condition.
Utility Corridors: Up to 35 additional one-way trips would be added to existing afternoon peak period; however, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary.	**Utility Corridors:** Up to 45 additional one-way trips would be added to existing afternoon peak period; however, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary.	**Utility Corridors**: Up to 60 additional one-way trips would be added to existing afternoon peak period; however, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary.	**Utility Corridors**: Up to 110 additional one-way trips would be added to existing afternoon peak period; however, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary.
Transportation Corridors: Upgrade of CR 13 and the intersection of CR 13 and SR 121 are planned and would cause localized traffic delays; however, a state-required traffic management plan would limit major disruption of traffic, and delays would be temporary.	**Transportation Corridors:** No roadway or intersection improvements planned; therefore, no impacts to vehicular traffic are expected. Construction of new railroad sidetrack is expected to have minimal and temporary impacts to existing CSX Railroad operations because the CSX ROW in this location contains switching facilities that would allow approaching trains to be switched away from the track to which the sidetrack is being connected.	**Transportation Corridors:** No roadway or intersection improvements planned, and therefore, no impacts to transportation resources are expected. Construction of new railroad sidetrack is expected to have temporary impacts to existing Burlington Northern Santa Fe Railroad operations. Impacts would be minimized by completing connection during hours when this track has lightest expected traffic.	**Transportation Corridors:** One grade-separated crossing would be required to extend FM 1601 under railroad and would result in temporary localized traffic delays (additional traffic numbers for this project component were included in traffic analysis conducted for proposed power plant site). Construction of new railroad sidetrack is expected to have temporary impacts to existing Union Pacific Railroad operations. Impacts would be minimized by completing connection during hours when this track has lightest expected traffic.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Transportation and Traffic (continued)			
Construction/Operations: Changes to traffic signal timings may be required at the CH 18/I-57 ramp intersections to accommodate changes in the turning volumes.	**Construction/Operations:** Changes to traffic signal timings may be required at the US 36/I-57 ramp intersections to accommodate changes in the turning volumes at those intersections.	**Construction/Operations:** Changes to traffic signal timings may be required at the US 79/I-45 ramp intersections to accommodate changes in turning volumes at those intersections.	**Construction/Operations:** Traffic signals may be required at two key intersections on FM 1601 to accommodate changes in the turning volumes.
Operations: CR 13 (between SR 121 and CH 18) would degrade from LOS A to B, which represents reasonably free flow of traffic. Other roadway LOSs would remain the same.	**Operations:** CR 1050N and CR 750E would degrade from LOS A to B, which represents reasonably free flow of traffic. Other roadway LOS would remain the same.	**Operations:** FM 39 and SH 164 would degrade from LOS B to C, which represents stable flow of traffic. Other roadway LOS would remain the same.	**Operations:** CR FM 1601 would degrade from LOS A to B, which represents reasonably free flow of traffic. Other roadway LOS would remain the same.
Rail traffic on Canadian National main line and Peoria spur would increase by 10 and 71 percent, respectively, or less than two additional trains per day.	Rail traffic on CSX rail line would increase by 36 percent or less than two additional trains per day.	Rail traffic on Burlington Northern Santa Fe line would increase up to 14 percent or less than two additional trains per day.	Rail traffic on Union Pacific line would increase up to 11 percent or less than two additional trains per day.
Approximately one additional train per day at two at-grade crossings of Peoria spur would delay traffic 6 to 7 minutes at each crossing. No additional railroad crossing protection would be required.	Approximately one additional train per day at CR 750E at-grade rail crossing would delay traffic 6 to 7 minutes. Actuated gates and warning lights would be required at one existing at-grade crossing (CR 750E at CSX rail line).	No traffic delays associated with increased rail traffic are expected. No at-grade crossings would be impacted.	Same as Jewett.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Noise and Vibration			
Construction: Noise increase (above background level) at closest receptors to plant site: 2 residences: increase of up to 41 A-weighted sound measurement (dBA) (30 feet [9.1 meters] from boundary) Noise exceeding 3 dBA increase above background noise level (impact threshold) within 1.9 miles (3.1 kilometers) from the site boundary. Receptors affected: One school; several dozen residences	**Construction:** Noise increase (above background level) at closest receptors to plant site: 3 residences: up to 45.7 dBA (adjacent to boundary) 3 residences: up to 9.2 dBA (within 1 mile (1.6 kilometers) Noise exceeding 3 dBA increase (impact threshold) within 1.9 miles (3.1 kilometers) from the site boundary. Receptors affected: Numerous residences (much of downtown Tuscola)	**Construction:** Noise increase (above background level) at closest receptors to plant site: Chapel: <13 dBA (0.25 mile [0.4 kilometer]) Cemetery: <5 dBA (0.7 mile [1.1 kilometers]) Noise exceeding 3 dBA increase (impact threshold) within 1.9 miles (3.1 kilometers) from the site boundary. Receptors affected: None	**Construction:** Noise increase (above background level) at closest receptors to plant site: 1 residence: <2 dBA (0.5 mile [0.8 kilometer]) Noise exceeding 3 dBA increase (impact threshold) within 1.9 miles (3.1 kilometers) from the site boundary. Receptors affected: None
Construction Traffic: Noise increase above background: CH 13 south of CH 18: <8 dBA CH 18 east of CH 13: <4 dBA SR 121 near site: 2 dBA	**Construction Traffic:** Noise increase above background: CR 750E north of US 36: <14 dBA CR 1050N west of US 45: <7 dBA US 36 east of CR 750E: <3 dBA	**Construction Traffic:** No residence along local access route FM 39; no sensitive receptors impacted.	**Construction Traffic:** Noise increase above background: FM 1601 south of I-20: <7 dBA Near I-20: <3 dBA
Startups/Restarts: Noise increase at closest receptors: 2 residences: up to 21 dBA (30 feet [9 meters]) 3 residences: up to 13 dBA (<1 mile [1.6 kilometers])	**Startups/Restarts:** Noise increase at closest receptors: 3 residences: up to 25 dBA (adjacent to boundary) 4 residences: up to 15 dBA (<1 mile [1.6 kilometers])	**Startups/Restarts:** Noise increase at closest receptors: Chapel: <13 dBA (0.3 mile [0.5 kilometers]) Cemetery: <9 dBA (0.7 mile [1.1 kilometers])	**Startups/Restarts:** Noise increase at closest receptors: 1 residence: <3 dBA (0.5 mile [0.8 kilometers])
Routine Operations: Noise increase (above background level) at closest receptors to plant site: 2 residences: 6 to 9 dBA (30 feet [9.1 meters] from boundary)	**Routine Operations:** Noise increase (above background level) at closest receptors to plant site: 3 residences: up to 12 dBA (adjacent to boundary)	**Routine Operations:** Noise increase (above background level) at closest receptors to plant site: No residences: <3 dBA Chapel: <3 dBA (0.3 mile [0.5 kilometer]) Cemetery: <3 dBA (0.7 mile [1.1 kilometer])	**Routine Operations:** Noise increase (above background level) at closest receptors to plant site: No residences: <3 dBA

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Noise and Vibration (continued)			
Routine Operations (continued): Noise exceeding 3 dBA threshold within 1.2 miles (1.9 kilometers) from the center of the site. Receptors affected: 12 residences ***3 dBA is the threshold level for human hearing.***	**Routine Operations (continued):** Noise exceeding 3 dBA threshold within 1.2 miles (1.9 kilometers) from the center of the site. Receptors affected: 4 residences ***3 dBA is the threshold level for human hearing.***		
On-Site Train Operations: Noise increase at closest receptors to rail loop during unloading: 2 residences: <17 dBA 3 residences: <3 dBA (1 mile [1.6 kilometers])	**On-Site Train Operations:** Noise increase at closest receptors to rail loop during unloading: 3 residences: <3 dBA 12 residences: <12 dBA (1 mile [1.6 kilometers])	**On-Site Train Operations:** Noise increase at closest receptors to rail loop during unloading: No residences: <3 dBA Chapel: <3 dBA Cemetery: <10 dBA	**On-Site Train Operations:** Noise increase at closest receptors to rail loop during unloading: No residences: <3 dBA
Potential vibration impact within Federal Transit Administration (FTA) threshold of 200 feet (61.0 meters) from rail loop: 1 residence	Potential vibration impact within FTA threshold of 200 feet (61.0 meters) from rail loop: No residences	Potential vibration impact within FTA threshold of 200 feet (61.0 meters) from rail loop: No residences	Potential vibration impact within FTA threshold of 200 feet (61.0 meters) from rail loop: No residences
Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.	Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.	Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.	Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.
Operations Traffic: Noise increase above background: CH 13 south of CH 18: <4 dBA CH 18 east of CH 13: >2 dBA SR 121 near site: >1 dBA	**Operations Traffic:** Noise increase above background: CR 750E north of US 36: <9.2 dBA CR 1050N west of US 45: <3.5 dBA US 36 east of CR 750E: <3 dBA	**Operations Traffic:** No residence along local access route FM 39; no sensitive receptors impacted.	**Operations Traffic:** Noise increase above background: FM 1601 south of I-20: <1 dBA near I-20 <3 dBA
Train Traffic: The frequency of occurrence of noise at current levels from passing trains would increase by 71 percent on the Peoria spur and 10 percent on the Canadian National main line (less than two additional trains per day).	**Train Traffic:** The frequency of occurrence of noise at current levels from passing trains on the CSX rail line would increase by 24 to 36 percent (less than two additional trains per day).	**Train Traffic:** The frequency of occurrence of noise at current levels from passing trains on the Burlington Northern Santa Fe rail line would increase by 14 percent (less than two additional trains per day).	**Train Traffic:** The frequency of occurrence of noise at current levels from passing trains would increase by 11 percent on the Union Pacific rail line (less than two additional trains per day).

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Utility Systems			
Potable Water: Source: Municipal system Sufficient capacity: Yes Pipelines: 1 mile (1.6 kilometers)	**Potable Water:** Source: Municipal system Sufficient capacity: Yes Pipelines: <1 mile (<1.6 kilometers)	**Potable Water:** Source: Same as process water Sufficient capacity: Yes Pipelines: Same as process water	**Potable Water:** Source: Same as process water Sufficient capacity: Yes Pipelines: Same as process water
Process Water: Source: Mattoon and possibly Charleston Wastewater Treatment[1] Plants Sufficient capacity: Yes 7.1 million gallons per day (MGD) (26.9 million liters per day [MLD]) Pipelines: Possibly up to 14.3 miles[2] (23 kilometers)	**Process Water:** Source: Lyondell-Equistar & Kaskaskia River Sufficient capacity: Yes 150 million-gallon (568 million-liter) holding pond Pipelines: 1.5 miles (2.4 kilometers)	**Process Water:** Source: Groundwater Carrizo-Wilcox Sufficient capacity: Yes 3,000 gallons (11,356 liters) per minute Pipelines: <1.0 mile (<1.6 kilometer)	**Process Water:** Source: Groundwater Multiple aquifers Sufficient capacity: Yes Based on state geologist report Pipelines: 24 to 54 miles (38.6 to 86.9 kilometers)
Sanitary Wastewater: Source: Municipal system Sufficient capacity: Yes Pipelines: 1.25 mile (2 kilometers)	**Sanitary Wastewater:** Source: Municipal system Sufficient capacity: Yes Pipelines: 0.9 mile (1.4 kilometers)	**Sanitary Wastewater:** Source: New on-site system Sufficient capacity: Yes Pipelines: No pipeline required	**Sanitary Wastewater:** Source: New on-site system Sufficient capacity: Yes Pipelines: No pipeline required
Electrical Transmission: Transmission Capacity - Preliminary indication that capacity exists. Further study required: Yes (Midwest Independent System Operator [MISO] Study ongoing) Possibility of curtailment[3]: Yes New or upgraded lines: 0.5 to 16 miles (0.8 to 25.7 kilometers)	**Electrical Transmission:** Transmission Capacity - Preliminary indication that capacity exists. Further study required: Yes (MISO Study ongoing) Possibility of curtailment[3]: Yes New or upgraded lines: 0.5 to 17 miles (0.8 to 27.3 kilometers)	**Electrical Transmission:** Transmission Capacity – Upgrade needed prior to operation. Further study required: No Possibility of curtailment[3]: Yes New or upgraded lines: 0 to 2 miles (0 to 3.2 kilometers)	**Electrical Transmission:** Transmission Capacity – Upgrade needed prior to operation. Further study required: No Possibility of curtailment[3]: Yes New or upgraded lines: 0.7 to 1.8 miles (1.1 to 2.9 kilometers)

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Utility Systems (continued)			
Natural Gas: Sufficient capacity: Yes 42 million cubic feet per hour (mcf/hr) (1.3 million cubic meters per hour [mcm/hr]) Pipelines: 0.25 mile (0.4 kilometer) **CO_2 Pipeline:** No off-site pipeline required.	**Natural Gas:** Sufficient capacity: Yes 42 mcf/hr (1.3 mcm/hr) Pipelines: No pipeline required. **CO_2 Pipeline:** New ROW: 11 miles (17.7 kilometers)	**Natural Gas:** Sufficient capacity: Yes 12 mcf/hr (0.3 mcm/hr) Pipelines: Same as Tuscola. **CO_2 Pipeline:** New ROW: 6 to 9 miles (10 to 14 kilometers)	**Natural Gas:** Sufficient capacity: Yes 12 mcf/hr (0.3 mcm/hr) Pipelines: Same as Tuscola. **CO_2 Pipeline:** New ROW: 2 to 14 miles (3 to 22.5 kilometers)

[1] Possibility of larger reservoir (200 million gallons [757 million liters]), then connection to the Charleston WWTP may not be necessary.
[2] Process water from the effluent of the municipal WWTPs of Mattoon with a 6.2-mile (10.0-kilometer) pipeline and possibly Charleston with 8.1 miles (13.0-kilometers) of pipeline, could result in up to 14.3 miles (23 kilometers) of total pipeline ROW.
[3] Curtailment occurs when the system controller from the Independent System Operator observes a thermal or voltage limit overload for an operating situation or, upon performing a contingency analysis, predicts a thermal or voltage limit overload for a planned project.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Materials and Waste Management			
Construction Materials: No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs: Concrete: 500 yd^3/hr (382 m^3/hr) Asphalt: 750 tons/hr[1] (680 metric tons/hr) Aggregate: 900,000 tpy (816,466 mtpy) Construction of process water reservoir would increase fill and spoils handling requirements.	**Construction Materials:** No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs: Concrete: 330 yd^3/hr (252 m^3/hr) Asphalt: 1,900 tons/hr[1] (1,700 metric tons/hr) Aggregate: 4.4 million tpy (4 MMT per year)	**Construction Materials:** No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs: Concrete: 550 yd^3/hr (420 m^3/hr) Asphalt: 8,000 tons/day[1] (7,257 metric tons/day) Aggregate: multiple suppliers, production rates not available	**Construction Materials:** No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs: Concrete: >230 yd^3/hr (>176 m^3/hr) Asphalt: >2,500 tons/day[1] (2,268 metric tons/day) Aggregate: Same as Jewett.
Construction Waste: Regional landfill availability of up to 116 years – Adequate capacity.	**Construction Waste:** Same as Mattoon.	**Construction Waste:** Regional landfill availability of up to 132 years – Adequate capacity.	**Construction Waste:** Regional landfill availability of up to 177 years – Adequate capacity.
Construction Hazardous Waste: Small amounts of hazardous waste generated. Resource Conservation and Recovery Act (RCRA) permit not required. 5 hazardous waste landfills within approximately 100 to 400 miles (161 to 644 kilometers). >14 million yd^3 (>10 million m^3) available disposal capacity at closest hazardous waste landfill site.	**Construction Hazardous Waste:** Same as Mattoon. Same as Mattoon. Same as Mattoon.	**Construction Hazardous Waste:** Same as Mattoon. 2 hazardous waste landfills within 300 miles (483 kilometers). 2.7 million yd^3 (2 million m^3) available disposal capacity as closest landfill.	**Construction Hazardous Waste:** Same as Mattoon. 1 hazardous waste landfill within 60 miles (96.6 kilometers). 5.0 million yd^3 (3.8 million m^3) available disposal capacity at closest site.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Materials and Waste Management (continued)			
Operations Materials: FutureGen demand represents 3.5 percent of coal consumption by electric utilities within the state.	**Operations Materials:** Same as Mattoon.	**Operations Materials:** FutureGen demand represents 1.9 percent of coal consumption by electric utilities within the state.	**Operations Materials:** Same as Jewett.
Chemicals and materials required for operations are common and readily available; markets exist for sulfur, bottom slag, byproducts, and ash.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Operations Waste: Sanitary landfill availability same as identified for construction.	**Operations Waste:** Same as Mattoon.	**Operations Waste:** Same as Mattoon.	**Operations Waste:** Same as Mattoon.
Operations Hazardous Waste: Hazardous waste landfill availability same as identified for construction.	**Operations Hazardous Waste:** Same as Mattoon.	**Operations Hazardous Waste:** Same as Mattoon.	**Operations Hazardous Waste:** Same as Mattoon.
Potential for Spills and Releases: Some risk due to on-site chemical storage requirements. Precautions would be taken to prevent and mitigate the impacts of releases of hazardous materials and waste during construction and routine operations (see Table S-12, Human Health, Safety, and Accidents for evaluations or potential ammonia spills).	**Potential for Spills and Releases:** Same as Mattoon.	**Potential for Spills and Releases:** Same as Mattoon.	**Potential for Spills and Releases:** Same as Mattoon.

[1] Illinois reported by tons/hr and Texas by tons/day for capacity.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents			
Occupational Risks	**Occupational Risks**	**Occupational Risks**	**Occupational Risks**
Construction: Predicted number of annual accident cases (based on expected workforce for the entire project):	**Construction:** Predicted number of annual accident cases (based on expected workforce for the entire project):	**Construction:** Predicted number of annual accident cases (based on expected workforce for the entire project):	**Construction:** Predicted number of annual accident cases (based on expected workforce for the entire project):
Average workforce (350) Total recordable cases = 20 Lost workday cases = 11 Fatalities = <1 (0.1)	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Peak workforce (700) Total recordable cases = 39 Lost workday cases = 22 Fatalities = <1 (0.2)	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Operations: Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):	**Operations:** Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):	**Operations:** Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):	**Operations:** Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):
Total recordable cases = 2 Lost workdays cases = 1 Fatalities = <1 (0.002)	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Hazardous Air Emissions	**Hazardous Air Emissions**	**Hazardous Air Emissions**	**Hazardous Air Emissions**
Construction: No appreciable risks from hazardous air emissions to general public.	**Construction:** No appreciable risks from hazardous air emissions to general public.	**Construction:** No appreciable risks from hazardous air emissions to general public.	**Construction:** No appreciable risks from hazardous air emissions to general public.
Plant Operations: Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) = 0.084×10^{-6}	**Plant Operations:** Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) = 0.022×10^{-6}	**Plant Operations:** Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) = 0.222×10^{-6}	**Plant Operations:** Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) = 0.114×10^{-6}
Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0007	Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0002	Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0017	Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0009

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents (continued)			
Unintentional Sequestration Releases	**Unintentional Sequestration Releases**	**Unintentional Sequestration Releases**	**Unintentional Sequestration Releases**
Construction: Not applicable prior to operation of sequestration facilities.	**Construction:** Not applicable prior to operation of sequestration facilities.	**Construction:** Not applicable prior to operation of sequestration facilities.	**Construction:** Not applicable prior to operation of sequestration facilities.
Pipeline Operations: Number of individuals potentially impacted by release from pipeline rupture (risk rated as extremely unlikely [1 or more occurrences in 10,000 to 1 million years]):	**Pipeline Operations:** Number of individuals potentially impacted by release from pipeline rupture (risk rated as unlikely [1 or more occurrences in 100 to 10,000 years]):	**Pipeline Operations:** Number of individuals potentially impacted by release from pipeline rupture (risk rated as unlikely [1 or more occurrences in 100 to 10,000 years]):	**Pipeline Operations:** Number of individuals potentially impacted by release from pipeline rupture (risk rated as unlikely [1 or more occurrences in 100 to 100,000 years]):
CO_2 Adverse effect[1]: 0 Irreversible[2]: 0 Life threatening[3]: 0	CO_2 Same as Mattoon.	CO_2 Same as Mattoon.	CO_2 Same as Mattoon.
H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0	H_2S Adverse effect: 7 Irreversible: ≤1 Life threatening: <1	H_2S Adverse effect: 52 Irreversible: <1 Life threatening: 1	H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0
Number of individuals potentially impacted by release from pipeline puncture (risk rated as extremely unlikely [1 or more occurrences in 10,000 to 1 million years]):	Number of individuals potentially impacted by release from pipeline puncture (risk rated as unlikely [1 or more occurrences in greater than 1 million years]):	Number of individuals potentially impacted by release from pipeline puncture (risk rated as likely (≥1 in 100 years) to unlikely [1 occurrence per 100 to 10,000 years]):	Number of individuals potentially impacted by release from pipeline puncture (risk rated as unlikely [1 or more occurrences in 100 to 10,000 years]):
CO_2 Adverse effect: 0 Life threatening: 0	CO_2 Adverse effect: 0 Life threatening: 0	CO_2 Same as Mattoon.	CO_2 Same as Mattoon.
H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0	H_2S Adverse effect: 1 Irreversible: 0 Life threatening: 0	H_2S Adverse effect: 6 Irreversible: 0 Life threatening: 0	H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents (continued)			
Sequestration Operations: Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely [1 occurrence per 10,000 to 1 million years]):	**Sequestration Operations:** Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely):	**Sequestration Operations:** Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely):	**Sequestration Operations:** Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely):
CO_2 Adverse effect: 0 Irreversible: 0 Life threatening: 0	CO_2 Same as Mattoon.	CO_2 Same as Mattoon.	CO_2 Same as Mattoon.
H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0	H_2S Adverse effect: <1 Irreversible: 0 Life threatening: 0	H_2S Adverse effect: 4 Irreversible: 0 Life threatening: 0	H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0
Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 1	Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 6	Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 0.4-26	Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 0.3
Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 1	Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 6	Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 0.4-26	Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 0.3

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents (continued)			
Catastrophic Accidents/Terrorism or Sabotage **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[4] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 26 Life threatening: 4 SO_2 Irreversible: 19 Life threatening: 10 H_2S Irreversible: 143 Life threatening: 4 **Ammonia Spills:** Evaluations of potential ammonia spills indicate that both workers and the general public could be affected if a leak from a tank valve, a tanker truck spill, or a tank rupture occurred. Estimated distance for potential adverse effect from a tanker truck release: 14,763 feet (4,500 meters)	**Catastrophic Accidents/Terrorism or Sabotage** **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[4] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 21 Life threatening: 3 SO_2 Irreversible: 15 Life threatening: 8 H_2S Irreversible: 115 Life threatening: 3 **Ammonia Spills:** Same as Mattoon. Estimated distance for potential adverse effect from tanker a truck release: 14,107 feet (4,300 meters)	**Catastrophic Accidents/Terrorism or Sabotage** **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[4] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 17 Life threatening: 2 SO_2 Irreversible: 12 Life threatening: 5 H_2S Irreversible: 92 Life threatening: 2 **Ammonia Spills:** Same as Mattoon. Estimated distance for potential adverse effect from a tanker truck release: 15,092 feet (4,600 meters)	**Catastrophic Accidents/Terrorism or Sabotage** **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[4] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 2 Life threatening: 0 SO_2 Irreversible: 2 Life threatening: 1 H_2S Irreversible: 12 Life threatening: 0 **Ammonia Spills:** Same as Mattoon. Estimated distance for potential adverse effect from a tanker truck release: 15,584 feet (4,750 meters)

[1] Adverse effects – Health effects ranging from headache or sweating to irreversible effects, including death or impaired organ function.
[2] Irreversible adverse effects – Health effects to include death, permanent impaired organ function and other effects that impair everyday functions.
[3] Life threatening effects – Subset of irreversible adverse effects that may lead to death.
[4] Pipeline rupture and puncture impacts are shown in a separate category of Table S-12. None of the sites had predicted irreversible or life threatening effects to the public from CO_2.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Community Services			
Construction and Operations: Impacts to community services during the operational phase of the proposed facilities would be minor; less than 1 percent reduction to the capacity for community services.	**Construction and Operations:** Same as Mattoon.	**Construction and Operations:** Same as Mattoon.	**Construction and Operations:** Same as Mattoon.
No impact on healthcare. The ratio of hospital beds per thousand residents would remain at approximately 3.6.	No impact on health care. The ratio of hospital beds per thousand residents would remain at approximately 3.0.	No impact on health care. The ratio of hospital beds per thousand residents would remain at approximately 2.6.	No impact on health care. The ratio of hospital beds per thousand residents would remain at approximately 4.5.
During operations, school enrollment would increase by approximately 0.08 percent, which would result in minimal impacts to capacity of local public school systems.	During operations, school enrollment would increase by approximately 0.07 percent, which would result in minimal impacts to capacity of local public school systems.	During operations, school enrollment would increase by approximately 0.22 percent, which would result in minimal impacts to capacity of local public school systems.	During operations, school enrollment would increase by approximately 0.36 percent, which would result in minimal impacts to capacity of local public school systems.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Socioeconomics			
Construction: A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 74 percent. Residences within facility viewshed that could experience adverse impact to property values: 2 residences (adjacent to site) 2 residences (within 0.25 mile [0.4 kilometer]) 20 residences (within 1 mile [1.6 kilometers])	**Construction:** A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 80 percent. Residences within facility viewshed that could experience adverse impact to property values: 3 residences (adjacent to site) 7 residences (within 0.5 mile [0.8 kilometer]) Several dozen residences (beyond 1 mile [1.6 kilometers])	**Construction:** A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 65.6 percent. Residences within facility viewshed that could experience adverse impact to property values: None	**Construction:** A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 72.6 percent. Residences within facility viewshed that could experience adverse impact to property values: None
Operations: Permanent workers and facility operations would result in: Overall percent increase in population: 0.04 Permanent jobs: 200 Induced jobs: 240 Percent increase workers: 0.08 Impact to housing market: Percent decrease for sale: 2.2 Percent decrease for rent: 0.4	**Operations:** Permanent workers and facility operations would result in: Overall percent increase in population: 0.04 Same as Mattoon. Impact to housing market: Percent decrease for sale: 3.0 Percent decrease for rent: 1.3	**Operations:** Permanent workers and facility operations would result in: Overall percent increase in population: 0.10 Permanent jobs: 200 Induced jobs: 113 Percent increase workers: 0.09 Impact to housing market: Percent decrease for sale: 4.5 Percent decrease for rent: 0.8	**Operations:** Permanent workers and facility operations would result in: Overall percent increase in population: 0.20 Permanent jobs: 200 Induced jobs: 113 Percent increase workers: 0.18 Impact to housing market: Percent decrease for sale: 7.8 Percent decrease for rent: 3.9

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Environmental Justice			
Construction: No disproportionately high and adverse impact to minority populations. No such populations are present as defined under Executive Order (EO) 12898 within the ROI.	**Construction:** Same as Mattoon.	**Construction:** Minority populations are interspersed within the ROI, however, impacts would not be considered disproportionately high and adverse under EO 12898.	**Construction:** Same as Jewett.
Low-income populations are located within the ROI when compared to regional and national percentages; however, impacts would not be considered disproportionately high and adverse under EO 12898. Short-term job creation during construction.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Operations: Aesthetics, transportation, noise, and socioeconomic impacts resulting from operations were determined not to have a disproportionately high and adverse effect to minority or low-income populations.	**Operations:** Same as Mattoon.	**Operations:** Noise impacts resulting from operations were determined not to have a disproportionately high and adverse effect to minority or low-income populations.	**Operations:** Aesthetics and noise impacts resulting from operations were determined not to have a disproportionately high and adverse effect to minority or low-income populations.
Long-term job creation during operation may benefit low-income populations.	Long-term job creation during operation may benefit low-income populations.	Long-term job creation during operation may benefit low-income populations.	Long-term job creation during operation may benefit low-income populations.
The potential risks to health, although unlikely, were determined to be from a slow, upward leak of H_2S from an injection or existing well. A potential risk could also occur from a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.	The potential risks to health were determined to be from the unlikely event of a pipeline rupture or puncture and the extremely unlikely event of a slow, upward leakage of H_2S from an injection or existing well, or a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.	The potential risks to health were determined to be from the unlikely event of a pipeline rupture or puncture, the extremely unlikely event of a wellhead equipment rupture, and a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.	The potential risks to health were determined to be from a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.

10. GLOSSARY

Term	Definition
"A-weighted" Scale	Assigns a weight to sound frequencies that is related to how sensitive the human ear is to each sound frequency. Frequencies that are less sensitive to the human ear are weighted less than those for which the ear is more sensitive. A-weighted measurements indicate the potential damage a noise might cause to hearing.
Ambient Noise	Background noise associated with a given environment. Ambient noise is typically formed as a composite of sounds from many near and far sources, with no particular dominant sound.
Aquifer	Body of rock or sediment that is capable of transmitting groundwater and yielding usable quantities of water to wells or springs.
Arterial Highway	Highway generally characterized by its ability to quickly move a relatively large volume of traffic, but often with restricted capacities to serve abutting properties. The arterial system typically provides for high travel. The rural and urban arterial highway systems are connected to provide continuous through movements.
Attenuate	To lessen the amount of force, magnitude, or value of something.
Best Management Practice	Method for preventing or reducing the pollution resulting from an activity. Best Management Practice (BMP) includes non-regulatory methods designed to minimize harm to the environment.
Blowdown	Minimum discharge of recirculating water to discharge materials contained in the water, the further buildup of which would cause concentration in amounts exceeding limits established by best engineering practice.
Blowdown Water	Portion of circulating cooling tower water removed to maintain the amount of dissolved solids and other impurities at an acceptable level. Because blowdown water is an industrial wastewater, it is essential to mitigate the potential environmental impact by reducing the volume and hazardous makeup of blowdown water.
Brackish Water	Water that is saltier than fresh water, but less than seawater. Salt content of brackish water is between 0.5 and 30 parts per thousand.
Carbon Dioxide	Greenhouse gas created by combustion and emitted primarily from human activity such as the burning of fossil fuels to generate electricity and operate vehicles, abbreviated CO_2.
Class I Railroad	Railroad with operating revenues exceeding $277.5 million.

Term	Definition
Class I Truck Route	Limited access divided highway that can handle five-axle tractor semi trailers up to 8.5 feet (2.6 meters) wide, up to 13.5 feet (4 meters) high, of any length, and with a gross weight up to 80,000 pounds (36,000 kilograms).
Class II Railroad	Railroad with operating revenues greater than $20.5 million but less than $277.5 million for at least three consecutive years.
Class II Truck Route	Roadway that allows 80,000-pound (36,000-kilogram) vehicles up to 60 feet (17 meters) long with a width of 8.5 feet (2.6 meters).
Class III Railroad	Railroad with less than $10 million in operating revenue; typically short in length.
Class III Truck Route	Roadway that allows 80,000-pound (36,000-kilogram) vehicles up to 60 feet (17 meters) long with a width of 8 feet (2.5 meters).
Clean Water Act	Primary federal law governing water pollution. The Clean Water Act's (CWA's) goals include eliminating toxic substance releases to water, eliminating additional water pollution, and ensuring that surface waters meet standards necessary for human sports and recreation (see *National Pollutant Discharge Elimination System*).
Coal Combustion Products	Incombustible by-products generated in coal-burning industrial facilities. The by-products are generated in various steps of the process. Coal combustion products (CCPs) generated in the boilers or furnaces are ash and slag. Other by-products such as fly ash and synthetic gypsum are collected from the emission control systems.
Collector Route	Low or moderate-capacity route which does not provide a highway or arterial road level of service. A collector route often leads traffic to arterial roads or directly to highways. Occasionally a collector route will fill gaps in a grid system between arterial roads. Traffic volumes and speeds are typically lower than those of arterial highways.
Combined Cycle	Combination of two or more thermodynamic cycles in a chemical process, usually for power generation.
Conceptual Site Model	Summary of a site's conditions that identifies the type and location of all potential contamination sources and how and where people, plants, or animals may be exposed.
Continuous Equivalent Sound Level	Steady-state decibel level which would produce the same A-weighted sound energy over a stated period of time as an equivalent sound over time.

Term	Definition
Corona Noise	Noise caused by partial discharges on insulators and in air surrounding electrical conductors of overhead power lines. Corona noise level is dependent on weather conditions.
Cultural Resources	Archaeological sites, historical sites (e.g., standing structures), Native-American resources, and paleontological resources.
Day-night Equivalent Sound Level	A-weighted equivalent decibel level for a 24-hour period with an additional 10-dB weighting imposed on the equivalent sound levels occurring during nighttime hours (10 pm to 7 am).
Decibel	Unit used to convey intensity of sound, abbreviated (dB).
Deep Ocean Sequestration	Deliberate injection of captured CO_2 into the ocean at great depths where it could potentially be isolated from the atmosphere for centuries. While the technologies currently exist to directly inject CO_2 into the deep ocean, the knowledge base is inadequate to determine what biological, physical, or chemical impacts might occur from interactions with the marine ecosystem.
Deep Saline Aquifer	Deep underground rock formation composed of permeable materials and containing highly saline fluids.
Density	Ratio of a substance's weight relative to its volume.
Dissolution	Process of dissolving a substance into a liquid.
Effluent	Waste stream flowing into the atmosphere, surface water, groundwater, or soil.
End Moraines	Irregular ridges of glacial sediments that formed at the margin or edge of the ice sheet.
Endangered Species	Plants or animals that are in danger of extinction. A federal list of endangered species can be found in 50 CFR 17.11 (wildlife), 50 CFR 17.12 (plants), and 50 CFR 222.23(a) (marine organisms). Illinois maintains its list of endangered species with the Illinois Endangered Species Protection Board and Texas maintains its list with the Texas Parks and Wildlife Department.
Exergy	Amount of energy available to perform useful work ("exergy" is also known as "availability").
Floodplain	Flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding.
Frequency	The number of cycles of completed occurrences per unit of time of a sound wave, most often measured in Hertz.

Term	Definition
Fuel Cell	Electrochemical cell in which the energy of a reaction between a fuel, such as liquid hydrogen, and an oxidant, such as liquid oxygen, is converted directly and continuously into electrical energy.
Fujita Scale	Standard metric to qualitatively identify the intensity of a tornado based on the damage caused. There are seven categories that range from F0 (weak) to F6 (violent). Each category represents a qualitative level of damage and an estimated range of sustained wind speed delivered by the tornado.
Gasification	Conversion process to gas or a gas-like phase.
Geologic Sequestration	CO_2 capture and storage in deep underground geologic formations.
Greenhouse Gas	Gas that contributes to the greenhouse effect by absorbing infrared radiation and ultimately warming the atmosphere. Greenhouse gases include water vapor, nitrous oxide (NO_X), methane, CO_2, ozone (O_3), halogenated fluorocarbons, hydrofluorocarbons, and perfluorinated carbons.
Ground Moraine	Rolling-to-flat landscape that forms under an ice sheet.
Hazardous Waste	Waste that exhibits at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or that is specifically listed by the U.S. Environmental Protection Agency as a hazardous waste. Hazardous waste is regulated under the Resource Conservation and Recovery Act (RCRA) Subtitle C.
Heat Rate	Amount of heat required (usually in Btu) to produce an amount of electricity (usually in kW-hr).
Historic Property	Prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places.
Indirect Job	Job created or sustained from a project's purchase of goods and services from businesses in a region.
Induced Job	Job created or sustained when wage incomes of those employed in direct and indirect jobs are spent on the purchase of goods and services in a region.
Industrial Process Waste	Any liquid, solid, semisolid, or gaseous waste generated when manufacturing a product or performing a service. Examples include cutting oils; paint sludges; equipment cleanings; metallic dust sweepings; used solvents from parts cleaners; and off-specification, contaminated, or recalled wholesale or retail products. The following wastes are not industrial process wastes: uncontaminated packaging materials, uncontaminated machinery components, general household waste, landscape waste, and construction or demolition debris.

Term	Definition
Integration	Organization or structure so that constituent units function cooperatively.
Koppen Climate Classification	Most widely used system to classify world climate regions based on annual and monthly averages of temperature and precipitation.
Level of Service	Measure of traffic operation effectiveness on a particular roadway facility type.
Local Roads	Public roads and streets not classified as arterials or collectors are classified as local roads. Local roads and streets are characterized by the many points of direct access to adjacent properties and the relatively minor value in accommodating mobility. Speeds and volumes are usually low and trip distances short.
Low Income Population	A community that has a proportion of low-income population greater than the respective average. Low income populations in an affected area should be identified with the annual statistical poverty thresholds from Bureau of the Census Current Population Reports, Series P-60, Income and Poverty.
Mean Sea Level	Average ocean surface height at a particular location for all stages of the tide over a specified time interval (generally 19 years).
Megawatt	Unit of power equal to one million watts. A power plant with 1 megawatt (MW) of capacity operating continuously for a year could supply electricity to approximately 750 households.
Mineral Sequestration	Process of CO_2 reacting with metal oxide bearing materials to form insoluble stable carbonates. Mineral sequestration's main economic challenge is the extremely slow reaction process of naturally occurring minerals with CO_2.
Minority	Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
Minority Population	Identified where either the affected area's minority population exceeds 50 percent or the affected area's minority population percentage is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.
Miscible	Property of liquids that allows them to be mixed together and form a single homogeneous phase.
Monitoring, Mitigation, and Verification	Capability to measure the amount of CO_2 stored at a sequestration site, monitor the site for leaks, to verify that the CO_2 is stored in a way that is permanent and not harmful to the host ecosystem, and to respond to CO_2 leakage or ecological damage in the unlikely event that it should occur. Monitoring, mitigation, and verification (MM&V) applies to geologic sequestration and terrestrial sequestration.

Term	Definition
Moraine	Rock debris, fallen, or plucked from a mountain and transported by glaciers or ice sheets (see *Ground Moraine*).
National Energy Policy	The National Energy Policy (NEP), developed by the National Energy Policy Development Group in 2001 with members of the President's cabinet, is based on three principles: provide a long-term, comprehensive energy strategy; advance new, environmentally-friendly technologies to increase energy supplies and encourage cleaner, more efficient energy use; and seek to raise the living standards of the American people, recognizing that to do so our country must fully integrate its energy, environmental, and economic policies.
National Environmental Policy Act	Signed into law on January 1, 1970, the National Environmental Policy Act (NEPA) declared a national policy to protect the environment and created the Council on Environmental Quality (CEQ) in the Executive Office of the President. To implement the national policy, NEPA requires that environmental factors be considered when federal agencies make decisions, and that a detailed statement of environmental impacts be prepared for all major federal actions significantly affecting the human environment.
National Oceanic Atmospheric and Administration	Department of Commerce agency focused on the condition of the oceans and atmosphere. NOAA divisions include the National Weather Service, the National Hurricane Center, and the National Marine Fisheries Service.
National Pollutant Discharge Elimination System	Provision of the Clean Water Act that prohibits discharge of pollutants into U.S. waters unless a special permit is issued by EPA, a state, or where delegated, a tribal government on a Native American reservation, abbreviated NPDES.
Peak Particle Velocity	Measure of ground vibration. Peak particle velocity is the maximum velocity caused by a sound wave during a particular event.
Permeability	Rate at which fluids flow through the subsurface and reflects the degree to which pore space is connected.
pH	A measure of the acidity or alkalinity of a solution.
Plume Radius	Radius within which 95 percent of the sequestered gas-phase CO_2 mass occurs.
Resultant Noise Level	A-weighted sound measured in dBA, also called sound level.
Root-Mean-Square	Statistical measure of the magnitude of a varying quantity. The root-mean-square (RMS or rms) is the square root of the mean of the squares of the values.
Saline Formation	Porous rock formation that is overlain by one or more impermeable rock formations and thus has the potential to trap injected CO_2.

Term	Definition
Solubility	Ability or tendency of one substance to dissolve into another at a given temperature and pressure.
Sorbent	Material used to absorb other materials. A surface that takes up or holds a substance, by absorption or adsorption.
Sound Pressure Level	Measure of a sound's strength or intensity, expressed in dB. The sound pressure level generated by a steady source of sound will usually vary with distance and direction from the source.
Special Waste	As regulated by the State of Illinois, special waste includes hazardous waste, potentially infectious medical waste, industrial process waste, and pollution control waste (e.g., baghouse dust, landfill waste, scrubber sludge, and chemical spill cleaning material).
Supercritical CO_2	CO_2 usually behaves as a gas in air or as a solid in dry ice. If the temperature and pressure are both increased (above its supercritical temperature of 88ºF [31.1ºC] and 73 Atmosphere [1073 psi]), it can adopt properties midway between a gas and a liquid, such that it expands to fill its container like a gas, but has a density like that of a liquid.
Surface Water	All bodies of water on the surface and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.
Syngas	Gas mixture containing varying amounts of carbon monoxide (CO) and hydrogen (H_2) generated by the gasification of a carbon-containing fuel.
Terrestrial Sequestration	Process through which CO_2 from the atmosphere is absorbed by trees, plants, and crops through photosynthesis and stored as carbon compounds in biomass (tree trunks, branches, foliage, and roots) and soils. While terrestrial sequestration may be an attractive and useful sequestration option, the long-term accountability and permanence, and the inability to directly store the CO_2 captured from a particular power plant make this option unlikely to be implemented in the electrical power industry.
Threatened Species	Plants or animals likely to become endangered species within the foreseeable future. A federal list of threatened species can be found in 50 CFR 17.11 (wildlife), 50 CFR 17.12 (plants), and 50 CFR 227.4 (marine organisms). Illinois maintains its list of threatened species with the Illinois Endangered Species Protection Board and Texas maintains its list with the Texas Parks and Wildlife Department.
Traditional Cultural Property	District, site, building, structure, or object that is valued by a community for the role it plays in sustaining the community's cultural integrity, abbreviated TCP.

Term	Definition
Unplanned Restart	A series of events where power plant components are re-activated in a sequence to bring the plant to its fully operating state after an upset condition has been remedied.
Upset	An unplanned start when the entire system is held at no load while an issue with a component is corrected.
Upset Condition	An unpredictable failure of process components or subsystems which leads to an overall malfunction or temporary shutdown of the power plant.
Vadose Zone	Area of soil between the ground surface and the area directly above the groundwater surface (i.e., the water table) of unconfined aquifers.
Vibration	Force that oscillates about a specified reference point. Vibration is commonly expressed in terms of frequency such as cycles per second (cps), Hertz (Hz), cycles per minute (cpm), and strokes per minute (spm).
Viscosity	Measure of a material’s resistance to flow.
Wetland	Area inundated or saturated by surface or groundwater 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.
Wind Rose	Circular diagram that illustrates the relative frequency of wind speeds for each compass direction based on a time interval.
Zero Liquid Discharge System	Process separates solids and dissolved constituents from the plant wastewater and allows the treated water to be recycled or reused in the industrial process, resulting in no discharge of wastewater to the environment.

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APPENDIX A
COORDINATION LETTERS

In the course of preparing this EIS, interaction efforts among state and federal agencies were necessary to discuss issues of concern or other interests that could be affected by the Proposed Action, obtain information pertinent to the environmental impact analysis of the Proposed Action, and initiate consultations or permit processes. Following are the coordination letters sent by various agencies for each of the four candidate sites.

A.1 MATTOON

The following agencies sent coordination letters:

- U.S. Fish and Wildlife Service
- Illinois Department of Natural Resources
- Coles County Highway Department
- Mattoon Township Highway Department
- Bureau of Indian Affairs
- Illinois Historic Preservation Agency

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Marion Illinois Suboffice (ES)
8588 Route 148
Marion, IL 62959
(618) 997-3344

April 14, 2006

Mr. Daniel Wheeler
Illinois Dept. of Commerce and
Economic Development
Office of Coal Development
620 East Adams Street
Springfield, Illinois 62701

Dear Mr. Wheeler:

The U.S. Fish and Wildlife Service has been requested to provide threatened and endangered species and critical habitat information associated with possible location of the proposed FutureGen power plant at a site identified as Mattoon – Dole #1 Site, located in Coles County, Illinois. To assist in our review, we have been provided township/section/range location information, an Illinois State Geological Survey map with the site identified, information regarding the land cover occurring on the site and a color infrared aerial photo of the site.

Our records do not indicate the known presence of any federally listed threatened or endangered species on the Mattoon – Dole #1 Site. County records indicate the potential presence of the endangered Indiana bat (*Myotis sodalis*) in Coles County. This species occupies caves and abandoned mines during the winter. During the remainder of the year, Indiana bats utilize trees with rough or exfoliating bark and/or cavities for roosting. Although Indiana bats will forage over open areas, they prefer to forage within the canopy of forests. Land cover on the Mattoon – Dole #1 Site consists of 100% cropland. Therefore, suitable habitat for this species is not present.

Finally, there is no designated critical habitat for federally listed threatened or endangered species in Coles County.

Thank you for the opportunity to provide information regarding threatened and endangered species. Please contact me at 618/997-3344, ext. 340, should you have any questions or require further assistance.

Sincerely,

Joyce A. Collins
Assistant Field Supervisor

cc: IDNR (Rettig)

Illinois Department of
Natural Resources
One Natural Resources Way • Springfield, Illinois 62702-1271
http://dnr.state.il.us
Rod R. Blagojevich, Governor
Sam Flood, Acting Director

September 13, 2006

Dan Wheeler
IL Department of Commerce & Economic Opportunity
620 East Adams Street
Springfield, IL 62701

**Re: FutureGen Mattoon – Threatened or Endangered Species, Natural Area,
And Wetland Review Updates
Project Number's: 0604520, 0604761, 0604762, 0604763, & 0703118**

Dear Mr.Wheeler :

The Department has conducted a more detailed review, based on additional site specific information, for each of the projects identified above. This letter contains recommendations to avoid or minimize adverse impacts to threatened or endangered species and Natural Areas, as well as the wetland mitigation required under State law for potential impacts to wetlands.

Project Number 0604520 - Proposed Power Plant & C02 Sequestration Site (Dole Property)

The Department terminated the Consultation Process on April 11, 2006. There are no documented threatened species, endangered species or Natural Areas in the vicinity of this site.

The original review did not identify any state jurisdictional wetlands on this site. A wetland delineation identified a 0.066 acre State jurisdictional wetland on property adjacent to the northeast corner of this site. The mitigation ratio required for temporary impacts to this wetland is between 1.0:1 and 2.0:1. The mitigation ratio required for permanent impacts is between 1.5:1 and 3.0:1.

Project Number 0604761 – Primary Cooling Water Corridor

Upland Sandpiper (Endangered in Illinois), Kirtland's Snake (threatened in Illinois), Eastern Sand Darter (threatened in Illinois), and the Riley Creek Natural Area were identified as in the vicinity of this corridor. Upon further review, the Department has determined that the corridor is not in the vicinity of Upland Sandpiper habitat. The Riley Creek Natural Area supports the Eastern Sand Darter.

Erosion control is especially important to minimize the potential for sedimentation impacts from construction activities adjacent to the stream. The Department recommends that Riley Creek be directionally bored to minimize the potential for adverse impact to Riley Creek and the Eastern Sand Darter. Cassell Creek is a tributary to Riley Creek and may also support the Eastern Sand Darter. Cassell Creek should also be directionally bored. An Incidental Take Authorization for impacts to the Eastern Sand Darter may be required in addition to mitigation for impacts to the Riley Creek Natural Area if these creeks cannot be directionally bored. The Kirtland's Snake is known to occur at the western edge of Charleston. Even though there are no known records within this corridor, the corridor does contain habitat that could be occupied by the Kirtland's Snake. The following recommendations should be incorporated into the construction plans to minimize the potential for adverse impacts to the Kirtland's Snake.

- Construction crews should be educated as to what a Kirtland's snake look's like and allow them to move out of harms way if encountered.
- Trenches should be backfilled immediately after piping has been installed, if possible.
- If trenches must be left open, they should be covered with plywood or similar material at the end of the day. This material should be covered with enough dirt to keep snakes from getting under it.
- Trenches that have not been backfilled must be inspected for the presence of Kirtland's Snakes at the beginning of each day. The Department must be contacted to make arrangements for the a staff biologist to capture and relocate any Kirtland's Snakes trapped in the open trench.

The potential for impacts to the Kirtland's Snake, Eastern Sand Darter, and the Riley Creek Natural Area are considered minor and will not jeopardize the continued existence of the Eastern Sand Darter or Kirtland's Snake in the State, or result in the destruction of the Riley Creek Natural Area.

A wetland delineation identified six State jurisdictional wetlands within this corridor. Impacts to wetlands 1, 2, 3, and 6 can be mitigated at a 1.0:1 ratio if disturbed areas are restored to their original condition after piping has been installed. Temporary impacts to wetlands 4 and 5 may occur if the staging area for directional bores under Riley Creek and Cassell Creek must be located in the wetland. These impacts can be mitigated at a 1.0:1 ratio if disturbed areas are restored to their original condition after piping has been installed.

Project Number 0604762 – Secondary Source Cooling Water Corridor

The intake structure for this corridor will impact the Cooks Mill Segment of the Kaskaskia River Natural Area which supports the Spike Mussel (threatened in Illinois). The construction of the intake should be done during low flow conditions. Erosion control is especially important to minimize these impacts. A mussel survey of the intake footprint must be done prior to construction activities associated with the intake. An Incidental Take Authorization is required to move Spike mussels out of intake footprint to other suitable habitat. Impacts resulting from the construction and operation of the intake as a secondary cooling water source are considered minor and will not jeopardize the continued existence of the Spike mussel in the State, or result in the destruction of the Cooks Mill segment of the Kaskaskia River Natural Area.

A wetland delineation identified two State jurisdictional wetlands in the area where the intake structure and pump house will be constructed. The larger forested wetland (0.308 acre) will not be impacted. Construction activities will result in permanent impacts to the smaller emergent wetland (0.068 acre). The mitigation ratio required for these impacts will be between 1.5:1 and 3.0:1.

Project Number 0604763 – 138kV Electric Gas Corridor

There are no documented threatened species, endangered species or Natural Areas within these corridors. The wetland delineation did not identify any State jurisdictional wetlands within these corridors.

Project 0703118 – 345kV Corridor

The preliminary review of this corridor identified the Bigeye Chub (endangered in Illinois), Kirtland's Snake (threatened in Illinois), and the Neoga Railroad Prairie Natural Area in the vicinity of this corridor. Upon further review, the Department has determined that the corridor is not in the vicinity of the Neoga Railroad Prairie Natural Area. The record documenting the presence of the Bigeye Chub in the Little Wabash River is very old (7-23-1950) and was collected in the middle of what is now Lake Mattoon. There are no other documented records of the Bigeye Chub within five miles of this corridor. The Kirtland's Snake is known to occur at the vicinity of Lake Paradise to the west of this corridor. Even though there are no known records within this corridor, the corridor does contain habitat that could be occupied by the Kirtland's Snake. The recommendations, made earlier in this letter, to minimize impacts to the Kirtland's Snake are appropriate for this corridor as well.

A wetland delineation identified eleven State jurisdictional wetlands within this corridor. Wetland impacts are avoidable if the existing 138kV corridor is utilized for the 345kV transmission lines. Impacts to these wetlands will not be avoidable if the 345kV corridor is located adjacent to the existing 138kV corridor. The mitigation ratios required for impacts to forested wetlands 12, 13, 14, 15, 19, and 21 along an adjacent corridor will be between 1.5 and 3.0:1. The mitigation ratios required for impacts to forested wetlands 16, 17, and 20 along an adjacent corridor will be between 2.5:1 and 5.5:1. Impacts to wetland 18 are unlikely if utility poles are not sited in this wetland. Wetland 22 will not be impacted.

Please do not hesitate to contact me at (217) 785-5500 if you should have any questions.

Michael Branham
Division of Ecosystems and Environment
217-785-5500

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Illinois Department of
Natural Resources
One Natural Resources Way • Springfield, Illinois 62702-1271
http://dnr.state.il.us

Rod R. Blagojevich, Governor
Sam Flood, Acting Director

October 24, 2006

Dan Wheeler
IL Department of Commerce & Economic Opportunity
620 East Adams Street
Springfield, IL 62701

Re: Follow-Up Questions on Diverting WWTP Effluents from Kickapoo and Cassell Creeks

Dear Mr.Wheeler :

The USDOE has requested additional information regarding the potential for impacts to Kickapoo and Cassell Creeks resulting from the diversion of the Mattoon and Charleston WWTP effluents. This effluent water would be the primary source of cooling water for the FutureGen project. The Department has reviewed the response prepared by Patrick Engineering (dated 10-24-06) and concurs with their findings. The diversion of this effluent water will also provide an opportunity to study the potential for beneficial impacts to three listed mussels not previously mentioned.

The Kidneyshell (*Ptychobranchus fasciolaris*) is endangered in Illinois and is only known to occur in Coles county. The Snuffbox (*Epioblasma triquetra*) is endangered in Illinois and is only known to occur in Coles and Douglas counties. The Little Spectaclecase (*Villosa lienosa*) is threatened in Illinois and known to occur in Coles, Douglas, Iroquois, and Vermilion counties. There are valid Coles county records for all three of these mussels in a reach of the Embarras River upstream of its confluence with Kickapoo Creek. The 7Q10 of the Embarras River in the vicinity of these records is between 2.0 cfs and 3.4 cfs. The relationship between the occurrence of specific listed species and the 7Q10 value, if any, is currently undocumented. The diversion of most of the Mattoon effluent should result in a 7Q10 of 3.4 cfs or less in the reach of the Embarras River located downstream of the Kickapoo Creek confluence.

The Embarrass River, downstream of the Kickapoo Creek confluence, should be monitored if Mattoon is selected for the FutureGen site to determine if these species ultimately populate this reach of the river. This data could be very valuable when considering if additional study of a relationship between 7Q10 values and specific species occurrence is worth pursuing. Please do not hesitate to contact me at (217) 785-5500 if you should have any questions.

Michael Branham
Division of Ecosystems and Environment

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Steven L. Newlin
Coles County Engineer , Acting

PHONE (217) 348-0527
FAX (217) 348-7322

Coles County Highway Department

COLES COUNTY COURTHOUSE
651 JACKSON STREET, ROOM 16
CHARLESTON, ILLINOIS 61920

8 September, 2006

Mr. David Wortman
City of Mattoon
Director of Public Works
208 North 19th Street
Mattoon, Illinois 61938

Subject: Status of County Highways

Dear Mr. Wortman:

The Coles County Highway Department currently maintains a Class II truck route along County Highway 18 (County Road 1000N) that begins at County Highway 13 (County Road 200E) and ends at U.S. Route 45(County Road 600E). The County also has an adjoining Class II truck route along County Highway 18 currently under construction. This section begins at U.S. Route 45(County Road 600E) and ends at (County Road 900E). This section includes a new interchange with Interstate 57. The estimated completion of this construction is June 1, 2008.

The remaining portion of County Highway 18 from County Road 200E to Illinois Route 121 west of the proposed FutureGen site is scheduled to be upgraded to a Class II truck route in fiscal year 2008(beginning July 1, 2007).

Upon completion of the current and proposed construction projects, County Highway 18 will be a non-stop Class II truck route from Interstate Route I-57 to Illinois Route 121.

Sincerely,

Steven L. Newlin
Coles County Engineer, Acting

cc: file

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Mike Diepholz Phone: (217) 235-2712

MATTOON TOWNSHIP HIGHWAY DEPARTMENT
2679 E County Rd 600 N
Mattoon, IL 61938

September 13, 2006

David Wortman
Public Works Director
208 North 19th Street
Mattoon, IL 61938

Subject: Placement of Potable Water Pipeline on County Road 800N

David,

Mattoon Township has jurisdiction over CR 800N in the area near the FutureGen site. Mattoon Township will allow a potable water pipeline to be placed on the right-of-way of County Road 800 N to serve the FutureGen Plant.

Let me know if there is any other way Mattoon Township can assist in helping FutureGen come to our area.

Sincerely,

Mike Diepholz
Mattoon Township,
Road Commissioner

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United States Department of the Interior

BUREAU OF INDIAN AFFAIRS

Eastern Oklahoma Regional Office
P.O. Box 8002
Muskogee, OK 74402-8002

IN REPLY REFER TO:
Division of Environmental
Safety and Cultural Resources

Mr. Mark L. McKoy
U.S. Department of Energy
P. O. Box 880
Morgantown, West Virginia 26507-0880

JAN 2 2 2007

Dear Mr. McKoy:

On December 11, 2006, the Bureau of Indian Affairs (BIA), Eastern Oklahoma Regional Office (EORO), received an information request from the U.S. Department of Energy (USDOE) regarding significant impacts to archeological, religious or cultural sites from the construction and operation of a coal-fueled electric power and Hydrogen gas (H_2) production plant located in Illinois or Texas. The EORO has no comments regarding the project.

The projects in Illinois are within the jurisdictional area of the Bureau's Eastern Region and the projects in Texas are within the jurisdiction area of the Bureau's Southern Plains Region. Both Regions have been provided the notice by copy of this letter. As the other two Regions may have environmental and/or cultural resources concerns relating to the project, it is recommended that the USDOE coordinate directly with them on any of their concerns. The contact addresses are:

Franklin Keel, Regional Director
Eastern Regional Office
545 Marriott Drive, Suite 700
Nashville, Tennessee 37214

Dan Deerinwater, Regional Director
Southern Plains Regional Office
P.O. Box 368
Anadarko, Oklahoma 73005-0368

If any additional information is required, please contact Mr. Bob Coleman, Division Chief, Division of Environmental, Safety and Cultural Resources, EORO, at (918) 781-4660.

Respectfully,

Regional Director

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Illinois Historic
Preservation Agency

1 Old State Capitol Plaza • Springfield, Illinois 62701-1512 • Voice (217) 782-4836 • Teletypewriter Only (217) 524-7128
www.illinois-history.gov

Coles County
Mattoon
Dole #1
Section 8, 9, 10, 11, 12, 13, 16, 21, 24 T12N R7E
Power Plant/FutureGen

PLEASE REFER TO: IHPA LOG #011041106

January 30, 2007

Mr. Ronald Swager
Patrick Engineering, Inc.
300 West Edwards Street, Suite 200
Springfield, Illinois 62704-1907

Dear Sir:

Acre(s): 527 Site(s): 0
Archaeological Contractor: UMA/Finney

Thank you for submitting the results of the archaeological reconnaissance. Our comments are required by Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties".

Our staff has reviewed the archaeological Phase I reconnaissance report performed for the project referenced above. The Phase I survey and assessment of the archaeological resources appear to be adequate. Accordingly, we have determined, based upon this report, that no significant historic, architectural, and archaeological resources are located in the project area.

Please submit a copy of this letter with your application to the state or federal agency from which you obtain any permit, license, grant, or other assistance. Please retain this letter in your files as evidence of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

Sincerely,

Anne E. Haaker

Anne E. Haaker
Deputy State Historic
Preservation Officer

AEH

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A.2 TUSCOLA

The following agencies sent coordination letters:

- U.S. Fish and Wildlife Service
- Illinois Department of Natural Resources
- City of Arcola
- City of Tuscola
- Duke Energy Generation Services
- Urbana and Champaign Sanitary District
- Tuscola-Douglas County FutureGen Task Force
- Bureau of Indian Affairs
- Illinois Historic Preservation Agency

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Marion Illinois Suboffice (ES)
8588 Route 148
Marion, IL 62959
(618) 997-3344

April 14, 2006

Mr. Daniel Wheeler
Illinois Dept. of Commerce and
Economic Development
Office of Coal Development
620 East Adams Street
Springfield, Illinois 62701

Dear Mr. Wheeler:

The U.S. Fish and Wildlife Service has been requested to provide threatened and endangered species and critical habitat information associated with possible location of the proposed FutureGen power plant at a site identified as Tuscola – Pflum #2 Site, located in Douglas County, Illinois. To assist in our review, we have been provided township/section/range location information, an Illinois State Geological Survey map with the site identified, information regarding the land cover occurring on the site and a color infrared aerial photo of the site.

Our records do not indicate the known presence of any federally listed threatened or endangered species on the Tuscola – Pflum #2 Site. County records indicate the potential presence of the endangered Indiana bat (*Myotis sodalis*) in Douglas County. This species occupies caves and abandoned mines during the winter. During the remainder of the year, Indiana bats utilize trees with rough or exfoliating bark and/or cavities for roosting. Although Indiana bats will forage over open areas, they prefer to forage within the canopy of forests. Land cover on the Tuscola – Pflum #2 Site consists of 100% cropland. Therefore, suitable habitat for this species is not present.

Finally, there is no designated critical habitat for federally listed threatened or endangered species in Douglas County.

Thank you for the opportunity to provide information regarding threatened and endangered species. Please contact me at 618/997-3344, ext. 340, should you have any questions or require further assistance.

Sincerely,

Joyce A. Collins
Assistant Field Supervisor

cc: IDNR (Rettig)

Illinois Department of
Natural Resources
One Natural Resources Way • Springfield, Illinois 62702-1271
http://dnr.state.il.us
Rod R. Blagojevich, Governor
Sam Flood, Acting Director

September 14, 2006

Dan Wheeler
IL Department of Commerce & Economic Opportunity
620 East Adams Street
Springfield, IL 62701

**Re: FutureGen Tuscola – Threatened or Endangered Species, Natural Area,
And Wetland Review Updates
Project Number's: 0604527, 0604748, 0604749, & 00604750**

Dear Mr.Wheeler:

The Department has conducted a more detailed review, based on additional site specific information, for each of the projects identified above. This letter contains recommendations to avoid or minimize adverse impacts to threatened or endangered species and Natural Areas, as well as the wetland mitigation required under State law for potential impacts to wetlands.

Project Number 0604527 - Proposed Power Plant Site (Pflum Property)

The Department terminated the Consultation Process on April 11, 2006. There are no documented threatened species, endangered species or Natural Areas in the vicinity of this site.
The wetland delineation did not identify any State jurisdictional wetlands in the vicinity of this site.

Project Number 0604748 – 345kV Corridor

The preliminary review concluded that adverse impacts to threatened or endangered species and Natural Areas are unlikely. Upon further review, the Department has determined that portions of the corridor may provide habitat for the Kirtland's Snake (threatened in Illinois). The following recommendations should be incorporated into the construction plans to minimize the potential for adverse impacts to the Kirtland's Snake.

- Construction crews should be educated as to what a Kirtland's snake look's like and allow them to move out of harms way if encountered.
- Trenches should be backfilled immediately after piping has been installed, if possible.

- If trenches must be left open, they should be covered with plywood or similar material at the end of the day. This material should be covered with enough dirt to keep snakes from getting under it.
- Trenches that have not been backfilled must be inspected for the presence of Kirtland's Snakes at the beginning of each day. The Department must be contacted to make arrangements for a staff biologist to capture and relocate any Kirtland's Snakes trapped in the open trench.

The potential for impacts to the Kirtland's Snake are considered minor and will not jeopardize the continued existence of the Kirtland's Snake in the State.

A wetland delineation identified twelve State jurisdictional wetlands within this corridor. Impacts to wetlands 1, 2, 4, 6, 7, 8, 9, 10, 11, and 12 are unlikely if utility poles are not sited in wetland areas. The Department must be consulted regarding the appropriate mitigation if a utility pole must be sited in one or more wetland areas. The mitigation ratio required for the removal of any trees in the vicinity of wetland 3 will be between 1.5:1 and 3.0:1. The mitigation ratio required for impacts to forested wetland 5 will be between 2.5:1 and 5.5:1.

Project Number 0604749 – CO2 corridor and Injection Site

There are no documented threatened species, endangered species or Natural Areas within the CO2 corridor. There are no documented threatened species, endangered species or Natural Areas in the vicinity of the injection site.

A wetland delineation identified one State jurisdictional wetland (Area 15) within the CO2 corridor. Impacts to this wetland can be mitigated at a 1.0:1 ratio if disturbed areas are restored to their original condition after piping has been installed. Four State jurisdictional wetlands (Area 16, 17, 18, & 19) were identified within the plume area associated with the injection site. These wetlands will not be impacted.

Project Number 0604749 – Cooling Water Corridor

The preliminary review concluded that adverse impacts to threatened or endangered species and Natural Areas are unlikely. The Equistar chemical plant was identified as the provider of cooling water for the FutureGen site. At the time of the review the Department did not know that the source of Equistar's water was the Kaskaskia River. Equistar maintains the water level of a large on-site reservoir by pumping water from the Kaskaskia River. During times of low flow groundwater pumps located approximately 20 miles upstream are utilized to maintain sufficient water in the Kaskaskia River to meet Equistar's needs. The Kaskaskia River from the Douglas-Champaign county line to the Equistar intake has been identified as a high mussel diversity stream known as the Chicken Bristle Segment of Kaskaskia River Natural Area. The Department conducted a mussel survey August 30, 2006, to document the status of this Natural Area and verify if any listed species of mussels were present. Very few mussels were found and none of them were listed. This segment of the river is unlikely to maintain it's status as a Natural Area. Therefore, Consultation regarding the cooling water source and the corridor to get it to the FutureGen site is terminated.

A wetland delineation identified two State Jurisdictional Wetlands in the vicinity of the Equistar Plant (Area 13) and the water intake (Area 14). Impacts to wetland 13 can be mitigated at a 1.0:1 ratio if disturbed areas are restored to their original condition after piping has been installed. There will be no impacts to wetland 14 associated with FutureGen.

Please do not hesitate to contact me at (217) 785-5500 if you should have any questions.

Michael Branham
Division of Ecosystems and Environment
217-785-5500

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City of Arcola

114 N. Locust Street
P.O. Box 215

Arcola, Illinois 61910

Phone: (217) 268-4966
Fax: (217) 268-4968

City Aldermen
RANDY WILLIAMS
KARLA LAMPE
GLENN GENTRY
KENDALL MOORE
JEREMY EAST
JASON GOAD

LARRY FERGUSON – Mayor
CAROL TURNER – City Clerk
FRED HARVEY – Treasurer
EMERSON L. MOORE – City Attorney

April 26, 2006

Patrick Engineering
300 West Edwards Street,
Suite 200
Springfield, IL 62704

RE: FutureGen Project

This letter is in reference to your investigation into the feasibility of Tuscola, IL as a site for the potential FutureGen Project. The City of Arcola in accordance with its zoning ordinance controls zoning 1.5 miles out from the municipal boundary.

> "25-2-1. Jurisdiction and compliance. The jurisdiction of this chapter shall include all lands and waters within the corporate limits of the municipality, and the area extending one and one-half miles beyond such corporate limits.
>
> All buildings erected hereafter, all uses of land or buildings established hereafter, all structural alterations or relocation of existing buildings occurring hereafter shall be subject to all regulations of this chapter which are applicable to the zoning districts in which such buildings, uses, or land shall be located."

Any development within the 1.5 miles boundary of the Arcola Municipal limits would only be required to obtain a building permit.

> "25-9-2. Permits.
> (a) No person shall erect, alter, remodel, move or remove any kind of a structure or building or part thereof without first securing a building permit therefore, provided no such permit shall be required for repairs, construction, reconstruction or alteration of a building where the size, basic configuration and location of the building remain the same.
> (b) Permit fees. Fees for building permits shall be as follows:
> (1) None for structures used for agricultural purposes within RD districts including residences of farm owners, tenants and members of the owners' immediate families.
> (2) Ten cents per square foot for the first 1,000 square feet of floor area and eight cents per square foot for floor area in excess of 1,000 square feet for all buildings, excluding buildings referred to in subparagraph (b) (1) of this section, provided that there shall be a minimum fee of twenty dollars for each permit.
> (c) Exhibits. Each application for a building permit and for an occupancy permit for the use of land shall be accompanied by the following exhibits unless waived by the Zoning Officer.

(1) Boundary survey of an area including the property in question and 100 feet beyond its outer boundaries showing existing utilities, lot boundaries and dimensions, buildings and easements. Foliage, topography, waterways and soil borings to be included if pertinent.
(2) Plot plan indicating location, size and placement of proposed structure and yards, parking and loading facilities, vehicular access and egress, and utility plant including surface drainage.
(d) Permit application procedure. Procedure for applying for a building permit and an occupancy permit shall be as follows:
(1) The property owner or his agent shall meet with the Zoning Officer to explain the situation, learn the procedures, and obtain an application form.
(2) The applicant shall file the completed application form together with the required exhibits with the Zoning Officer.
(3) The Zoning Officer shall issue a building permit and collect the required permit fee if the proposed project complies with the provisions of this chapter, and other relevant portions of this Code.
(e) Revocation of building permits. Where a building permit has been issued pursuant to the provisions of this chapter, such permit shall become null and void without further action by the Zoning Officer or City Council unless work thereon commences within 90 days from the date of granting such permit.
(f) Valuation. For purposes of valuation on the Zoning Officer's report, all residences and non-residences exclusive of garages and accessory buildings shall be valued at $75 per square foot of all floor area and all accessory buildings and garages shall be valued at $25 per square foot of all floor area.
(g) Penalty. It shall be unlawful for any contractor to erect, alter, remodel, move or remove any kind of a structure or building or part thereof without securing a building permit therefore. Any contractor violating this provision shall be subject to a penalty as follows: not less than $200 nor more than $500 for the first offense, not less than $300 nor more than $500 for the second offense, not less than $400 nor more than $500 for the third offense, and $500 for the fourth or subsequent offense."

Should you have any further questions, please do not hesitate to contact me.

Sincerely,

Bill Wagoner
City Administrator

BETH LEAMON
CITY CLERK

ALTA LONG
CITY TREASURER

DANIEL J. KLEISS
MAYOR

J. DREW HOEL
CITY ADMINISTRATOR

MEMBER OF ILLINOIS MUNICIPAL LEAGUE

City of Tuscola
214 NORTH MAIN STREET
TUSCOLA, ILLINOIS 61953-1486
TEL. (217) 253-2112
FAX (217) 253-5026

September 13, 2006

Futuregen Industrial Alliance
International Square
1875 I Street, N.W.
5th Floor
Washington , D.C. 20006
Att'n: Site Selection Team

RE: Tuscola, Illinois FutureGen Site

Dear Selection Team Members,

Please allow this letter to confirm the City of Tuscola staff position relative to zoning for the proposed FutureGen site west of the Tuscola City limits. Zoning is, potentially, a legislative process subject to consideration by the Tuscola City Council and the Tuscola Planning Commission. However, I do not anticipate that either of these entities will choose to pursue hearings or actions relative to the zoning on these parcels.

A portion of the proposed site does, in fact, lie within the one and one-half mile extra-territorial zoning jurisdiction of the City of Tuscola. However, the majority of the site does not lie within that jurisdiction. Further, the extra-territorial jurisdiction allowed pursuant to statute is permissive, rather than directive. In other words, the City of Tuscola has discretion to choose whether or not to implement its zoning authority in that jurisdiction.

Since the majority of the proposed site is outside of the jurisdiction, and since the proposed use is entirely consistent with the City's Comprehensive Land Use Plan, I am confident that the City of Tuscola will choose not to implement its zoning authority relative to the proposed FutureGen site.

Please feel free to contact me with any questions or comments. My staff and I stand ready to assist you in any that we can.

Sincerely,

J. Drew Hoel
City Administrator

cc: The Honorable Daniel J. Kleiss, Mayor
Mr. Steve Hettinger, Building Inspector
Mr. Brian Moody, Executive Director, TEDI

Duke Energy®
Generation Services

Brian A. Moody
Executive Director
Tuscola Economic Development, Inc.
214 N. Main Street
P.O. Box 145
Tuscola, IL 61953

Brian,

Here is an overview of how the water plant system works and the impact of "zero" discharge. This information provided is with the understanding that Duke is the owner/operators of the water treatment system and operates the waste treatment for Lyondell.

The Tuscola site obtains its raw water supply from the Kaskakia River. Through the use of a 18 acres 150 million gallon holding pond the site is able to run at the current rates for 30 to 45 days without pumping from the river if needed. During normal river flows the holding pond is pumped into on a regular basis. However during dryer periods the practice has been not to pump out of river to maintain the holding pond level but to wait for moderate to heavy rains to increase the river flow and pump at maximum rate to refill holding pond. During these high river flows the flow will get up to 477 million gallons a day plus. We also pump from the Bondville wells to supplement the river flow during dryer periods of time. One reasons for pumping from the Bondville wells is the discharge permit (NPDES permit) requires a 5:1 dilution ratio to discharge. With "zero" discharge pumping would no longer be need at the same rates if required at all.

Discussions have taken place over the years about going to "zero" discharge. One of the only draw backs could be the possibly of cycle up the metals in the holding pond. At present all metals are a less than the reporting limits but Zinc. Zinc was at .013 mg/l with a reporting limit of .010 mg/l. The cycling issue can be alleviated by putting in metals filtration. The overall cost in conjunction with a sizable project would be small (estimated at $300,000 or less). The site would be able to do this because of the 33 acres 51 million gallon of treatment ponds would then feed our holding pond at 1.5 million gallons a day on average. The site also has 15 acres 31 million gallons of diversion holding ponds. The primary need for these diversion holding ponds is that all runoff form the existing site go through this waste water treatment plant. This runoff can be as much as 8 million gallon a day coming in and must be held as to not over fill the oxidation ponds. On the Lyondell site they also have a 50 million gallon storm water basin in their north plant area that isn't part of the water system but could be added.

The site has installed water treatment facilities capable of producing 2400 gpm of sodium zeolite softened water and up to 900 gpm of reverse osmosis for boiler make-up water. The average current site demand for softened water is 1000 to 1400 gpm while the average RO system requirements are for 200 gpm to 620 gpm. There is adequate space for softeners and RO's to be increased if needed. The remaining water treatment system is capable of treating 9 million gallon a day of make-up to the process water, softeners and RO's.

2003 Data

River Flow

Max.	345 Million Gallon Day
Min.	4.0 Million Gallon Day
Avg.	19 Million Gallon Day

Discharge Rates

Max.	5.81 Million Gallon Day
Min.	0.39 Million Gallon Day
Avg.	1.56 Million Gallon Day

Consumption Rates

Max.	3.0 Million Gallon Day
Min.	1.83 Million Gallon Day
Avg.	2.19 Million Gallon Day

2004 Data

River Flow

Max.	477 Million Gallon Day
Min.	5.0 Million Gallon Day
Avg.	36.59 Million Gallon Day

Discharge Rates

Max.	5.62 Million Gallon Day
Min.	0.44 Million Gallon Day
Avg.	1.73 Million Gallon Day

Consumption Rates

Max.	3.01 Million Gallon Day
Min.	1.69 Million Gallon Day
Avg.	2.01 Million Gallon Day

2005 Data

River Flow

Duke Energy®
Generation Services

Max.	487 Million Gallon Day
Min.	3.0 Million Gallon Day
Avg.	8.85 Million Gallon Day

Discharge Rates

Max.	8.54 Million Gallon Day
Min.	0.3 Million Gallon Day
Avg.	1.34 Million Gallon Day

Consumption Rates

Max.	2.6 Million Gallon Day
Min.	1.71 Million Gallon Day
Avg.	1.96 Million Gallon Day

Note: Consumption is taken out before we measure river flow. So if we are pumping at a 3.0 million gallon a day rate from the up steam the river flow will be less that 3.0 million rate. We have no metering on our river pumps.

Larry Behl

Larry Behl

Production Team Group Leader
Duke Energy Generating Services
625 E US Highway 36
Tuscola, Il 61953

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James Crane PE

From: "Mike Little" <MRLittle@U-CSD.Com>
To: "'James Crane PE'" <James.Crane@douglascountyhighway.org>
Sent: Friday, September 08, 2006 2:29 PM
Subject: RE: plant discharge information

Mr. Crane,
The following is the flow data you requested for the District's Southwest Treatment Plant:
Current Average Daily Discharge = 6 million gallons per day (MGD)
Available Capacity:
Average Daily Flow 7.98 MGD
Peak Average Flow 17.25 MGD
Maximum Daily Flow 27.25 MGD

This facility was expanded in the last year and no future expansions are anticipated before 2019.

Mike Little
Executive Director
Urbana & Champaign Sanitary District
217.367.3409x224

From: James Crane PE [mailto:James.Crane@douglascountyhighway.org]
Sent: Friday, September 08, 2006 1:36 PM
To: mrlittle@u-csd.com
Subject: plant discharge information
Importance: High

Mr. Little

Please see attached letter. Thank you for your help and information.

James E Crane PE
Douglas County Engineer

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Rueben Kaufman
363 E CR 200N
Arcola, IL 61910

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. Kaufman,

Tuscola-Douglas County was recently selected as a finalist for FutureGen. FutureGen is a $1 billion public-private partnership to build the world's first coal-fueled, "near-zero emissions" power production plant. The FutureGen plant will use cutting-edge technologies to generate electricity while capturing and permanently storing carbon dioxide in geological formations. The plant will also produce hydrogen and byproducts for use by other industries.

The $1B FutureGen project will support significant employment across central Illinois. Preliminary employment estimates suggest that approximately 1300 construction jobs and 150 permanent jobs will be created as a result of this project being built. The potential economic impact to Douglas County and to the State of Illinois would be extraordinary if Tuscola-Douglas County is selected as the location for this project.

We have been gathering site specific information for the Department of Energy (Federal Government) over the past 3 months. The information gathered has ranged from information on the existing schools in the area to the presence of threatened or endangered species, both plants and animals. The Department of Energy has voiced a concern that this project is being considered within close proximity to the Amish Community and is concerned with what the community's concerns and opinion is concerning this project.

We have attached some information on the project for your review and have attached a questionnaire for you to fill out and send back to us. We would be more than happy to do a presentation on this project that outlines the details of the project and answer any specific questions that anyone may have, if it is wanted within the Amish Community.

Feel free to contact either Jim Crane (217-253-2113) or Brian Moody (217-253-2552) with any questions concerning this request.

Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

Cc: file
Lucy Swartz, Battelle Memorial Institute

Enc.

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Menno D. Miller
1822 N CR 280E
Arcola, IL 61910

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. Miller,

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Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

Cc: file
Lucy Swartz, Battelle Memorial Institute

Enc.

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Edwin Kaufman
485 E CR 200N
Arcola, IL 61910

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. Kaufman,

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Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

Cc: file
Lucy Swartz, Battelle Memorial Institute

Enc.

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Daniel Otto
260 N CR 425E
Arthur, IL 61911

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. Otto,

Tuscola-Douglas County was recently selected as a finalist for FutureGen. FutureGen is a $1 billion public-private partnership to build the world's first coal-fueled, "near-zero emissions" power production plant. The FutureGen plant will use cutting-edge technologies to generate electricity while capturing and permanently storing carbon dioxide in geological formations. The plant will also produce hydrogen and byproducts for use by other industries.

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Feel free to contact either Jim Crane (217-253-2113) or Brian Moody (217-253-2552) with any questions concerning this request.

Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

Cc: file
Lucy Swartz, Battelle Memorial Institute

Enc.

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Andy Ray Mast
348 E CR 300N
Arthur, IL 61911

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. Mast,

Tuscola-Douglas County was recently selected as a finalist for FutureGen. FutureGen is a $1 billion public-private partnership to build the world's first coal-fueled, "near-zero emissions" power production plant. The FutureGen plant will use cutting-edge technologies to generate electricity while capturing and permanently storing carbon dioxide in geological formations. The plant will also produce hydrogen and byproducts for use by other industries.

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Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

Cc: file
Lucy Swartz, Battelle Memorial Institute

Enc.

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Jake Stutzman
423 N CR 400E
Arcola, IL 61910

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. Stutzman,

Tuscola-Douglas County was recently selected as a finalist for FutureGen. FutureGen is a $1 billion public-private partnership to build the world's first coal-fueled, "near-zero emissions" power production plant. The FutureGen plant will use cutting-edge technologies to generate electricity while capturing and permanently storing carbon dioxide in geological formations. The plant will also produce hydrogen and byproducts for use by other industries.

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Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

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Lucy Swartz, Battelle Memorial Institute

Enc.

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Sam Schrock
615 N CR 300E
Tuscola, IL 61953

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. Schrock,

Tuscola-Douglas County was recently selected as a finalist for FutureGen. FutureGen is a $1 billion public-private partnership to build the world's first coal-fueled, "near-zero emissions" power production plant. The FutureGen plant will use cutting-edge technologies to generate electricity while capturing and permanently storing carbon dioxide in geological formations. The plant will also produce hydrogen and byproducts for use by other industries.
The $1B FutureGen project will support significant employment across central Illinois. Preliminary employment estimates suggest that approximately 1300 construction jobs and 150 permanent jobs will be created as a result of this project being built. The potential economic impact to Douglas County and to the State of Illinois would be extraordinary if Tuscola-Douglas County is selected as the location for this project.

We have been gathering site specific information for the Department of Energy (Federal Government) over the past 3 months. The information gathered has ranged from information on the existing schools in the area to the presence of threatened or endangered species, both plants and animals. The Department of Energy has voiced a concern that this project is being considered within close proximity to the Amish Community and is concerned with what the community's concerns and opinion is concerning this project.

We have attached some information on the project for your review and have attached a questionnaire for you to fill out and send back to us. We would be more than happy to do a presentation on this project that outlines the details of the project and answer any specific questions that anyone may have, if it is wanted within the Amish Community.

Feel free to contact either Jim Crane (217-253-2113) or Brian Moody (217-253-2552) with any questions concerning this request.

Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

Cc: file
Lucy Swartz, Battelle Memorial Institute

Enc.

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TUSCOLA-DOUGLAS COUNTY
FUTUREGEN TASK FORCE
C/O Douglas County Highway Department
200 S. Prairie Street
Tuscola, IL 61953

December 19, 2006

Mr. Joe A. Mast
2589 E CR 1450N
Humbolt, IL 61931

Re: Tuscola-Douglas County FutureGen Site
Questionnaire for select Amish Bishops concerning FutureGen Project

Dear Mr. NAME,

Tuscola-Douglas County was recently selected as a finalist for FutureGen. FutureGen is a $1 billion public-private partnership to build the world's first coal-fueled, "near-zero emissions" power production plant. The FutureGen plant will use cutting-edge technologies to generate electricity while capturing and permanently storing carbon dioxide in geological formations. The plant will also produce hydrogen and byproducts for use by other industries.

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Sincerely,

James E. Crane, PE
Douglas County Engineer

Brian Moody
Tuscola Economic Development, Inc.

Cc: file
Lucy Swartz, Battelle Memorial Institute

Enc.

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United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
Eastern Oklahoma Regional Office
P.O. Box 8002
Muskogee, OK 74402-8002

IN REPLY REFER TO:
Division of Environmental
Safety and Cultural Resources

Mr. Mark L. McKoy
U.S. Department of Energy
P. O. Box 880
Morgantown, West Virginia 26507-0880

JAN 2 2 2007

Dear Mr. McKoy:

On December 11, 2006, the Bureau of Indian Affairs (BIA), Eastern Oklahoma Regional Office (EORO), received an information request from the U.S. Department of Energy (USDOE) regarding significant impacts to archeological, religious or cultural sites from the construction and operation of a coal-fueled electric power and Hydrogen gas (H_2) production plant located in Illinois or Texas. The EORO has no comments regarding the project.

The projects in Illinois are within the jurisdictional area of the Bureau's Eastern Region and the projects in Texas are within the jurisdiction area of the Bureau's Southern Plains Region. Both Regions have been provided the notice by copy of this letter. As the other two Regions may have environmental and/or cultural resources concerns relating to the project, it is recommended that the USDOE coordinate directly with them on any of their concerns. The contact addresses are:

Franklin Keel, Regional Director
Eastern Regional Office
545 Marriott Drive, Suite 700
Nashville, Tennessee 37214

Dan Deerinwater, Regional Director
Southern Plains Regional Office
P.O. Box 368
Anadarko, Oklahoma 73005-0368

If any additional information is required, please contact Mr. Bob Coleman, Division Chief, Division of Environmental, Safety and Cultural Resources, EORO, at (918) 781-4660.

Respectfully,

Regional Director

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Illinois Historic Preservation Agency

1 Old State Capitol Plaza • Springfield, Illinois 62701-1512 • Teletypewriter Only (217) 524-7128

Voice (217) 782-4836

www.illinois-history.gov

Douglas County
Tuscola
Pflum #2
Section 29, 30, 31, 32 T16N R8E, Section 36 T16N R7E
Section 5, 8, 17, 20, 29, 32 T15N R8E, Section 5, 8 T14N R8E
Power Plant/FutureGen

PLEASE REFER TO: IHPA LOG #012041106

January 30, 2007

Mr. Ronald Swager
Patrick Engineering, Inc.
300 West Edwards Street, Suite 200
Springfield, Illinois 62704-1907

Dear Sir:

Acre(s): 532 Site(s): 0
Archaeological Contractor: UMA/Finney

Thank you for submitting the results of the archaeological reconnaissance. Our comments are required by Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties".

Our staff has reviewed the archaeological Phase I reconnaissance report performed for the project referenced above. The Phase I survey and assessment of the archaeological resources appear to be adequate. Accordingly, we have determined, based upon this report, that no significant historic, architectural, and archaeological resources are located in the project area.

Please submit a copy of this letter with your application to the state or federal agency from which you obtain any permit, license, grant, or other assistance. Please retain this letter in your files as evidence of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

Sincerely,

Anne E. Haaker

Anne E. Haaker
Deputy State Historic
Preservation Officer

AEH

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A.3 JEWETT

The following agencies sent coordination letters:

- U.S. Fish and Wildlife Service
- Texas Parks and Wildlife Department
- Texas Commission on Environmental Quality
- Texas Historical Commission
- Limestone County Office of Road and Bridge Department
- U.S. Department of Energy
- Bureau of Indian Affairs

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
10711 Burnet Road, Suite 200
Austin, Texas 78758
(512) 490-0057

January 8, 2002

RECEIVED
JAN 10 2002
NWR-JEWETT
ENG/ENV SERVICES

Nellie Frisbee
Northwestern Resources Co.
P.O. Box 915
Jewett, Texas 75846

Consultation #: 2-15-97-F-396

Dear Ms. Frisbee:

This is a response to your letter dated July 30, 2001 requesting that the U.S. Fish and Wildlife Service (Service) concur with your determination that sites DX2, DX4, DX5, M7, and M25 in the 1998-2003 Permit 32E survey area are not suitable habitat for *Spiranthes parksii*. According to the information provided in the 1999 Re-survey Report (Report) for potential *Spiranthes parksii* sites on the Jewett Mine (Mine), sites DX2, DX4, and DX5 were surveyed in 1995 by Hicks and Company, Inc. and in 1997 by Horizon Environmental Services. Although these surveys indicated that *Spiranthes parksii* occurred on two other sites within the DX area (DX1 and DX3), no individuals of this species were found on DX2, DX4, and DX5. The Report also stated that site M7 was surveyed in 1991, 1992, 1993, and 1995 and site M25 was surveyed in 1991, 1992, and 1998. No *Spiranthes parksii* individuals were observed during any of the surveys conducted in these areas.

Although we cannot concur that no suitable habitat exists in the DX2, DX4, DX5, M7 and M25 areas, based on the results of the surveys conducted, the Service has determined that it is unlikely that individuals of *Spiranthes parksii* occur on these sites. Therefore, compensation for these sites is unnecessary.

In a telephone conversation dated December 13, 2001, you requested our concurrence that no further mitigation for sites M43, M44, and M45 were necessary. According to our files, the Service provided this concurrence on April 24, 2000 in response to a letter sent to our office by Horizon Environmental Services, Inc., which was dated April 18, 2000.

Also during the December 13, 2001 telephone conversation, you expressed concern for our acceptance of the "Interior Least Tern 2003 RCT Permit Term Management Plan (Plan) for the Jewett Surface Mine". We consider the Plan, dated July 2001 to be complete and the Mine to be in compliance with the Service's Biological Opinion, dated April 29, 1999. The Plan will serve as the standard operating procedure for managing interior least terns (*Sterna antillarum athalassos*) within the Permit 32E area of the Mine.

cc: Joel
Nellie
File-ous

We would like to commend the Jewett Mine and Northwestern Resources Co. for their continued concern for endangered species and other natural resources. If you have any questions about these comments, please contact Paige Najvar (512) 490-0057, ext. 229.

Sincerely,

for David C. Frederick
Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
10711 Burnet Road, Suite 200
Austin, Texas 78758
(512) 490-0057

January 23, 2002

Patsy Turner
PBS&J
206 Wild Basin Road, Suite 300
Austin, Texas 78746

Consultation #: 2-15-97-F-0396

Dear Ms. Turner:

This is a response to your January 11, 2002 letter requesting that the U.S. Fish and Wildlife Service (Service) provide information regarding federally listed or proposed threatened and endangered species and designated Critical Habitat that may occur in the Jewett Mine Permit 32E area in Leon, Limestone, and Freestone Counties, Texas.

Endangered and Threatened Species
According to our information, the Jewett Mine Permit 32E area is not located within designated Critical Habitat for any federally listed species. The list of federally endangered and threatened species, species proposed for listing, and species of concern that are known to occur in Leon, Limestone, and Freestone Counties is attached to this letter for your review.

Bald Eagle (*Haliaeetus leucocephalus*)--This large, threatened bird of prey, our Nation's symbol, may be found in almost any Texas county during migration. Preferred nesting habitat in Texas is undisturbed coastal regions, or along river systems or lake shores with large, tall (40-120 feet) trees for nesting and roosting. Nests are usually located within 1-2 miles of large bodies of water, such as lakes, reservoirs, or rivers, and are often located in the ecotone or edge between forest and marsh or water. Wintering habitat is characterized by abundant, readily available food sources. Most wintering areas are associated with open water, where eagles feed on fish, waterfowl, and turtles. The closest documented bald eagle sightings to the Jewett Mine Permit 32E area come from nearby Lake Limestone which lies immediately adjacent to the Mine's western permit boundary in Limestone County. Freestone County is within the bald eagles' known wintering range.

Large-Fruited Sand-Verbena (*Abronia macrocarpa*)--This rare plant is a perennial herb that stands up to 20-inches tall. The leaves are usually rounded, and the foliage is sticky from glandular hairs. The magenta flowers are grouped into rounded heads composed of 20-75 individual flowers. As of 1996, approximately 3,000 individuals existed within 3 populations found in Leon, Freestone, and Robertson County. This plant occurs on nearly level to gently sloping terrain within the post-oak savannah region. It is found in deep sandy, well drained soils with no or very light vegetative cover of grasses and colonizing herbaceous species. This species flowers in March through June and occasionally again in the fall following periods of high rainfall. Field investigations conducted on the Mine site in 1992 identified 25 potential habitat areas based on soils and other characteristics. Surveys conducted on these areas during this species' blooming seasons in1992 and 1995 yielded negative results.

Houston toad (*Bufo houstonensis*)--This non-glamorous but important endangered species is currently known to occur in just a handful of counties in east-central Texas. It is a terrestrial amphibian associated with deep sandy soils within the Post Oak Savannah vegetational area. Since it is a poor burrower, it requires loose, friable soils for burrowing in order to seek underground protection from cold winter temperatures and hot, dry summer conditions. Habitat conditions in currently occupied areas consist of pine or oak woodlands or savannahs with large areas of deep sandy soils. These toads require still or slow-flowing bodies of water, such as ephemeral pools, flooded fields, blocked drainages of upper creek reaches, wet areas associated with seeps or springs, or more permanent ponds for breeding and egg and tadpole development. This species has been extirpated from much of its former range in the Houston area due to habitat loss and degradation. Surveys for the Houston toad were conducted at almost 70 potentially suitable habitat areas at the Mine from January 30-April 9, 1992. No Houston toads were found in any of the surveys.

Interior Least Tern (*Sterna antillarum*)-- Interior least terns are the smallest North American terns. They breed inland along the Missouri, Mississippi, Colorado, Arkansas, Red, and Rio Grande River systems. Interior least terns prefer bare or sparsely vegetated sand, shell, and gravel beaches, sandbars, islands, or salt flats associated with rivers and reservoirs for nesting habitat. For feeding, these birds need shallow water with an abundance of small fish. They have been known to use sand and gravel pits, ash disposal areas of power plants, reservoir shorelines, and other manmade sites as natural nesting sites have become scarce. The normal operation of the bucketwheel excavator has created an area suitable for nesting and foraging of interior least terns within the Permit 32E area. This species was first noted in the area in July 1994 and have returned every year since, with the exception of 1998. Northwestern Resources has developed the "Interior Least Tern 2003 RCT Permit Term Management Plan for the Jewett Surface Mine", which will serve as the standard operating procedure for managing interior least terns within the Permit 32E area of the Jewett Mine.

Navasota ladies'- tresses (*Spiranthes parksii*)-- This orchid is an erect, slender-stemmed perennial growing 8-15 inches tall. The linear leaves form a rosette but are absent at the time of flowering. White flowers are arranged spirally on the stalk and have conspicuously white-tipped bracts that appear beneath each flower. Flowers are about one-quarter-of-an-inch long with rounded petals. Side petals have a distinct green stripe and extend past the central petals. The lower central petal is ragged. Buds appear in early to late October, and flowering occurs from mid-October to mid-November. Vegetatively, *Spiranthes* plants are very hard to discern in their habitat, and therefore, surveys are not recommended except during the blooming season. In addition, this species is very similar to two other species that can occur in the same area. Positive identification can only be made during flowering. Blooming is strongly dependent on adequate soil moisture. Navasota ladies'- tresses occur in Brazos, Burleson, Freestone, Fayette, Grimes, Jasper, Leon, Madison, Robertson, and Washington Counties.

Two populations of Navasota ladies'- tresses have been found within the Permit 32E area (sites DX1 and DX3). These occupied sites along with other areas the Service considered potential or supporting habitat sites within the Permit 32E area have been destroyed and compensated by Northwestern Resources with a monetary contribution to the National Fish and Wildlife Foundation to fund habitat conservation in perpetuity for the Navasota ladies'- tresses.

We thank you for your concern for threatened and endangered species and other natural resources. If we can be of further assistance or if you have questions about these comments, please contact Paige Najvar at the Service's Austin Office at (512) 490-0057. Please refer to the Service Consultation listed above in any future correspondence with this office regarding the Jewett Mine Permit 32E area.

Sincerely,

E. Dawn Whitehead

for David C. Frederick
Supervisor

Enclosures

Federally Listed as Threatened and Endangered Species of
Leon, Limestone, & Freestone Counties in Texas
January 18, 2002

DISCLAIMER

This County by County list is based on information available to the U.S. Fish and Wildlife Service at the time of preparation, date on page 1. This list is subject to change, without notice, as new biological information is gathered and should not be used as the sole source for identifying species that may be impacted by a project.

Edwards Aquifer species: (Edwards Aquifer County) refers to those six counties within the Edwards Aquifer region. The Edwards Aquifer underlies portions of Kinney, Uvalde, Medina, Bexar, Hays, and Comal Counties (Texas). The Service has expressed concern that the combined current level of water withdrawal for all consumers from the Edwards Aquifer adversely affects aquifer-dependent species located at Comal and San Marcos springs during low flows. Deterioration of water quality and/or water withdrawal from the Edwards Aquifer may adversely affect eight federally-listed species.

Comal Springs riffle beetle	(E)	*Heterelmis comalensis*
Comal Springs dryopid beetle	(E)	*Stygoparnus comalensis*
Fountain darter	(E w/CH)	*Etheostoma fonticola*
Peck's cave amphipod	(E)	*Stygobromus (=Stygonectes) pecki*
San Marcos gambusia	(E w/CH)	*Gambusia georgei*
Texas wild-rice	(E w/CH)	*Zizania texana*
Texas blind salamander	(E)	*Typhlomolge rathbuni*
San Marcos salamander	(T □w/CH)	*Eurycea nana*

* The Barton Springs salamander is found in Travis County but may be affected by activities within the Barton Springs Segment of the Edwards Aquifer, which includes portions of Northern Hays County.

Migratory Species Common to many or all Counties: Species listed specifically in a county have confirmed sightings. If a species is not listed they may occur as migrants in those counties.

Least tern	(E ~)	*Sterna antillarum*
Whooping crane	(E w/CH)	*Grus americana*
Bald eagle	(T)	*Haliaeetus leucocephalus*
Piping plover	(T w/P/CH)	*Charadrius melodus*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
White-faced ibis	(SOC)	*Plegadis chihi*

Leon County

Least tern	(E ~)	*Sterna antillarum*
Houston toad	(E w/CH)	*Bufo houstonensis*
Large-fruited sand-verbena	(E)	*Abronia macrocarpa*
Navasota ladies'-tresses	(E)	*Spiranthes parksii*
Bald eagle	(T)	*Haliaeetus leucocephalus*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
Bachman's sparrow	(SOC)	*Aimophila aestivalis*
Alligator snapping turtle	(SOC)	*Macroclemys temmincki*
Texas horned lizard	(SOC)	*Phrynosoma cornutum*

Golden wave tickseed	(SOC)	*Coreopsis intermedia*
Small-headed pipewort	(SOC)	*Eriocaulon kornickianum*
Umbrella sedge	(SOC)	*Cyperus grayioides*

Limestone County

Bald eagle	(T)	*Haliaeetus leucocephalus*
Least tern	(E ~)	*Sterna antillarum*
Mountain plover	(P/T)	*Charadrius montanus*
Bachman's sparrow	(SOC)	*Aimophila aestivalis*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
Texas horned lizard	(SOC)	*Phrynosoma cornutum*
Rough-seeded flameflower	(SOC)	*Talinum rugospermum*
Small-headed pipewort	(SOC)	*Eriocaulon kornickianum*

Freestone County

Least tern	(E ~)	*Sterna antillarum*
Large-fruited sand-verbena	(E)	*Abronia macrocarpa*
Navasota ladies'-tresses	(E)	*Spiranthes parksii*
Bald eagle	(T)	*Haliaeetus leucocephalus*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
White-faced ibis	(SOC)	*Plegadis chihi*
Alligator snapping turtle	(SOC)	*Macroclemys temmincki*
Texas garter snake	(SOC)	*Thamnophis sirtalis annectans*
Texas horned lizard	(SOC)	*Phrynosoma cornutum*
Golden wave tickseed	(SOC)	*Coreopsis intermedia*
Small-headed pipewort	(SOC)	*Eriocaulon kornickianum*
Umbrella sedge	(SOC)	*Cyperus grayioides*
Warner's hawthorn	(SOC)	*Crataegus warneri*

INDEX

Statewide or areawide migrants are not included by county, except where they breed or occur in concentrations. The whooping crane is an exception; an attempt is made to include all confirmed sightings on this list.

E	=	Species in danger of extinction throughout all or a significant portion of its range.
T	=	Species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
C	=	Species for which the Service has on file enough substantial information to warrant listing as threatened or endangered.
CH	=	Critical Habitat (in Texas unless annotated ‡)
P/	=	Proposed ...
P/E	=	Species proposed to be listed as endangered.
P/T	=	Species proposed to be listed as threatened.
TSA	=	Threatened due to similarity of appearance.
SOC	=	Species for which there is some information showing evidence of vulnerability, but not enough data to support listing at this time. These species are afforded no formal protection under the Endangered Species Act of 1973, as amended, but may be protected under other state or federal laws.
☐	=	with special rule

‡ = CH designated (or proposed) outside Texas

~ = protection restricted to populations found in the "interior" of the United States. In Texas, the least tern receives full protection, except within 50 miles (80 km) of the Gulf Coast.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
10711 Burnet Road, Suite 200
Austin, Texas 78758
(512) 490-0057

RECEIVED
JUN 26 2002
NWR-JEWETT
ENG/ENV SERVICES

June 20, 2002

Bonnie Lister
PBS&J
206 Wild Basin Road, Suite 300
Austin, Texas 78746

Consultation #:2-15-02-F-0214

Dear Ms. Lister:

This responds to your April 2, 2002 letter requesting that the U.S. Fish and Wildlife Service (Service) concur with your determination that sites M3/HC21, M5, M30, HC11a, HC12, HC18, HC28, and HC29 within the Jewett Mine Permit 47 survey area are unlikely to contain Navasota ladies'-tresses (*Spiranthes parksii*), and that sites M2/HC20, M16, M36, HC13, and HC23 are not suitable habitat for this plant species. According to the information provided in the 2001 Survey Report for potential *Spiranthes parksii* sites on the Jewett Mine, these thirteen sites were surveyed in three or more years.

Although we cannot concur that no suitable habitat exists in the M2/HC20, M16, M36, HC13, and HC23 areas, based on the results of the surveys conducted on each of the thirteen above mentioned sites, the Service has determined that it is unlikely that individuals of *Spiranthes parksii* occur on these sites. Therefore, we concur that additional surveys on these sites are unnecessary.

Your letter also states that Northwestern Resources Co. (Northwestern) wishes to provide monetary compensation for two sites (M28 and M41) that appear to have been altered either directly or indirectly by mining activities prior to the performance of a sufficient number of Navasota ladies'-tresses surveys. Northwestern would like to compensate for a total of 7.0 acres of potential habitat at sites M28 and M41 at a ratio of 3/4:1 at fair market value. Although an estimated contribution of $8,855 was suggested in your letter, we calculated that a contribution of $6,641.25 would be consistent with a compensation ratio of 3/4:1. Payments should be made to the National Fish and Wildlife Foundation for *Spiranthes parksii* habitat conservation initiatives.

We would like to commend the Jewett Mine and Northwestern Resources Co. for their continued concern for endangered species and other natural resources. If you have any questions about these comments, please contact Paige Najvar (512) 490-0057, ext. 229.

Sincerely,

for William Seawell
Acting Field Supervisor

cc: Joel
Nellie
Dave Simpson

FILE COPY

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
10711 Burnet Road, Suite 200
Austin, Texas 78758
(512) 490-0057

March 31, 2003

Kathy Calnan
PBS&J
206 Wild Basin Road, Suite 300
Austin, Texas 78746

Consultation #: 2-15-02-F-0214

Dear Ms. Calnan:

This responds to your March 12, 2003, letter requesting that the U.S. Fish and Wildlife Service (Service) concur with your determination that sites M6/HC24, M9/HC8, M10/HC7, M11/HC6, M13, M15/HC5, M17/HC4, M34, M35, M39, HC3, HC10, and HC11 within the Jewett Mine Permit 32E and 47 survey area are unlikely to contain Navasota ladies'-tresses (*Spiranthes parksii*), and that sites M29, M32, M40, M14, M23, M48, M49, M18, and M37 are not suitable habitat for this plant species. According to the information provided in the 2002 Survey Report for potential *Spiranthes parksii* sites on the Jewett Mine, these twenty-two sites were surveyed in three or more years, with the exception of sites M29, M32, and M40.

Although we cannot concur that no suitable habitat exists in the M29, M32, M40, M14, M23, M48, M49, M18, and M37 areas, based on the results of the surveys conducted on each of the twenty-two above mentioned sites, the Service has determined that it is unlikely that individuals of *Spiranthes parksii* occur on these sites. We agree with Horizon that one year of surveys is sufficient to demonstrate probable absence for sites M29, M32, and M40. Therefore, we concur that additional surveys on these sites are unnecessary.

Your letter also states that Northwestern Resources Co. (Northwestern) wishes to provide monetary compensation for one site (M12) that appears to have been altered either directly or indirectly by mining activities prior to a sufficient number of Navasota ladies'- tresses surveys. Northwestern would like to compensate for a total of 7.6 acres of potential habitat at site M12 at a ratio of 3/4:1 at fair market value. Although an estimated contribution of $7,211.50 was suggested in your letter, we calculated that a contribution of $7,210.50 would be consistent with the compensation ratio agreed upon for this site. We agree that total compensation of $7,210.50 is sufficient to offset potential impacts at site M12.

Northwestern also proposes to compensate for impacts to known existing habitat for Navasota ladies'-tresses at sites M1/HC1 (including M1/HC1/HC20), M4/HC22a, and M4/HC22b. We agree that the total compensation for these three sites of $34,155.00 is sufficient to offset potential impacts to this species.

We concur that total compensation to be made to the National Fish and Wildlife Foundation for *Spiranthes parksii* habitat conservation initiatives equaling $41,366.50 is sufficient to offset incidental impacts to Navasota ladies'-tresses due to mine construction activities.

Thank you for you continued concern for endangered species and other natural resources. If you have any questions about these comments, please contact Jana Milliken (512) 490-0057, extension 243.

Sincerely,

E Dawn Whitehead

for Robert T. Pine
Supervisor

cc: Joel
Nellie
Dave Simpson
File

United States Department of the Interior

FISH AND WILDLIFE SERVICE
10711 Burnet Road, Suite 200
Austin, Texas 78758
512 490-0057

JAN 2 0 2004

Shannon Dorsey
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, Texas 78716

Consultation #: 2-15-02-F-0214

Dear Mr. Dorsey:

This responds to your December 23, 2003, request that the U.S. Fish and Wildlife Service (Service) concur with your review of potential Navasota ladies'-tresses (*Spiranthes parksii*) habitat sites in advance of mining as agreed in our 1999 and 2002 consultations for the Northwestern Resources Company (Northwestern) Jewett Mine (Mine) in Freestone, Limestone, and Leon counties, Texas.

According to the information provided in the 2003 Horizon Survey Report for potential Navasota ladies'-tresses sites on the Mine, site M38 (within the Permit 32E area) was surveyed for four seasons (1991, 1992, 2002, and 2003); site HC9 (within the Permit 47 area) was surveyed for five seasons (1993, 1994, 1995, 2002, and 2003); and PBS&J 1 and 2 (within the newly acquired 162-acre (66-hectare) study area) were surveyed for two seasons (2002 and 2003). We agree that all survey seasons listed above (except 1993) had the appropriate climatic conditions for determining presence/absence of Navasota ladies'-tresses.

You determined that sites M38, and sites PBS&J 1 and 2 are unlikely to support the endangered Navasota ladies'-tresses. Although we cannot concur that no suitable habitat exists in the M38 and PBS&J 1 and 2 areas, based on the results of the surveys and site-specific conditions, the Service believes it is unlikely that Navasota ladies'-tresses occur on these sites. Therefore, we concur that additional surveys are unnecessary and no further action is necessary for impacts to these sites.

We understand that two small groups of Navasota ladies'-tresses were discovered in the vicinity of the HC9 survey area in 2002 by PBS&J biologists. These two groups are located approximately 300 to 400 feet (91 to 122 meters) south/southwest of the original HC9 survey area, based on approximate geographic coordinates and site descriptions provided by the PBS&J. They are identified as HC9 sites A, B, C, and D, and each site is approximately 0.06 acres (0.02 hectares) in size. It is unclear exactly which site (A, B, C, or D) the two groups were found on, or how many individual plants were identified. No

Navasota ladies'-tresses were found at the original HC9 site. Northwestern wishes to provide monetary compensation for sites A, B, C, and D, pursuant to the ratios agreed to in the Service's Biological Opinions for Permit 32E area (April 29, 1999) and Permit 47 Area (May 2, 2002). Northwestern wants to compensate for the 0.25 acres (0.1 hectares) of occupied habitat at a ratio of 2:1 at fair market value. In addition, Northwestern would like to compensate for a total of 0.5 acres (0.2 hectares) of supporting habitat at ratio of 1:1. We agree that a contribution of $1,265.00 would be consistent with the compensation ratio agreed upon for this site and is sufficient to offset potential impacts at site HC9. No further surveys are necessary for this site. We request receipt of payment to the National Fish and Wildlife Foundation prior to disturbance activities on this site.

Thank you for you continued concern for endangered species and other natural resources. If you have any questions about these comments, please contact Jana Milliken (512) 490-0057, extension 243.

Sincerely,

Robert T. Pine
Supervisor

cc: Richard Lowe, U.S. Army Corps of Engineers
Rob Blair, Railroad Commission of Texas
Nellie Frisbee, Northwestern Resources

United States Department of the Interior

FISH AND WILDLIFE SERVICE
10711 Burnet Road, Suite 200
Austin, Texas 78758
512 490-0057
FAX 490-0974

OCT 20 2006

Mr. James Wiersema
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, Texas 78716

Consultation Number 21450-2007-TA-0024

Dear Mr. Wiersema:

This is in response to your letter dated October 6, 2006, requesting review on the proposed site locations for the FutureGen project. Your conversation with my staff on October 16, 2006, clarified the level of review you were requesting. Our review did not result in any additional information other than that obtained from our web site (see below for address). Enclosed is a list of the U.S. Fish and Wildlife Service (Service) threatened and endangered species by county that the FutureGen project may impact if implemented. This list is organized by the counties you have indicated as potential sites for the project. We are providing this information to assist you in assessing and avoiding impacts to federally listed threatened and endangered species, their habitat, and designated wetlands. Further consultation with us may be necessary should this project go forward.

Federally listed species

The proposed project site is not located within designated critical habitat of any federally listed threatened or endangered species. You may access a list of federally listed or proposed species by county of occurrence in Texas at http://ifw2es.fws.gov/EndangeredSpecies/lists/. A searchable database with information related to the life history and ecology of each of these species can be found at http://endangered.fws.gov/.

Generally, the Service believes that the first step in determining impacts to endangered species is presence/absence surveys conducted within the project area by persons with appropriate biological expertise. Often, absence of endangered species is determined and the project can then proceed without additional responsibilities under the Endangered Species Act of 1973, as amended (Act). If assessments indicate that suitable habitat is likely to be affected either directly or indirectly, we recommend that you consult with us further. If any endangered species or their habitats are present, the project can often be modified to avoid all impacts. Please send any completed surveys or habitat assessments to our office for assistance in evaluating potential effects.

If impacts cannot be avoided, we recommend the Department of Energy (DOE) pursue formal consultation through section 7 of the Act. Section 7 requires that all Federal agencies consult with the Service to ensure that the actions authorized, funded, or carried out by such agencies do not jeopardize the continued existence of any threatened or endangered species or adversely modify or destroy critical habitat of such species. It is the primary responsibility of DOE, as the Federal action agency, to determine whether any action it authorizes, funds, or carries out may affect a federally listed or proposed species.

Candidate Species

We also recommend that you review the potential for your project to affect candidates. Candidate species are those that are being considered for possible addition to the threatened and endangered species list. There is sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but higher priority listings currently preclude issuance of a proposed rule for those species. Candidate species currently have no legal protection. If you find your project may potentially impact these species, the Service would like to provide technical assistance to help avoid or minimize adverse effects. Addressing these species at this stage could better provide for overall ecosystem health in the local area and may avert potential future listing.

State-listed species

The State of Texas also protects certain species of plants and animals. Contact the Texas Parks and Wildlife Department (Endangered Resources Branch), Fountain Park Plaza Building, Suite 100, 3000 South IH-35, Austin, Texas 78704 (512-912-7011) for information concerning fish, wildlife, and plants of State concern.

Wetlands and Native Habitats

If your project will involve filling, dredging, or trenching of a wetland or riparian area it may require a Section 404 permit from the U.S. Army Corps of Engineers. For permitting requirements under Section 404 of the Clean Water Act, please contact the Fort Worth District, Permits Section, CESWF-EV-0, P.O. Box 17300, Fort Worth, Texas, 76102-0300, 817-978-2681.

Wetlands and riparian zones provide valuable fish and wildlife habitat as well as contribute to flood control, water quality enhancement, and groundwater recharge. Wetland and riparian vegetation provides food and cover for wildlife, stabilizes banks, and decreases soil erosion. These areas are inherently dynamic and very sensitive to changes caused by such activities as overgrazing, logging, major construction, or earth disturbance. Construction activities near such areas should be carefully designed to minimize impacts. If vegetation clearing is needed in riparian areas, these areas should be revegetated with native wetland and riparian vegetation to prevent erosion or loss of habitat. We recommend minimizing the area of soil scarification and initiating incremental reestablishment of herbaceous vegetation at the proposed work sites. Denuded and/or disturbed areas should be revegetated with a mixture of native legumes and grasses. Species commonly used for soil stabilization are listed in the Texas Department of Agriculture's (TDA) Native Tree and Plant Directory, available from TDA at P.O. Box 12847, Austin, Texas, 78711.

We also urge you to take all precautions to ensure sediment loading does not occur to receiving streams in the project area. To prevent and/or minimize soil erosion and compaction associated with construction activities, avoid any unnecessary clearing of vegetation, and follow established rights-of-way whenever possible. All machinery and petroleum products should be stored outside the floodplain and/or wetland area during construction to prevent possible contamination of water and soils. No permanent structures should be placed in the 100-year floodplain.

We thank you for your concern for endangered and threatened species and other natural resources, and we appreciate the opportunity to comment on the proposed project. If we can be of further assistance or answer questions about these comments, please contact William Amy at 512-490-0057, extension 234. Please refer to the Service Consultation number listed above in any future correspondence regarding this project.

Sincerely,

Robert T. Pine
Supervisor

Enclosures

Federally Listed as Threatened and Endangered Species of Texas
September 27, 2006

This list represents species that may be found in counties throughout the Austin Ecological Services office's area of responsibility. Please contact the Austin ES office (U.S. Fish and Wildlife Service, 10711 Burnet Rd., Suite 200, Austin, Texas 78758, 512/490-0057) if additional information is needed.

DISCLAIMER

This list is based on information available to the U.S. Fish and Wildlife Service at the time of preparation. This list is subject to change, without notice, as new biological information is gathered and should not be used as the sole source for identifying species that may be impacted by a project.

Migratory Species Common to many or all Counties: Species listed specifically in a county have confirmed sightings. If a species is not listed they may occur as migrants in those counties.

Least tern	(E ~)	*Sterna antillarum*
Whooping crane	(E w/CH)	*Grus americana*
Bald eagle	(T)	*Haliaeetus leucocephalus*
Piping plover	(T w/CH)	*Charadrius melodus*

Andrews County

Sand dune lizard	(C)	*Sceloporus arenicolus*

Freestone County

Least tern	(E ~)	*Sterna antillarum*
Large-fruited sand-verbena	(E)	*Abronia macrocarpa*
Navasota ladies'-tresses	(E)	*Spiranthes parksii*
Bald eagle	(T)	*Haliaeetus leucocephalus*

Leon County

Least tern	(E ~)	*Sterna antillarum*
Houston toad	(E w/CH)	*Bufo houstonensis*
Large-fruited sand-verbena	(E)	*Abronia macrocarpa*
Navasota ladies'-tresses	(E)	*Spiranthes parksii*
Bald eagle	(T)	*Haliaeetus leucocephalus*

Limestone County

Bald eagle	(T)	*Haliaeetus leucocephalus*
Least tern	(E ~)	*Sterna antillarum*
Navasota ladies'-tresses (E) *Spiranthes parksii*		

Pecos County

Black-capped vireo	(E)	*Vireo atricapilla*
Pecos gambusia	(E)	*Gambusia nobilis*
Leon Springs pupfish	(E w/CH)	*Cyprinodon bovinus*
Pecos (=puzzle) sunflower	(T)	*Helianthus paradoxus*
Pecos assiminea snail	(E w/CH)	*Assiminea pecos*
DiamondY Spring snail	(C)	*Tryonia adamantina*
Gonzales springsnail	(C)	*Tryonia stocktonensis*

Winkler County

Sand dune lizard	(C)	*Sceloporus arenicolus*

INDEX

E	=	Species in danger of extinction throughout all or a significant portion of its range.
T	=	Species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
C	=	Species for which the Service has on file enough substantial information to warrant listing as threatened or endangered. These species currently have no legal protection. However, addressing these species at this stage could better provide for overall ecosystem health in the local area and may avert potential future listing.
CH	=	Critical Habitat (in Texas unless annotated ‡)
P/	=	Proposed ...
P/E	=	Species proposed to be listed as endangered.
P/T	=	Species proposed to be listed as threatened.
TSA	=	Threatened due to similarity of appearance. Protections of the Act, such as consultation requirements for Federal agencies under section 7, and recovery planning provisions under section 4(f), do not apply to species listed under similarity of appearance provisions.
□	=	with special rule
‡	=	CH designated (or proposed) outside Texas

~ = protection restricted to populations found in the "interior" of the United States. In Texas, the least tern receives full protection, except within 50 miles (80 km) of the Gulf Coast.

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January 23, 2002

TEXAS PARKS & WILDLIFE

Ms. Patsy Turner, Sr. Staff Ecologist
PBS&J
206 Wild Basin Road, Suite 300
Austin, Texas 78746

Dear Ms. Turner:

This letter is in response to your request, dated January 11, 2002, for confirmation that the most recent information on rare and threatened and endangered (T&E) species was collected from our maps by Bonnie Lister on January 4, 2002.

The current revision date for the County Lists of Rare Resources for Freestone, Leon, and Limestone counties is still 8/26/99, the same Revised Date appearing on the lists when copied by Bonnie. Without being able to see the maps and notes prepared by Bonnie, I can only use the list of occurrence printouts you noted to me by fax; however, general "Houston Toad habitat" notations on our maps will not have any accompanying printouts. After reviewing the list of rare resources noted from the 7.5' topographic quadrangles of interest (Donie, Farrar, Dew, Jewett, Buffalo, Round Prairie, and Lanely), I found that "Houston Toad habitat" in general should be noted on all the quads. This may have been noted by Bonnie on your maps, but since there is no accompanying printout you may not have included this notation with the list of printouts you supplied me. The Lanely quad had a record of Coreopsis intermedia, but this plant is not a listed species and the printout likely not collected, based on your parameters of getting printouts for only listed species. On your fax, you note on the Lanely quad "Bufo houstonensis habitat" but do not separately note the documented occurrence of Bufo houstonensis (Houston Toad) appearing on that quad. This may simply be semantics, but a record of occurrence for Houston Toad (printout attached) and general Houston Toad habitat both appear on the Lanely quad.

While data depicted on our maps represents the most recent public information available and processed into the data system, the following disclaimer still applies:

To manage and conserve the natural and cultural resources of Texas for the use and enjoyment of present and future generations.

Given the small proportion of public versus private land in Texas, the TPWD Biological and Conservation Data System (BCD) does not include a representative inventory of rare resources in the state. Although it is based on the best data **available** to TPWD regarding rare species, the data from the BCD do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in your project area. These data cannot substitute for an on-site evaluation by your qualified biologists. The BCD information is intended to assist you in avoiding harm to species that may occur on your site.

I hope this fulfills your need for confirmation of collection of the most recent information available on January 4, 2002, and apparently remains current today, January 23, 2002.

Sincerely,

Dorinda Scott

Dorinda Scott, Information System Manager
Texas Biological and Conservation Data System
Wildlife Diversity Branch, Wildlife Division

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us

Enclosure

N. .: BUFO HOUSTONENSIS
COMMON NAME: HOUSTON TOAD
OTHER NAME:
FEDERAL STATUS: LE
GLOBAL RANK: G1
IDENTIFIED: Y TRACK: Y
COUNTY: Freestone

STATE STATUS: E
STATE RANK: S1
SENSITIVITY:

USGS TOPO MAPS:
LANELY

TOPO QUAD: 3109651
MARGIN #: 3

ELEMENT OCCURRENCE NUMBER: 016
PRECISION: S
OCCURRENCE RANK:
SURVEY COMMENTS:

DATE LAST OBSERVED: 1990-10-16
DATE FIRST OBSERVED: 1990
DATE SURVEYED: 1990-10-16

MANAGED AREAS:

CONTAINED:

DIRECTIONS:
APPROXIMATELY 8 KILOMETERS SOUTH AND 5 KILOMETERS EAST OF LANELY BY COUNTY ROADS, EAST SIDE OF COUNTY ROAD AND EAST SIDE OF TRIANGLE DRIVEWAY

DESCRIPTION:
POST-OAK AND SANDJACK WOODLAND

QUALITATIVE/QUANTITATIVE DATA:

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:
A SINGLE FEMALE TAKEN AT 1215 HOURS; SPECIMEN PRESERVED (TO BE DEPOSITED AT TMM) AFTER H, L, K, M TISSUES TAKEN FOR ELECTROPHORESIS

SOURCE OF INFORMATION:
YANTIS, JAMES H. 1990. PERSONAL COMMUNICATION.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
12 FEB 2002

NAME: ABRONIA MACROCARPA
COMMON NAME: LARGE-FRUITED SAND-VERBENA
OTHER NAME:
FEDERAL STATUS: LE
STATE STATUS: E
GLOBAL RANK: G2
STATE RANK: S2
IDENTIFIED: Y
TRACK: Y
SENSITIVITY:
COUNTY: Leon

USGS TOPO MAPS: ROUND PRAIRIE
TOPO QUAD: 3109633
MARGIN #: 1

ELEMENT OCCURRENCE NUMBER: 004
PRECISION: S
OCCURRENCE RANK:
DATE LAST OBSERVED: 1994
DATE FIRST OBSERVED: 1994
DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS:
CONTAINED:

DIRECTIONS:
1.4 MILES NORTH ON HIGHWAY 1146 FROM THE JUNCTION OF HIGHWAY 1146 AND UNNAMED EASTBOUND COUNTY ROAD IN LONG HOLLOW; PLANTS CA. 1300 FEET EAST OF ROAD

DESCRIPTION:

QUALITATIVE/QUANTITATIVE DATA:
100 PLANTS

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:
YANTIS, JIM. NO DATE. ROUTE 1, BOX 611, HEARNE, TEXAS 77859; 409/279-2048.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
12 FEB 2002

NAME: ABRONIA MACROCARPA
COMMON NAME: LARGE-FRUITED SAND-VERBENA
OTHER NAME:
FEDERAL STATUS: LE — STATE STATUS: E
GLOBAL RANK: G2 — STATE RANK: S2
IDENTIFIED: Y — TRACK: Y — SENSITIVITY:
COUNTY: Freestone

USGS TOPO MAPS: LANELY
TOPO QUAD: 3109651
MARGIN #: 3

ELEMENT OCCURRENCE NUMBER: 003
DATE LAST OBSERVED: 1996-04
PRECISION: S
DATE FIRST OBSERVED: 1990
OCCURRENCE RANK:
DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS:
CONTAINED:

DIRECTIONS:
5.5 MILES SOUTH OF LANELY, TEXAS ON COUNTY ROAD 1848, THEN 2.8 AIR MILES EAST OF CONCORD

DESCRIPTION:
OPEN SAND FIELD WITH LIGHT COVER OF SLENDER THREE-AWN GRASS (ARISTIDA LONGESPICA); FLAT SAND, NOT DUNE SAND

QUALITATIVE/QUANTITATIVE DATA:
PERSONAL COMMUNICATION FROM JIM YANTIS; "THOUSANDS OF PLANTS"; 1996, ESTIMATED POPULATION 3000-4000

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:
THREATENED BY CONVERSION TO COASTAL BERMUDA (CYNODON DACTYLON); IN GENETIC STUDY, 5 SUBPOPULATIONS SAMPLED (10 INDIVIDUALS EACH)

SOURCE OF INFORMATION:
YANTIS, JAMES H. 1990. PERSONAL COMMUNICATION. TEXAS PARKS & WILDLIFE DEPARTMENT, ROUTE 1, BOX 611, HEARNE, TEXAS 77859, PHONE: 409/279-2048.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
12 FEB 2002

NAME: HALIAEETUS LEUCOCEPHALUS
COMMON NAME: BALD EAGLE
OTHER NAME:
FEDERAL STATUS: LT-PDL
STATE STATUS: T
GLOBAL RANK: G4
STATE RANK: S3B,S3N
IDENTIFIED: Y
TRACK: Y
SENSITIVITY: Y
COUNTY: Limestone

USGS TOPO MAPS:	TOPO QUAD:	MARGIN #:
FARRAR	3109643	1

ELEMENT OCCURRENCE NUMBER: 026
DATE LAST OBSERVED: 1990
PRECISION: G
DATE FIRST OBSERVED: 1981
OCCURRENCE RANK:
DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS:
CONTAINED:

DIRECTIONS:
LIMESTONE RESERVOIR, LIMESTONE COUNTY

DESCRIPTION:
LAKE SHORE, FORESTED

QUALITATIVE/QUANTITATIVE DATA:
NEST #147-1A: 1982-1983 INACTIVE, 1984 NEST FELL; NEST #147-1B: 1987-1989 INACTIVE, 1990 NEST FELL

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:
MITCHELL, MARK. 1997. MEMO TO SHANNON BRESLIN OF 30 JULY 1997 PROVIDING BALD EAGLE NESTING DATA, INCLUDING COUNTY MAPS WITH ESTIMATED TERRITORIES.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
12 FEB 2002

NAME: HALIAEETUS LEUCOCEPHALUS
COMMON NAME: BALD EAGLE
OTHER NAME:
FEDERAL STATUS: LT-PDL — STATE STATUS: T
GLOBAL RANK: G4 — STATE RANK: S3B,S3N
IDENTIFIED: Y — TRACK: Y — SENSITIVITY: Y
COUNTY: Robertson
Leon

USGS TOPO MAPS: ROUND PRAIRIE
TOPO QUAD: 3109633
MARGIN #: 2

ELEMENT OCCURRENCE NUMBER: 041 — DATE LAST OBSERVED: 1999
PRECISION: S — DATE FIRST OBSERVED: 1994
OCCURRENCE RANK: — DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS: — CONTAINED:

DIRECTIONS:
NORTHEAST OF ROUND PRAIRIE

DESCRIPTION:

QUALITATIVE/QUANTITATIVE DATA:
ONE BALD EAGLE NEST, WITH NESTING BALD EAGLES IN 1994; NEST #198-3A: 1994 ACTIVE NEST PRODUCED 2 YOUNG, 1995 ACTIVE NEST PRODUCED 3 YOUNG, 1996-1997 ACTIVE NEST PRODUCED 2 YOUNG, 1998 ACTIVE NEST PRODUCED 3 YOUNG, 1999 ACTIVE NEST PRODUCED 2 YOUNG

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:
THE MARATHON OIL COMPANY HAS CHOSEN AN ALTERNATIVE SITE FOR ITS OPERATION; THE NEW SITE IS OUTSIDE THE ONE-MILE MANAGEMENT ZONE FOR THE NESTING BALD EAGLES; TPWD NEST #198-3A

SOURCE OF INFORMATION:
MITCHELL, MARK. 1999. PROJECT NO. 30: BALD EAGLE NEST SURVEY AND MANAGEMENT. PERFORMANCE REPORT. AUGUST 31, 1999.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
12 FEB 2002

NAME: SPIRANTHES PARKSII
COMMON NAME: NAVASOTA LADIES'-TRESSES
OTHER NAME:
FEDERAL STATUS: LE — STATE STATUS: E
GLOBAL RANK: G3 — STATE RANK: S3
IDENTIFIED: Y — TRACK: Y — SENSITIVITY:
COUNTY: Freestone

USGS TOPO MAPS: DONIE — TOPO QUAD: 3109642 — MARGIN #: 2

ELEMENT OCCURRENCE NUMBER: 097 — DATE LAST OBSERVED: 1991
PRECISION: S — DATE FIRST OBSERVED:
OCCURRENCE RANK: — DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS: — CONTAINED:

DIRECTIONS:
CA. 2600 FEET (BY AIR) NORTH OF STATE ROUTE 164, CA. 4.3 ROAD MILES EAST OF RAILROAD TRACKS ON EAST SIDE OF DONIE; JUST SOUTHWEST OF TANK MARKED ON TOPO; ALSO ON NORTHWEST SIDE OF DRAIN ON WEST SIDE OF SAME TANK

DESCRIPTION:
OPENING IN POST OAK WOODLAND; ALSO ON SEEP ZONE ON SOUTHWEST SIDE OF TANK, WHERE IT OCCURS WITH ERIOCAULON SP., ETC.

QUALITATIVE/QUANTITATIVE DATA:
28 PLANTS SEEN BY SEVERINSON IN 1991; THREE GROUPS OF 3 PLANTS EACH ON NORTHWEST SIDE OF DRAIN - TYPICAL; 19 PLANTS IMMEDIATELY SOUTHWEST OF TANK ON SEEPAGE SLOPE WITH ERIOCAULON; ERIOCAULON KOERNICKIANUM AT 400 FEET NEARBY

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:
SEVERINSON, D. 1992. PERSONAL COMMUNICATION. CONVERSATION WITH J. POOLE AND W.R. CARR, 29 JANUARY 1992.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
30 JAN 2002

NAME: CYPERUS GRAYIOIDES
COMMON NAME: MOHLENBROCK'S UMBRELLA-SEDGE
OTHER NAME:
FEDERAL STATUS: STATE STATUS:
GLOBAL RANK: G3 STATE RANK: S3
IDENTIFIED: Y TRACK: W SENSITIVITY:
COUNTY: Freestone

USGS TOPO MAPS: DONIE
TOPO QUAD: 3109642
MARGIN #: 1

ELEMENT OCCURRENCE NUMBER: 011
PRECISION: S
OCCURRENCE RANK:
SURVEY COMMENTS:
DATE LAST OBSERVED: 1988-07-11
DATE FIRST OBSERVED:
DATE SURVEYED: 1988-07-11

MANAGED AREAS:
CONTAINED:

DIRECTIONS:
JUST NORTH OF OLD ZION CEMETERY, CA. 0.4 MILE SOUTH OF TX164 AT A POINT 6.2 MILES WEST OF BUFFALO (LEON COUNTY) ALONG HEADWATERS OF RENA BRANCH

DESCRIPTION:
SANDHILL WOODLAND-BARRENS

QUALITATIVE/QUANTITATIVE DATA:

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:
ORZELL #7347 (ILL, NCU, SMU, TEX)

SOURCE OF INFORMATION:
BRIDGES, E.L. AND S.L. ORZELL. 1989. ADDITIONS AND NOTEWORTHY VASCULAR PLANT COLLECTIONS FROM TEXAS AND LOUISIANA, WITH HISTORICAL, ECOLOGICAL, AND GEOGRAPHIC NOTES. PHYTOLOGIA 66(1):12-69.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
30 JAN 2002

NAME: COREOPSIS INTERMEDIA
COMMON NAME: GOLDEN WAVE TICKSEED
OTHER NAME:
FEDERAL STATUS: | STATE STATUS:
GLOBAL RANK: G3 | STATE RANK: S3
IDENTIFIED: Y | TRACK: W | SENSITIVITY:
COUNTY: Leon

USGS TOPO MAPS:	TOPO QUAD:	MARGIN #:
DONIE	3109642	3

ELEMENT OCCURRENCE NUMBER: 030 | DATE LAST OBSERVED: 1989-06-08
PRECISION: S | DATE FIRST OBSERVED:
OCCURRENCE RANK: | DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS: | CONTAINED:

DIRECTIONS:
JUST NORTH OF GRAVEL ROAD CROSSING OF NEEDHAM MARSH BRANCH, 3.5 MILES NORTH OF U.S. 79 AT JEWETT VIA DIVISION STREET

DESCRIPTION:
XERIC BLUEJACK OAK-POST OAK SANDHILL WOODLANDS/SAND BARRENS; GEOLOGY - CARRIZO SAND (EOCENE)

QUALITATIVE/QUANTITATIVE DATA:

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:
ORZELL, S.L. AND E.L. BRIDGES. (#10502). 1989. SPECIMEN # NONE TEX-LL.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
30 JAN 2002

NAME: COREOPSIS INTERMEDIA
COMMON NAME: GOLDEN WAVE TICKSEED
OTHER NAME:
FEDERAL STATUS:
GLOBAL RANK: G3
IDENTIFIED: Y TRACK: W
COUNTY: Freestone

STATE STATUS:
STATE RANK: S3
SENSITIVITY:

USGS TOPO MAPS:
DONIE

TOPO QUAD: 3109642
MARGIN #: 4

ELEMENT OCCURRENCE NUMBER: 036
PRECISION: S
OCCURRENCE RANK: B

DATE LAST OBSERVED: 1995-08-19
DATE FIRST OBSERVED: 1995-08-19
DATE SURVEYED: 1995-08-19

SURVEY COMMENTS:

MANAGED AREAS:

CONTAINED:

DIRECTIONS:
FROM JUNCTION OF STATE ROUTES 80 AND 164 AT DONIE, GO EAST 4.5 MILES ON 164, PLANTS ON NORTH SIDE OF ROAD

DESCRIPTION:
ROADSIDE FLAT SANDHILL; BLUEJACK OAK-POSTOAK-BLACKJACK OAK; RIGHT-OF-WAY AND ADJACENT LAND

QUALITATIVE/QUANTITATIVE DATA:
< 100 PLANTS IN FLOWER AND FRUIT ON 19 AUGUST 1995

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:
SINGHURST, JASON RAY. 1996. MASTER'S THESIS. THE STATUS OF NINE ENDANGERED PLANTS OF EAST TEXAS: HISTORICAL, ECOLOGICAL, AND PHYTOGEOGRAPHICAL NOTES. STEPHEN F. AUSTIN STATE UNIVERSITY, AUGUST 1996.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
30 JAN 2002

NAME: ERIOCAULON KOERNICKIANUM
COMMON NAME: SMALL-HEADED PIPEWORT
OTHER NAME:
FEDERAL STATUS: STATE STATUS:
GLOBAL RANK: G2 STATE RANK: S1
IDENTIFIED: Y TRACK: Y SENSITIVITY:
COUNTY: Leon
Freestone

USGS TOPO MAPS: TOPO QUAD: MARGIN #:
DONIE 3109642 5

ELEMENT OCCURRENCE NUMBER: 004 DATE LAST OBSERVED: 1984?
PRECISION: G DATE FIRST OBSERVED:
OCCURRENCE RANK: X? DATE SURVEYED:
SURVEY COMMENTS: PROBABLY DESTROYED BY STRIP MINING

MANAGED AREAS: CONTAINED:

DIRECTIONS:
JEWETT MINE SITE

DESCRIPTION:
HILLSIDE BOGS - SEEPAGE SLOPES WITH PARTIALLY OPEN POST OAK CANOPY

QUALITATIVE/QUANTITATIVE DATA:
TWO POPULATIONS OBSERVED, PROBABLY DESTROYED BY STRIP MINE ACTIVITIES

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:
AJILVSGI, GEYATA. 1984. DISCUSSION WITH TINA ALLDAY-BONDY, JULY 25, 1984.

TEXAS BIOLOGICAL AND CONSERVATION DATA SYSTEM
TEXAS PARKS AND WILDLIFE DEPARTMENT
30 JAN 2002

NAME: ULMUS AMERICANA-CELTIS SPP SERIES
COMMON NAME: AMERICAN ELM-HACKBERRY SERIES
OTHER NAME: CONFLUENCE OF BUFFALO AND LINN CREEK
FEDERAL STATUS: STATE STATUS:
GLOBAL RANK: G4 STATE RANK: S4
IDENTIFIED: Y TRACK: Y SENSITIVITY:
COUNTY: Freestone

USGS TOPO MAPS: TOPO QUAD: MARGIN #:
DEW 3109652 1

ELEMENT OCCURRENCE NUMBER: 003 DATE LAST OBSERVED:
PRECISION: G DATE FIRST OBSERVED:
OCCURRENCE RANK: DATE SURVEYED:
SURVEY COMMENTS: USF&WS PRIORITY 3

MANAGED AREAS: CONTAINED:

DIRECTIONS:
CONFLUENCE OF BUFFALO AND LINN CREEKS ABOUT 2 MILES WEST OF INTERSTATE 45 AND 3 MILES NORTH OF HIGHWAY 164

DESCRIPTION:
SOME GOOD OLD GROWTH WATER OAK-BASSWOOD-AMERICAN ELM-SUGARBERRY-PECAN WITH UPLAND POST OAK INCLUSIONS; MAY BE PECAN-SUGARBERRY

QUALITATIVE/QUANTITATIVE DATA:
TRINITY RIVER SYSTEM

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:
BASED ON JIM NEAL'S USF&WS BOTTOMLAND HARDWOOD REPORT; NEEDS FIELD CHECKING

SOURCE OF INFORMATION:
USF&WS, USDOI. 1985-05. TEXAS BOTTOMLAND HARDWOOD PRESERVATION PROGRAM: FINAL CONCEPT PLAN. USF&WS, ALBUQUERQUE, NM.

Species	Federal Status	State Status
*****AMPHIBIANS *****		
Houston Toad (*Bufo houstonensis*) - endemic; species sandy substrate, water in pools, ephemeral pools, stock tanks; breeds in spring especially after rains; burrows in soil when inactive; breeds February-June; found associated with soils of the Carrizo, Goliad, Queen City, Recklaw, Sparta, Willis, and Weches geologic formations	LE	E
***** BIRDS *****		
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - due to similar field characteristics, treat all Peregrine Falcons as federal listed Endangered; potential migrant	DL	T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern (*Sterna antillarum athalassos*) - nests along sand and gravel bars within braided streams and rivers; also known to nest on man-made structures	LE	E
Whooping Crane (*Grus americana*) - potential migrant	LE	E
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
***** MAMMALS *****		
Plains Spotted Skunk (*Spilogale putorius interrupta*) - catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Southeastern Myotis (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Texas Garter Snake (*Thamnophis sirtalis annectens*) - wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

FREESTONE COUNTY

	Federal Status	State Status
***** VASCULAR PLANTS *****		
Large-fruited sand verbena (*Abronia macrocarpa*) - endemic; deep, somewhat excessively drained sandy soils in openings in post oak woodlands, sometimes in active sand blowouts; flowering April-June (-October)	LE	E
Navasota ladies'-tresses (*Spiranthes parksii*) - endemic; margins of and openings within post oak woodlands in sandy loams along intermittent tributaries of rivers; flowering late October-early November	LE	E

LE, LT - Federally Listed Endangered/Threatened
PE, PT - Federally Proposed Endangered/Threatened
E/SA, T/SA - Federally Endangered/Threatened by Similarity of Appearance
C1 - Federal Candidate, Category 1; information supports proposing to list as endangered/threatened
DL ,PDL - Federally Delisted/Proposed Delisted
E, T - State Endangered/Threatened
"blank" - Rare, but with no regulatory listing status

Species appearing on these lists do not share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

	Federal Status	State Status
*****AMPHIBIANS *****		
Houston Toad (*Bufo houstonensis*) - endemic; species sandy substrate, water in pools, ephemeral pools, stock tanks; breeds in spring especially after rains; burrows in soil when inactive; breeds February-June; found associated with soils of the Carrizo, Goliad, Queen City, Recklaw, Sparta, Willis, and Weches geologic formations	LE	E
***** BIRDS *****		
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - due to similar field characteristics, treat all Peregrine Falcons as federal listed Endangered; potential migrant	DL	T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Whooping Crane (*Grus americana*) - potential migrant	LE	E
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
***** MAMMALS *****		
Plains Spotted Skunk (*Spilogale putorius interrupta*) - catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Southeastern Myotis (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Texas Garter Snake (*Thamnophis sirtalis annectens*) - wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

LEON COUNTY

*** VASCULAR PLANTS ***

Species	Federal Status	State Status
Large-fruited sand verbena (*Abronia macrocarpa*) - endemic; deep, somewhat excessively drained sandy soils in openings in post oak woodlands, sometimes in active sand blowouts; flowering April-June (-October)	LE	E
Navasota ladies'-tresses (*Spiranthes parksii*) - endemic; margins of and openings within post oak woodlands in sandy loams along intermittent tributaries of rivers; flowering late October-early November	LE	E
Parks' jointweed (*Polygonella parksii*) - endemic; deep loose sands of Carrizo and similar Eocene formations, including disturbed areas; flowering spring-summer		
Sandhill woolywhite (*Hymenopappus carrizoanus*) - endemic; open areas in deep sands derived from Carrizo and similar Eocene formations, including disturbed areas; flowering late spring-fall		
Small-headed pipewort (*Eriocaulon koernickianum*)- wet acid sands of upland seeps and bogs, often on sphagnum mats with little other vegetative cover; flowering/fruiting late May-late June		

LE, LT - Federally Listed Endangered/Threatened
PE, PT - Federally Proposed Endangered/Threatened
E/SA, T/SA - Federally Endangered/Threatened by Similarity of Appearance
C1 - Federal Candidate, Category 1; information supports proposing to list as endangered/threatened
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Species appearing on these lists do not share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

LIMESTONE COUNTY

	Federal Status	State Status
***** BIRDS *****		
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - due to similar field characteristics, treat all Peregrine Falcons as federal listed Endangered; potential migrant	DL	T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking; likely to occur, but few records within this county		
Interior Least Tern (*Sterna antillarum athalassos*) - nests along sand and gravel bars within braided streams and rivers; also known to nest on man-made structures	LE	E
Migrant Loggerhead Shrike (*Lanius ludovicianus migrans*) - open and semi-open grassy areas with scattered trees and brush; breeding March-late August		
Western Burrowing Owl (*Athene cunicularia hypugaea*) - open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
Whooping Crane (*Grus americana*) - potential migrant	LE	E
*****FISHES*****		
Smalleye shiner (*Notropis buccula*) - endemic to upper Brazos River system and its tributaries; apparently introduced into adjacent Colorado River drainage; medium to large prairie streams with sandy substrate and turbid to clear warm water; presumably eats small aquatic invertebrates		
***** MAMMALS *****		
Cave Myotis Bat (*Myotis velifer*) - colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Plains Spotted Skunk (*Spilogale putorius interrupta*) - catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
***** REPTILES *****		
Texas Garter Snake (*Thamnophis sirtalis annectens*) - wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T

LIMESTONE COUNTY

	Federal Status	State Status
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland, limestone bluffs; sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

VASCULAR PLANTS

Small-headed pipewort (*Eriocaulon koernickianum*) – wet acid sands of upland seeps and bogs, often on sphagnum mats with little other vegetative cover, usually associated with post oak woodlands; also in native prairies or along stream banks; flowering/fruiting late May-late June

LE, LT - Federally Listed Endangered/Threatened
PE, PT - Federally Proposed Endangered/Threatened
E/SA, T/SA - Federally Endangered/Threatened by Similarity of Appearance
C1 - Federal Candidate, Category 1; information supports proposing to list as endangered/threatened
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TEXAS PARKS & WILDLIFE

November 10, 2006

Mr. James M. Wiersema
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, Texas 78716

Dear Mr. Wiersema:

Regarding the proposed FutureGen Heart of Brazos Project I would like to offer addition information concerning the construction plans.

You need to be aware that the proposed carbon dioxide pipelines will be routed through some of the best remaining wildlife habitat corridors in that part of northern Leon and southern Freestone Counties. In addition, the pipeline will cross 15 properties under wildlife management plans and bisect the Friendship Community Wildlife Management Association.

It is vital that proper consideration be given to the possible adverse effects of this construction on wildlife habitat in order to minimize or mitigate these effects.

Thank you for the opportunity to review and comment on this project. If you have any additional questions, please let me know.

Sincerely,

David Sierra
District 5 Leader
Wildlife Division

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800

www.tpwd.state.tx.us

To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

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Jim Wiersema

From: Beth Helms Seaton [BSeaton@tceq.state.tx.us]

Sent: Friday, October 13, 2006 4:39 PM

To: Jim Wiersema

Cc: Earl Lott; L'oreal Stepney

Subject: FutureGen

Dear Mr. Wiersema,

Thank you for your letters dated October 6, 2006, requesting information concerning resources that could be utilized to determine existing contamination in aquatic plants and animals on the proposed Heart of Brazos and Odessa proposed developement sites for the proposed FutureGen Project. Your letter stated that you reviewed the TCEQ 2004 Texas 303 (d) list and the TCEQ 2004 Water Quality Assessment for Individual Water Bodies as resources listing existing contamination in aquatic plants and animals within the 5-mile region of influence of the proposed power plant sites. You requested the disclosure of any additional potential resources concerning existing contamination that was not listed in your letter. The Water Quality Division uses the 303(d) list referenced above for information regarding contamination in aquatic plants and animals and does not have any additional site specific information. No 303(d) listing issues have been identified in the general vicinity of these proposed sites.

In a phone conversation with you on 10/11/06, you indicated that no effluent discharge is being proposed at this time. If it becomes apparent that an effluent discharge is necessary, a discharge permit may be required and the applicant would need to determine the point of discharge, the amount of wastewater expected to be discharged, and the types of wastewater expected to be discharged. Permit limits for oxygen demanding substances (i.e. Carbonaceous BOD_5 and Ammonia-Nitrogen) should be expected for wastewater streams containing potentially elevated concentrations of these constituents. This could include process wastewater as well as cooling tower blowdown if treated domestic wastewater is used as makeup water. Information on the expected concentrations of these constituents, and any other pollutants used in the process water would need to be estimated and submitted during the permit application process so that modeling can be performed to assess the impact of the wastewater on dissolved oxygen concentrations in any streams receiving this effluent. In addition, the waters that the discharge would enter would need to be characterized. To do this the applicant would need to determine the point of discharge and identify the unclassified water bodies along the course (discharge route) for at least three miles downstream and determine the classified segment that the discharge would eventually meet. If the discharge is directly to a classified segment, then the aquatic life uses will be defined by that segment. Next, the applicant should characterize the unclassified water bodies (streams, lakes, or ponds) along the discharge route. This involves determining whether streams in the discharge route are perennial, intermittent with perennial pools, or intermittent. In any of these water bodies, for sites where available information indicates that the presumed uses and criteria in the standards for unclassified streams may be inappropriate, additional data may be obtained by the TCEQ or the applicant in the form of a "receiving water assessment."

Please let me know if you need additional information. As stated above, if it becomes apparent that an effluent discharge is necessary, we would be happy to meet with you if needed to discuss any permitting issues, process, or the application if needed.

Sincerely,

Beth Seaton, Special Assistant
Water Quality Division
512-239-2526

TEXAS
HISTORICAL
COMMISSION

The State Agency for Historic Preservation

RICK PERRY, GOVERNOR
JOHN L. NAU, III, CHAIRMAN
F. LAWERENCE OAKS, EXECUTIVE DIRECTOR

October 31, 2006

Russ Brownlow
Cultural Resources Director
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, TX 78716

Re: Project review under Section 106 of the National Historic Preservation Act of 1966
FutureGen Project, Proposed Heart of Brazos Site Areas of New Construction (DOE)

Dear Mr. Brownlow:

Thank you for your correspondence describing the above referenced project. This letter serves as comment on the proposed federal undertaking from the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission.

The review staff, led by Bill Martin, has examined our records. We concur with your assessment that archeological surveys are unnecessary for the Waterline Corridors east and west of the plant. We also concur with your recommendations for the proposed CO_2 Pipeline Corridors. Specifically, we concur that no cultural resources surveys are required for segments A-C and B-C. We also concur that all remaining segments (C-D, D-E, D-F, F-G, F-H, and H-I) require cultural resources surveys.

The work should meet the minimum archeological survey standards posted on-line at www.thc.state.tx.us. A report of investigations should be produced in conformance with the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation, and submitted to this office for review. In addition, any buildings 50 years old or older that are located on or adjacent to the tract should be documented with photographs and included in the report. You may obtain lists of archeologists in Texas on-line at: www.counciloftexasarcheologists.org or www.rpanet.org. Please note that other potentially qualified archeologists not included on these lists may be used.

Thank you for your cooperation in this federal review process, and for your efforts to preserve the irreplaceable heritage of Texas. **If you have any questions concerning our review or if we can be of further assistance, please contact Bill Martin at 512/463-5867.**

Sincerely,

William A. Martin

for
F. Lawerence Oaks, State Historic Preservation Officer

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TEXAS HISTORICAL COMMISSION

The State Agency for Historic Preservation

RICK PERRY, GOVERNOR

JOHN L. NAU, III, CHAIRMAN

F. LAWERENCE OAKS, EXECUTIVE DIRECTOR

October 31, 2006

Russ Brownlow
Cultural Resources Director
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, TX 78716

Re: Project review under Section 106 of the National Historic Preservation Act of 1966
FutureGen Project, Proposed Heart of Brazos Sequestration Reservoirs (DOE)

Dear Mr. Brownlow:

Thank you for your correspondence describing the above referenced project. This letter serves as comment on the proposed federal undertaking from the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission.

The review staff, led by Bill Martin, has examined our records. We concur with your assessment that archeological surveys are needed for both the Northern and the Southern Sequestration Reservoirs.

The work should meet the minimum archeological survey standards posted on-line at www.thc.state.tx.us. A report of investigations should be produced in conformance with the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation, and submitted to this office for review. In addition, any buildings 50 years old or older that are located on or adjacent to the tract should be documented with photographs and included in the report. You may obtain lists of archeologists in Texas on-line at: www.counciloftexasarcheologists.org or www.rpanet.org. Please note that other potentially qualified archeologists not included on these lists may be used.

Thank you for your cooperation in this federal review process, and for your efforts to preserve the irreplaceable heritage of Texas. **If you have any questions concerning our review or if we can be of further assistance, please contact Bill Martin at 512/463-5867.**

Sincerely,

William A. Martin

for
F. Lawerence Oaks, State Historic Preservation Officer

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Office of
Road and Bridge Department
Engineer - T. L. KANTOR, P. E.

STATE OF TEXAS
Limestone County
GROESBECK, TEXAS

P. O. Box 101
Groesbeck, Texas 76642
Office - 254-729-5513

May 22, 2006

Scott W. Tinker, Ph.D.
Director
Bureau of Economic Geology
The University of Texas at Austin
University Station, Box X
Austin, Texas 78713-8924

Subject: Heart of Brazos Site Flood Hazard clarification

Dear Dr. Tinker,

Per your request, I have reviewed the proposed FutureGen site as it relates to potential floodplain conflicts. The site in question is located in Limestone, Freestone, and Leon Counties.

I have reviewed the most recent Flood Hazard Boundary Maps available for Limestone County and for Freestone County. Interpretation of said maps reveals that no areas of the proposed site that are situated in Limestone or Freestone Counties lie within the area of a 100 year flood.

The area of Leon County in which a portion of the subject site is located is currently unmapped with regard to Flood Hazard Boundary Maps. Floodplain determination, therefore, must be made via alternate methods.

In this case, consultation of the NRCS Soil Survey for Leon County shows that the soils on the subject site all having a flooding frequency class of "none". The definition of said flooding frequency class is that of having 0% chance of flooding in any given year, or less than 1 time in 500 years. Based upon this information, it is my opinion that no areas of the proposed site that are situated in Leon County lie within the area of the 100 year flood.

If you have any questions regarding my determination, please feel free to give me a call.

Sincerely,

05/22/2006

Ted L. Kantor, P.E.
Limestone County Engineer
Limestone County Floodplain Administrator

STATE OF TEXAS
T L KANTOR
83492
LICENSED
PROFESSIONAL ENGINEER

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December 6, 2006

, Chief
Tribal
Address
City, state, zip

Re: Executive Memo (4/29/1994): "Government to Government Relations"
Executive Order 13175 (11/6/2000): Consultation and Coordination with Indian Tribal Governments,
Section 106 of the National Historic Preservation Act and
NAGPRA Consultation for the Environmental Impact Statement for Implementation of the FutureGen Project

Dear :

The U.S. Department of Energy (DOE) is preparing an Environmental Impact Statement (EIS) for the proposed FutureGen Project, which would receive Federal cost-share funding for up to $700 million on a $950 million (total, in 2004 dollars) project. The project would comprise the planning, design, construction and operation of a research and development power plant by the FutureGen Alliance, Inc. (a not-for-profit organization). A Notice of Intent to prepare the EIS was published in the Federal Register / Vol. 71, No. 145 / Friday, July 28, 2006. The FutureGen Project would feature a coal-fueled electric power and hydrogen gas (H_2) production plant integrated with carbon dioxide (CO_2) capture and geologic sequestration of the captured gas. Four sites have been identified as reasonable alternatives: (1) Mattoon, Illinois; (2) Tuscola, Illinois; (3) Jewett, Texas; and (4) Odessa, Texas.

In accordance with the referenced Executive Orders and Acts, DOE would like to solicit your input on the project 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 significant archeological, religious or cultural sites. DOE is requesting that you (or your designated representative) submit to my office any concerns or issues you may have or notify my office if you are aware of any significant archeological, religious, or cultural sites within the areas of potential impact.

To assist in your review, the enclosed maps illustrate the potential areas where construction impacts may occur. Impacts to archeological resources (if present) could occur as a result of site development and other land-disturbing activities from the project. In addition, DOE is considering the potential for impacts related to visual or atmospheric resources associated with potential air emissions. The following discussion provides a more detailed description of the project.

FutureGen Project Processes

The 275-MW FutureGen power plant would employ advanced coal gasification technology integrated with combined cycle electricity generation, H_2 production, CO_2 capture, and sequestration of the captured gas in geologic repositories. The gasification process would combine coal, oxygen (O_2), and steam to produce a H_2-rich ‘‘synthesis gas.’’ After exiting the conversion reactor, the composition of the synthesis gas would be ‘‘shifted’’ to produce additional H_2. The product stream would consist mostly of H_2, steam, and CO_2. Following separation of these three gas components, the H_2 would be used to generate electricity in a gas turbine and/or fuel cell. Some of the H_2 could be used as a feedstock for chemical plants or petroleum refineries or as a transportation fuel. Steam from the process could be condensed, treated, and recycled into the gasifier or added to the plant's cooling water circuit. CO_2 from the process would be sequestered in deep underground geologic formations that would be monitored to verify the permanence of CO_2 storage.

Technology Alternatives

As a research and development project, FutureGen would incorporate cutting-edge and emerging technologies ready for full-scale or subscale testing prior to their commercial deployment. Identification of technology alternatives is currently in progress for key components: gasification, O_2 production, H_2 production, synthesis gas cleanup, H_2 turbines, CO_2 capture, byproduct utilization, and others. Decisions on incorporation of specific technologies would be made by the Alliance consistent with the overall project goal of proving the technical and economic feasibility of the near-zero emissions concept. It is expected that sequestration would be accomplished using existing state-of-the-art technologies for both transmission and injection of the CO_2 stream. Various technologies would be considered for monitoring at the injection sites.

We are very interested in receiving your concerns about possible effects of the project on archeological, religious, or cultural sites that are considered significant to your tribe. If you have questions, please do not hesitate to call, (304-285-4426).

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. DOE would appreciate your response by January 4, 2007.

Sincerely,

Mark L. McKoy
NEPA Document Manager
U.S. DOE

Attachments:
- Maps of alternative sites
- Notice of Intent

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: _________________________________

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United States Department of the Interior

BUREAU OF INDIAN AFFAIRS

Southern Plains Regional Office
P.O. Box 368
Anadarko, Oklahoma 73005

IN REPLY REFER TO:
Natural Resources

DEC 29 2006

Mark L. McKoy
NEPA Document Manager
U.S. DOE
National Energy Technology Laboratory
3610 Collins Ferry Road
Morgantown, WV 26507-0880

Dear Mr. McKoy:

Thank you for the opportunity to review the documentation describing the proposed FutureGen Project. The closest alternative sites where this office might have some input are the Jewett and Odessa, Texas sites.

A review of the maps of these project alternative locations indicates that there are no tribal or Individual Indian trust lands within the areas of potential effect. The Bureau of Indian Affairs has no jurisdiction within the alternative project areas in the Jewett or Odessa areas. However, Tribes that have historic ties to the area may have some concern if the project has a potential to impact sites of importance in their histories or cultural traditions. We recommend that you contact the Kiowa Tribe of Oklahoma, the Comanche Nation, the Wichita and Affiliated Tribes, and the Mescalero Apache Tribe regarding the Odessa alternative and the Alabama-Coushatta Tribe of Texas, and the Caddo Nation regarding the Jewett alternative.

Sincerely,

Acting Regional Director

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United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
Eastern Oklahoma Regional Office
P.O. Box 8002
Muskogee, OK 74402-8002

IN REPLY REFER TO:
Division of Environmental
Safety and Cultural Resources

Mr. Mark L. McKoy
U.S. Department of Energy
P. O. Box 880
Morgantown, West Virginia 26507-0880

JAN 2 2 2007

Dear Mr. McKoy:

On December 11, 2006, the Bureau of Indian Affairs (BIA), Eastern Oklahoma Regional Office (EORO), received an information request from the U.S. Department of Energy (USDOE) regarding significant impacts to archeological, religious or cultural sites from the construction and operation of a coal-fueled electric power and Hydrogen gas (H_2) production plant located in Illinois or Texas. The EORO has no comments regarding the project.

The projects in Illinois are within the jurisdictional area of the Bureau's Eastern Region and the projects in Texas are within the jurisdiction area of the Bureau's Southern Plains Region. Both Regions have been provided the notice by copy of this letter. As the other two Regions may have environmental and/or cultural resources concerns relating to the project, it is recommended that the USDOE coordinate directly with them on any of their concerns. The contact addresses are:

Franklin Keel, Regional Director
Eastern Regional Office
545 Marriott Drive, Suite 700
Nashville, Tennessee 37214

Dan Deerinwater, Regional Director
Southern Plains Regional Office
P.O. Box 368
Anadarko, Oklahoma 73005-0368

If any additional information is required, please contact Mr. Bob Coleman, Division Chief, Division of Environmental, Safety and Cultural Resources, EORO, at (918) 781-4660.

Respectfully,

Regional Director

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A.4 ODESSA

The following agencies sent coordination letters:

- U.S. Fish and Wildlife Service
- Texas Parks and Wildlife Department
- Texas Commission on Environmental Quality
- Texas Historical Commission
- U.S. Department of Energy
- Bureau of Indian Affairs

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
10711 Burnet Road, Suite 200
Austin, Texas 78758
512 490-0057
FAX 490-0974

OCT 20 2006

Mr. James Wiersema
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, Texas 78716

Consultation Number 21450-2007-TA-0024

Dear Mr. Wiersema:

This is in response to your letter dated October 6, 2006, requesting review on the proposed site locations for the FutureGen project. Your conversation with my staff on October 16, 2006, clarified the level of review you were requesting. Our review did not result in any additional information other than that obtained from our web site (see below for address). Enclosed is a list of the U.S. Fish and Wildlife Service (Service) threatened and endangered species by county that the FutureGen project may impact if implemented. This list is organized by the counties you have indicated as potential sites for the project. We are providing this information to assist you in assessing and avoiding impacts to federally listed threatened and endangered species, their habitat, and designated wetlands. Further consultation with us may be necessary should this project go forward.

Federally listed species

The proposed project site is not located within designated critical habitat of any federally listed threatened or endangered species. You may access a list of federally listed or proposed species by county of occurrence in Texas at http://ifw2es.fws.gov/EndangeredSpecies/lists/. A searchable database with information related to the life history and ecology of each of these species can be found at http://endangered.fws.gov/.

Generally, the Service believes that the first step in determining impacts to endangered species is presence/absence surveys conducted within the project area by persons with appropriate biological expertise. Often, absence of endangered species is determined and the project can then proceed without additional responsibilities under the Endangered Species Act of 1973, as amended (Act). If assessments indicate that suitable habitat is likely to be affected either directly or indirectly, we recommend that you consult with us further. If any endangered species or their habitats are present, the project can often be modified to avoid all impacts. Please send any completed surveys or habitat assessments to our office for assistance in evaluating potential effects.

If impacts cannot be avoided, we recommend the Department of Energy (DOE) pursue formal consultation through section 7 of the Act. Section 7 requires that all Federal agencies consult with the Service to ensure that the actions authorized, funded, or carried out by such agencies do not jeopardize the continued existence of any threatened or endangered species or adversely modify or destroy critical habitat of such species. It is the primary responsibility of DOE, as the Federal action agency, to determine whether any action it authorizes, funds, or carries out may affect a federally listed or proposed species.

Candidate Species

We also recommend that you review the potential for your project to affect candidates. Candidate species are those that are being considered for possible addition to the threatened and endangered species list. There is sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but higher priority listings currently preclude issuance of a proposed rule for those species. Candidate species currently have no legal protection. If you find your project may potentially impact these species, the Service would like to provide technical assistance to help avoid or minimize adverse effects. Addressing these species at this stage could better provide for overall ecosystem health in the local area and may avert potential future listing.

State-listed species

The State of Texas also protects certain species of plants and animals. Contact the Texas Parks and Wildlife Department (Endangered Resources Branch), Fountain Park Plaza Building, Suite 100, 3000 South IH-35, Austin, Texas 78704 (512-912-7011) for information concerning fish, wildlife, and plants of State concern.

Wetlands and Native Habitats

If your project will involve filling, dredging, or trenching of a wetland or riparian area it may require a Section 404 permit from the U.S. Army Corps of Engineers. For permitting requirements under Section 404 of the Clean Water Act, please contact the Fort Worth District, Permits Section, CESWF-EV-0, P.O. Box 17300, Fort Worth, Texas, 76102-0300, 817-978-2681.

Wetlands and riparian zones provide valuable fish and wildlife habitat as well as contribute to flood control, water quality enhancement, and groundwater recharge. Wetland and riparian vegetation provides food and cover for wildlife, stabilizes banks, and decreases soil erosion. These areas are inherently dynamic and very sensitive to changes caused by such activities as overgrazing, logging, major construction, or earth disturbance. Construction activities near such areas should be carefully designed to minimize impacts. If vegetation clearing is needed in riparian areas, these areas should be revegetated with native wetland and riparian vegetation to prevent erosion or loss of habitat. We recommend minimizing the area of soil scarification and initiating incremental reestablishment of herbaceous vegetation at the proposed work sites. Denuded and/or disturbed areas should be revegetated with a mixture of native legumes and grasses. Species commonly used for soil stabilization are listed in the Texas Department of Agriculture's (TDA) Native Tree and Plant Directory, available from TDA at P.O. Box 12847, Austin, Texas, 78711.

We also urge you to take all precautions to ensure sediment loading does not occur to receiving streams in the project area. To prevent and/or minimize soil erosion and compaction associated with construction activities, avoid any unnecessary clearing of vegetation, and follow established rights-of-way whenever possible. All machinery and petroleum products should be stored outside the floodplain and/or wetland area during construction to prevent possible contamination of water and soils. No permanent structures should be placed in the 100-year floodplain.

We thank you for your concern for endangered and threatened species and other natural resources, and we appreciate the opportunity to comment on the proposed project. If we can be of further assistance or answer questions about these comments, please contact William Amy at 512-490-0057, extension 234. Please refer to the Service Consultation number listed above in any future correspondence regarding this project.

Sincerely,

Robert T. Pine
Supervisor

Enclosures

Federally Listed as Threatened and Endangered Species of Texas
September 27, 2006

This list represents species that may be found in counties throughout the Austin Ecological Services office's area of responsibility. Please contact the Austin ES office (U.S. Fish and Wildlife Service, 10711 Burnet Rd., Suite 200, Austin, Texas 78758, 512/490-0057) if additional information is needed.

DISCLAIMER

This list is based on information available to the U.S. Fish and Wildlife Service at the time of preparation. This list is subject to change, without notice, as new biological information is gathered and should not be used as the sole source for identifying species that may be impacted by a project.

Migratory Species Common to many or all Counties: Species listed specifically in a county have confirmed sightings. If a species is not listed they may occur as migrants in those counties.

Least tern	(E ~)	*Sterna antillarum*
Whooping crane	(E w/CH)	*Grus americana*
Bald eagle	(T)	*Haliaeetus leucocephalus*
Piping plover	(T w/CH)	*Charadrius melodus*

Andrews County

Sand dune lizard	(C)	*Sceloporus arenicolus*

Freestone County

Least tern	(E ~)	*Sterna antillarum*
Large-fruited sand-verbena	(E)	*Abronia macrocarpa*
Navasota ladies'-tresses	(E)	*Spiranthes parksii*
Bald eagle	(T)	*Haliaeetus leucocephalus*

Leon County

Least tern	(E ~)	*Sterna antillarum*
Houston toad	(E w/CH)	*Bufo houstonensis*
Large-fruited sand-verbena	(E)	*Abronia macrocarpa*
Navasota ladies'-tresses	(E)	*Spiranthes parksii*
Bald eagle	(T)	*Haliaeetus leucocephalus*

Limestone County

Bald eagle	(T)	*Haliaeetus leucocephalus*
Least tern	(E ~)	*Sterna antillarum*
Navasota ladies'-tresses (E) *Spiranthes parksii*		

Pecos County

Black-capped vireo	(E)	*Vireo atricapilla*
Pecos gambusia	(E)	*Gambusia nobilis*
Leon Springs pupfish	(E w/CH)	*Cyprinodon bovinus*
Pecos (=puzzle) sunflower	(T)	*Helianthus paradoxus*
Pecos assiminea snail	(E w/CH)	*Assiminea pecos*
DiamondY Spring snail	(C)	*Tryonia adamantina*
Gonzales springsnail	(C)	*Tryonia stocktonensis*

Winkler County

Sand dune lizard	(C)	*Sceloporus arenicolus*

INDEX

E	=	Species in danger of extinction throughout all or a significant portion of its range.
T	=	Species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
C	=	Species for which the Service has on file enough substantial information to warrant listing as threatened or endangered. These species currently have no legal protection. However, addressing these species at this stage could better provide for overall ecosystem health in the local area and may avert potential future listing.
CH	=	Critical Habitat (in Texas unless annotated ‡)
P/	=	Proposed ...
P/E	=	Species proposed to be listed as endangered.
P/T	=	Species proposed to be listed as threatened.
TSA	=	Threatened due to similarity of appearance. Protections of the Act, such as consultation requirements for Federal agencies under section 7, and recovery planning provisions under section 4(f), do not apply to species listed under similarity of appearance provisions.
□	=	with special rule
‡	=	CH designated (or proposed) outside Texas

~ = protection restricted to populations found in the "interior" of the United States. In Texas, the least tern receives full protection, except within 50 miles (80 km) of the Gulf Coast.

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19 October 2006

Mr. James M. Wiersema
Vice President
Horizon Environmental Services
P. O. Box 162017
Austin, TX 78716

Dear Mr. Wiersema,

I have reviewed the information you provided on the proposed FutureGen Project. Your examination of Texas Parks and Wildlife Department and US Fish and Wildlife Service records should have provided you with the most current information available. It is my opinion based upon the location and scope of work to be completed that there will be no negative impacts to threatened or endangered species of wildlife or their habitats.

I appreciate the opportunity to comment on this proposed project and the material provided by Horizon Environmental Services.

Thank You,

Philip Dickerson

Philip Dickerson
District Wildlife Biologist
Texas Parks and Wildlife
4500 W. Illinois Ste 203
Midland, TX 79703
432-520-1581

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Jim Wiersema

From: Beth Helms Seaton [BSeaton@tceq.state.tx.us]
Sent: Friday, October 13, 2006 4:39 PM
To: Jim Wiersema
Cc: Earl Lott; L'oreal Stepney
Subject: FutureGen

Dear Mr. Wiersema,

Thank you for your letters dated October 6, 2006, requesting information concerning resources that could be utilized to determine existing contamination in aquatic plants and animals on the proposed Heart of Brazos and Odessa proposed developement sites for the proposed FutureGen Project. Your letter stated that you reviewed the TCEQ 2004 Texas 303 (d) list and the TCEQ 2004 Water Quality Assessment for Individual Water Bodies as resources listing existing contamination in aquatic plants and animals within the 5-mile region of influence of the proposed power plant sites. You requested the disclosure of any additional potential resources concerning existing contamination that was not listed in your letter. The Water Quality Division uses the 303(d) list referenced above for information regarding contamination in aquatic plants and animals and does not have any additional site specific information. No 303(d) listing issues have been identified in the general vicinity of these proposed sites.

In a phone conversation with you on 10/11/06, you indicated that no effluent discharge is being proposed at this time. If it becomes apparent that an effluent discharge is necessary, a discharge permit may be required and the applicant would need to determine the point of discharge, the amount of wastewater expected to be discharged, and the types of wastewater expected to be discharged. Permit limits for oxygen demanding substances (i.e. Carbonaceous BOD_5 and Ammonia-Nitrogen) should be expected for wastewater streams containing potentially elevated concentrations of these constituents. This could include process wastewater as well as cooling tower blowdown if treated domestic wastewater is used as makeup water. Information on the expected concentrations of these constituents, and any other pollutants used in the process water would need to be estimated and submitted during the permit application process so that modeling can be performed to assess the impact of the wastewater on dissolved oxygen concentrations in any streams receiving this effluent. In addition, the waters that the discharge would enter would need to be characterized. To do this the applicant would need to determine the point of discharge and identify the unclassified water bodies along the course (discharge route) for at least three miles downstream and determine the classified segment that the discharge would eventually meet. If the discharge is directly to a classified segment, then the aquatic life uses will be defined by that segment. Next, the applicant should characterize the unclassified water bodies (streams, lakes, or ponds) along the discharge route. This involves determining whether streams in the discharge route are perennial, intermittent with perennial pools, or intermittent. In any of these water bodies, for sites where available information indicates that the presumed uses and criteria in the standards for unclassified streams may be inappropriate, additional data may be obtained by the TCEQ or the applicant in the form of a "receiving water assessment."

Please let me know if you need additional information. As stated above, if it becomes apparent that an effluent discharge is necessary, we would be happy to meet with you if needed to discuss any permitting issues, process, or the application if needed.

Sincerely,

Beth Seaton, Special Assistant
Water Quality Division
512-239-2526

10/25/2006

TEXAS HISTORICAL COMMISSION

The State Agency for Historic Preservation

RICK PERRY, GOVERNOR

JOHN L. NAU, III, CHAIRMAN

F. LAWERENCE OAKS, EXECUTIVE DIRECTOR

October 31, 2006

Russ Brownlow
Cultural Resources Director
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, TX 78716

Re: Project review under Section 106 of the National Historic Preservation Act of 1966
FutureGen Project, Proposed Odessa Site Areas of New Construction (DOE)

Dear Mr. Brownlow:

Thank you for your correspondence describing the above referenced project. This letter serves as comment on the proposed federal undertaking from the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission.

The review staff, led by Bill Martin, has examined our records. We concur with your assessment that archeological surveys are necessary for the CO_2 Pipeline Corridors east of the Injection Site and west of the Injection Site, and that no archeological survey is needed for the CO_2 Pipeline Corridor near the plant. We also concur that the Potential Transmission Line Corridor north of the plant does not need to be surveyed, but that all other Potential Transmission Line Corridors and Waterline Corridors will require cultural resources surveys.

The work should meet the minimum archeological survey standards posted on-line at www.thc.state.tx.us. A report of investigations should be produced in conformance with the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation, and submitted to this office for review. In addition, any buildings 50 years old or older that are located on or adjacent to the tract should be documented with photographs and included in the report. You may obtain lists of archeologists in Texas on-line at: www.counciloftexasarcheologists.org or www.rpanet.org. Please note that other potentially qualified archeologists not included on these lists may be used.

Thank you for your cooperation in this federal review process, and for your efforts to preserve the irreplaceable heritage of Texas. **If you have any questions concerning our review or if we can be of further assistance, please contact Bill Martin at 512/463-5867.**

Sincerely,

for
F. Lawerence Oaks, State Historic Preservation Officer

FLO/wam

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TEXAS HISTORICAL COMMISSION

The State Agency for Historic Preservation

RICK PERRY, GOVERNOR

JOHN L. NAU, III, CHAIRMAN

F. LAWERENCE OAKS, EXECUTIVE DIRECTOR

October 31, 2006

Russ Brownlow
Cultural Resources Director
Horizon Environmental Services, Inc.
P.O. Box 162017
Austin, TX 78716

Re: Project review under Section 106 of the National Historic Preservation Act of 1966
FutureGen Project, Proposed Odessa Site Sequestration Reservoirs (DOE)

Dear Mr. Brownlow:

Thank you for your correspondence describing the above referenced project. This letter serves as comment on the proposed federal undertaking from the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission.

The review staff, led by Bill Martin, has examined our records. We concur with your assessment that an archeological survey is necessary. We believe that a professional archeologist should survey the study area, paying particular attention to areas within 100 m of the drainages.

The work should meet the minimum archeological survey standards posted on-line at www.thc.state.tx.us. A report of investigations should be produced in conformance with the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation, and submitted to this office for review. In addition, any buildings 50 years old or older that are located on or adjacent to the tract should be documented with photographs and included in the report. You may obtain lists of archeologists in Texas on-line at: www.counciloftexasarcheologists.org or www.rpanet.org. Please note that other potentially qualified archeologists not included on these lists may be used.

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Sincerely,

for
F. Lawerence Oaks, State Historic Preservation Officer

FLO/wam

P.O. BOX 12276 • AUSTIN, TX 78711-2276 • 512/463-6100 • FAX 512/475-4872 • TDD 1-800/735-2989
www.thc.state.tx.us

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December 6, 2006

, Chief
Tribal
Address
City, state, zip

Re: Executive Memo (4/29/1994): "Government to Government Relations"
Executive Order 13175 (11/6/2000): Consultation and Coordination with Indian Tribal Governments,
Section 106 of the National Historic Preservation Act and
NAGPRA Consultation for the Environmental Impact Statement for Implementation of the FutureGen Project

Dear :

The U.S. Department of Energy (DOE) is preparing an Environmental Impact Statement (EIS) for the proposed FutureGen Project, which would receive Federal cost-share funding for up to $700 million on a $950 million (total, in 2004 dollars) project. The project would comprise the planning, design, construction and operation of a research and development power plant by the FutureGen Alliance, Inc. (a not-for-profit organization). A Notice of Intent to prepare the EIS was published in the Federal Register / Vol. 71, No. 145 / Friday, July 28, 2006. The FutureGen Project would feature a coal-fueled electric power and hydrogen gas (H_2) production plant integrated with carbon dioxide (CO_2) capture and geologic sequestration of the captured gas. Four sites have been identified as reasonable alternatives: (1) Mattoon, Illinois; (2) Tuscola, Illinois; (3) Jewett, Texas; and (4) Odessa, Texas.

In accordance with the referenced Executive Orders and Acts, DOE would like to solicit your input on the project 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 significant archeological, religious or cultural sites. DOE is requesting that you (or your designated representative) submit to my office any concerns or issues you may have or notify my office if you are aware of any significant archeological, religious, or cultural sites within the areas of potential impact.

To assist in your review, the enclosed maps illustrate the potential areas where construction impacts may occur. Impacts to archeological resources (if present) could occur as a result of site development and other land-disturbing activities from the project. In addition, DOE is considering the potential for impacts related to visual or atmospheric resources associated with potential air emissions. The following discussion provides a more detailed description of the project.

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

FutureGen Project Processes

The 275-MW FutureGen power plant would employ advanced coal gasification technology integrated with combined cycle electricity generation, H_2 production, CO_2 capture, and sequestration of the captured gas in geologic repositories. The gasification process would combine coal, oxygen (O_2), and steam to produce a H_2-rich ‘‘synthesis gas.’’ After exiting the conversion reactor, the composition of the synthesis gas would be ‘‘shifted’’ to produce additional H_2. The product stream would consist mostly of H_2, steam, and CO_2. Following separation of these three gas components, the H_2 would be used to generate electricity in a gas turbine and/or fuel cell. Some of the H_2 could be used as a feedstock for chemical plants or petroleum refineries or as a transportation fuel. Steam from the process could be condensed, treated, and recycled into the gasifier or added to the plant's cooling water circuit. CO_2 from the process would be sequestered in deep underground geologic formations that would be monitored to verify the permanence of CO_2 storage.

Technology Alternatives

As a research and development project, FutureGen would incorporate cutting-edge and emerging technologies ready for full-scale or subscale testing prior to their commercial deployment. Identification of technology alternatives is currently in progress for key components: gasification, O_2 production, H_2 production, synthesis gas cleanup, H_2 turbines, CO_2 capture, byproduct utilization, and others. Decisions on incorporation of specific technologies would be made by the Alliance consistent with the overall project goal of proving the technical and economic feasibility of the near-zero emissions concept. It is expected that sequestration would be accomplished using existing state-of-the-art technologies for both transmission and injection of the CO_2 stream. Various technologies would be considered for monitoring at the injection sites.

We are very interested in receiving your concerns about possible effects of the project on archeological, religious, or cultural sites that are considered significant to your tribe. If you have questions, please do not hesitate to call, (304-285-4426).

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. DOE would appreciate your response by January 4, 2007.

Sincerely,

Mark L. McKoy
NEPA Document Manager
U.S. DOE

Attachments:
- Maps of alternative sites
- Notice of Intent

U.S. Department of Energy

National Energy Technology Laboratory

December 6, 2006

Arturo Senclair, Governor
Ysleta del Sur Pueblo
P.O. Box 17579 – Ysleta Station
El Paso, TX 79917

Re: Executive Memo (4/29/1994): "Government to Government Relations"
Executive Order 13175 (11/6/2000): Consultation and Coordination with Indian Tribal Governments,
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To assist in your review, the enclosed maps illustrate the potential areas where construction impacts may occur. Impacts to archeological resources (if present) could occur as a result of site development and other land-disturbing activities from the project. In addition, DOE is considering the potential for impacts related to visual or atmospheric resources associated with potential air emissions. The following discussion provides a more detailed description of the project.

DEC 11 2006

cc: Javier Loera, Captain

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

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Sincerely,

Mark L. McKoy

Mark L. McKoy
NEPA Document Manager
U.S. DOE

Attachments:
- Maps of alternative sites
- Notice of Intent

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Southern Plains Regional Office
P.O. Box 368
Anadarko, Oklahoma 73005

IN REPLY REFER TO:
Natural Resources

DEC 2 9 2006

Mark L. McKoy
NEPA Document Manager
U.S. DOE
National Energy Technology Laboratory
3610 Collins Ferry Road
Morgantown, WV 26507-0880

Dear Mr. McKoy:

Thank you for the opportunity to review the documentation describing the proposed FutureGen Project. The closest alternative sites where this office might have some input are the Jewett and Odessa, Texas sites.

A review of the maps of these project alternative locations indicates that there are no tribal or Individual Indian trust lands within the areas of potential effect. The Bureau of Indian Affairs has no jurisdiction within the alternative project areas in the Jewett or Odessa areas. However, Tribes that have historic ties to the area may have some concern if the project has a potential to impact sites of importance in their histories or cultural traditions. We recommend that you contact the Kiowa Tribe of Oklahoma, the Comanche Nation, the Wichita and Affiliated Tribes, and the Mescalero Apache Tribe regarding the Odessa alternative and the Alabama-Coushatta Tribe of Texas, and the Caddo Nation regarding the Jewett alternative.

Sincerely,

Acting Regional Director

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United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Eastern Oklahoma Regional Office
P.O. Box 8002
Muskogee, OK 74402-8002

IN REPLY REFER TO:
Division of Environmental
Safety and Cultural Resources

Mr. Mark L. McKoy
U.S. Department of Energy
P. O. Box 880
Morgantown, West Virginia 26507-0880

JAN 2 2 2007

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Franklin Keel, Regional Director
Eastern Regional Office
545 Marriott Drive, Suite 700
Nashville, Tennessee 37214

Dan Deerinwater, Regional Director
Southern Plains Regional Office
P.O. Box 368
Anadarko, Oklahoma 73005-0368

If any additional information is required, please contact Mr. Bob Coleman, Division Chief, Division of Environmental, Safety and Cultural Resources, EORO, at (918) 781-4660.

Respectfully,

Regional Director

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APPENDIX B
PUBLIC SCOPING SUMMARY

B.1 INTRODUCTION

To ensure that all of the issues related to the FutureGen Project Environmental Impact Statement (EIS) are addressed, DOE invited comments on the proposed scope and content of the EIS from all interested parties. This process, referred to as scoping, began with an Advance Notice of Intent (ANOI) to Prepare an EIS for Implementation of the FutureGen Project published in the *Federal Register* on February 16, 2006, in which the public was requested to provide comments. On July 28, 2006, a Notice of Intent (NOI) was published announcing the four candidate site alternatives identified for evaluation and analysis in the EIS, and the formal public scoping period of July 28 through September 13, 2006, requesting public input. Following the NOI, a Notice of Public Scoping Meetings was published in the *Federal Register* on August 4, 2006, announcing the dates, times and locations of the public scoping meetings (see Section B.2).

The DOE National Energy Technology Laboratory (NETL) conducted the public scoping meetings in which government agencies, private-sector organizations, and the general public were invited to present verbal comments or suggestions with regard to the alternatives and impacts to be considered in the EIS. Scoping meetings were held in August 2006 near each proposed project site (see Table B-1). Oral comments were heard during the scoping meetings and transcribed.

The following issues were listed in the NOI. As part of the EIS process, DOE will address the issues when considering the potential impacts resulting from the siting, construction, and operation of the FutureGen power plant, sequestration site, and associated facilities. The environmental issues include:

- Air quality impacts: potential for air emissions during construction and operation of the power plant and appurtenant facilities to impact local sensitive receptors, local environmental conditions, and special-use areas, including impacts from smog and haze, and impacts from dust and any significant vapor plumes
- Noise and light impacts: potential impacts from construction, transportation of materials, and facility operations
- Traffic issues: potential impacts from construction and operation of the facilities, including changes in local traffic patterns, deterioration of roads, traffic hazards, and traffic controls
- Floodplains: potential impacts to flood flow resulting from earthen fills, access roads, and dikes that might be needed in a floodplain
- Wetlands: potential impacts resulting from fill, sediment deposition, vegetation clearing, and facility erection that might be needed in a wetland
- Visual impacts associated with facility structures: views from neighborhoods, impacts to scenic views (e.g., impacts from water vapor plumes, power transmission lines, pipelines), internal and external perception of the community or locality
- Historic and cultural resources: potential impacts from the site selection, design, construction, and operation of the facilities
- Water quality impacts: potential impacts from water utilization and consumption, and potential impacts from wastewater discharges
- Infrastructure and land use impacts: potential environmental and socioeconomic impacts of project site selection, construction, delivery of feed materials, and distribution of products (e.g., power transmission lines, pipelines)

- Marketability of products and market access to feedstock
- Solid wastes: pollution prevention plans and waste management strategies, including the handling of ash, slag, water treatment sludge, and hazardous materials
- Disproportionate impacts on minority and low-income populations
- Connected actions: potential development of support facilities or supporting infrastructure
- Ecological impacts: potential on-site and off-site impacts to vegetation, terrestrial wildlife, aquatic wildlife, threatened or endangered species, and ecologically sensitive habitats
- Geologic impacts: potential impacts from the sequestration of CO_2 and other captured gases on underground resources such as potable water supplies, mineral resources, and fossil fuel resources
- Ground surface impacts from CO_2 sequestration: potential impacts from leakage of injected CO_2, potential impacts from induced flows of native fluids to the ground surface or near the ground surface, and the potential for induced ground heave or microseisms
- Fate and stability of sequestered CO_2 and other captured gases
- Health and safety issues associated with CO_2 capture and sequestration
- Cumulative effects that result from the incremental impacts of the proposed project when added to other past, present, and reasonably foreseeable future projects
- Compliance with regulatory requirements and environmental permitting
- Environmental monitoring plans associated with the power plant and with the CO_2 sequestration site
- Mitigation of identified environmental impacts
- Ultimate closure plans for the CO_2 sequestration site and reservoirs

B.2 PUBLIC SCOPING MEETINGS

DOE held four public scoping meetings for the FutureGen Project EIS; the dates and locations of these meetings are shown in Table B-1. The meeting locations were selected based on their close proximity to the alternative site locations in Texas and Illinois.

Table B-1. Public Scoping Meeting Locations and Dates

Location	Date
Jewett (Fairfield), Texas City of Fairfield's Green Barn, Fairfield, Texas	August 22, 2006
Odessa (Midland), Texas Center for Energy and Economic Diversification (CEED) Building, Midland, Texas	August 24, 2006
Tuscola, Illinois Tuscola Community Building, Tuscola, Illinois	August 29, 2006
Mattoon, Illinois Riddle Elementary School, Mattoon, Illinois	August 31, 2006

In addition to the NOI and Notice of Public Scoping Meetings published in the *Federal Register,* DOE published notices in local newspapers during the weeks of August 13, 20, and 27, 2006, as shown in Table B-2. The public scoping period ended on September 13, 2006.

Table B-2. Dates and Publications for Advertisements

Meeting Location/ Newspaper	Dates of Publication
Jewett (Fairfield), TX (August 22, 2006)	
The Press	August 17, 2006
The Bryan-College Station Eagle	August 17, 19, 20, and 22, 2006
Jewett Messenger	August 16, 2006
Waco Tribune-Herald	August 17, 2006
Fairfield Recorder	August 17, 2006
Odessa (Midland), TX (August 24, 2006)	
Midland Reporter-Telegram	August 17, 20, and 23, 2006
Andrews County News	August 17 and 20, 2006
The Fort Stockton Pioneer	August 17, 2006
Odessa American	August 17, 20, and 24, 2006
El Seminario	August 17, 2006
Tuscola, IL (August 29, 2006)	
The Tuscola Review	August 22 and 29, 2006
The Regional	August 25, 2006
The Tuscola Journal	August 22, 2006
Tri-County Journal	August 24, 2006
The News-Gazette	August 22, 27, and 28, 2006
Mattoon, IL (August 31, 2006)	
Mattoon Journal Gazette	August 24, 27, and 30, 2006
Charleston Times Courier	August 24, 27, and 30, 2006
Decatur Herald and Review	August 24, 27, and 30, 2006

Each meeting began with an informal open house from 4:00 to 7:00 pm (Central Daylight Time) during which time attendees were given information packages about the project and were able to view project-related posters. DOE-NETL and FutureGen Project personnel were available to answer questions. Alliance and local representatives were also available at displays illustrating various features of the proposed project and proposed sites.

The informal open house was followed by a formal DOE presentation. The Jewett, Texas meeting began at 7:03 pm and adjourned at 9:32 pm; the Odessa, Texas meeting began at 7:01 pm and adjourned at 9:32 pm; the Tuscola, Illinois meeting began at 7:00 pm and adjourned at 9:34 pm, and the Mattoon, Illinois meeting began at 7:02 pm and adjourned at 10:38 pm. Collectively, 917 individuals attended the public scoping meetings; a few individuals attended more than one meeting (see Table B-3).

Table B-3. Attendance at Public Scoping Meetings

Meeting Location	Number of People in Attendance[1]
Jewett (Fairfield), Texas	171
Odessa (Midland), Texas	148
Tuscola, Illinois	234
Mattoon, Illinois	364
Total	**917**

[1] Based on individuals who signed the attendance sign-in sheets.

All attendees were invited to provide comments, either written or spoken, on the proposed project. Those attendees wishing to speak were given an opportunity to sign up to do so. Comment sheets were made available for all attendees wishing to provide written comments.

DOE-NETL led the presentations and presided over the four formal meetings. A court recorder was present at each meeting to ensure that all spoken comments were recorded and legally transcribed. A total of 132 individuals presented verbal comments (see Table B-4). In addition, individuals could request to receive the Draft EIS, Final EIS, or Summary (hard copy of the full EIS or a hard copy summary plus a compact disk [CD] that contains the entire EIS).

Table B-4. Verbal Comments Received during the Public Scoping Meetings

Meeting Location	Number of People who Gave Verbal Comments[1]
Jewett (Fairfield), Texas	30
Odessa (Midland), Texas	24
Tuscola, Illinois	31
Mattoon, Illinois	47
Total	**132**

[1] Based on transcripts for each meeting.

Anyone who wished to provide comments in writing was invited to do so by completing a comment card at the public scoping meetings and giving it to DOE or a FutureGen team member at the meeting. DOE-NETL also provided an e-mail address for members of the public who preferred to submit their comments electronically, a postal address for those who preferred to mail their comments, a telephone fax number for those who preferred to fax their comments, and a toll-free telephone number for those who preferred to provide spoken comments. In all, 318 comments were submitted via e-mail, mail, fax, or telephone, or at the public meetings (see Table B-5).

Table B-5. Number of Written Comments Received During the Scoping Period

Meeting Location	Number of Comments Received[1]
Jewett (Fairfield), Texas	47
Odessa (Midland), Texas	195
Tuscola, Illinois	24
Mattoon, Illinois	46
Tuscola and Mattoon[2]	2
Site not Specified	4
Total	**318**

[1] Includes comments received at public scoping meetings, by electronic mail, facsimile, U.S. Postal Service, or telephone.
[2] Comments were for both the Tuscola and the Mattoon sites, not one site specifically.

B.3 PUBLIC COMMENTS AND CONCERNS

Numerous comments were received with respect to specific natural and human environmental resources. The comments received were consolidated, summarized and categorized as appropriate into major groupings, including general comments about the project, the EIS and the scoping process; purpose and need for the Proposed Action; the Proposed Action; the alternative sites, and resource-specific concerns. Respondents expressed concerns about the need for the proposed FutureGen Project, both from the perspective of electricity demand and from the perspective of whether coal use is the best choice to meet that demand. In particular, some respondents stated that wind energy could be a more viable alternative to generate electricity. Questions were also raised about who would be responsible for monitoring the FutureGen Project. Comments also requested that connected actions such as other proposed development projects and cumulative impacts of reasonably foreseeable projects and the proposed FutureGen Project be considered in the EIS.

The majority of the comments were related to the use of natural resources (e.g., coal, land, water), the discharge of pollutants to the natural environment (e.g. air, water,), and the socioeconomic impacts of the project (e.g. jobs, taxes, property values). Comments were also received relating to wetlands impacts, vehicular and rail traffic, and demands on local community services (e.g., emergency responders, local water systems). Concerns were expressed about the potential for the project to be targeted by a terrorist group. Several comments were expressed about connected actions and the cumulative effects of current industrial activities and future projects planned within the vicinity of the alternative site locations. Respondents requested that project information and details be included in the EIS, including process information, information about the expected efficiency and reliability of the plant, feedstock, utilities and resource requirements, and emissions. Other comments showed concerns relative to the transmission corridors, pipelines and various other features. Questions and concerns were raised regarding the permanence and safety of geologic sequestration of CO_2. Table B-6 provides a summary of all substantive comments received that relate to the resource-specific areas. This table does not include all of the comments received; rather, it summarizes the general themes of public concern.

Table B-6. Summary of Comments Received

Resource Area	Comment
Air Quality	• What types and amounts of air pollutants, including mercury, would be emitted by the proposed FutureGen Project? • Consider the air emissions from sources other than the proposed power plant, including coal handling and storage, and construction of additional infrastructure.
Geology and Soils	• The EIS should evaluate what surface/subsurface fault activation may occur due to carbon sequestration. • The EIS should evaluate the impact of potential destruction that may result from a magnitude 5 or higher earthquake or other seismic event from any fault that may possibly impact the plant and the sequestration plan.
Water Resources and Floodplains	• The EIS should address the availability of the water supply. • How much non-point source water pollution would be generated by the FutureGen Project? • How much and where would the FutureGen Project affect floodplains? • What connections of saline aquifers with freshwater aquifers exist where carbon sequestration is proposed for the FutureGen Project? • The EIS should evaluate the impact of this facility on surface and groundwater that flows near or under the plant during construction and operation.
Wetlands	• How much and where would the FutureGen Project affect emergent and forested wetlands?
Ecological Resources	• The EIS should evaluate plant and wildlife that are currently on the endangered species list, including the Texas Horned Toad. • This EIS should include an analysis that quantifies air pollution, noise pollution, wildlife habitat loss, wildlife habitat fragmentation, and other environmental impacts.
Cultural Resources	• The EIS should evaluate archaeology in the area; there are some important Native American sites in this area which must be protected.
Land Use (including Prime Farmland)	• The EIS should evaluate how much land use change would occur due to the FutureGen Project. • The EIS should evaluate how much and where prime farmland would be affected due to the FutureGen Project.
Aesthetics	• The potential visual impacts of the proposed power plant and associated infrastructure (e.g., electrical lines) should be addressed in the EIS.
Traffic and Transportation	• The EIS should evaluate how the FutureGen Project would affect roads in the area or create the need to build more roads or improve roads. • The EIS should evaluate if congestion and connectivity would be affected due to the FutureGen Project. • If coal is to arrive by rail, would current infrastructure support new coal trains? How many trains and coal carloads would arrive per day or week? In many areas we have unguarded rail crossings, and bridges or overpasses that are impractical. What would be the cost of infrastructure improvements to permit this volume of rail traffic to function safely, and without large negative impacts on automobile traffic? What is the net energy yield expected from all this?

Table B-6. Summary of Comments Received

Resource Area	Comment
Noise	• An analysis of the noise that would be produced both during construction as well as operation of the plant, transmission lines and any pipelines used to sequester CO_2 should be undertaken including a complete analysis of the impact to any individual with hearing problems who may reside along or near hearing distance from the plant, pipeline, or transmission lines. • The EIS should evaluate noise levels from vibrations and noise generated by the unloading of approximately 200 train car loads of coal per week.
Utility Systems	• The EIS should evaluate what additional infrastructure is needed including pipelines, roads, storage facilities, pumping stations, etc. and the impacts on already damaged environments (for example, fragmentation of prairies, bottomland hardwoods, emergent wetlands, etc.). • The EIS should evaluate if existing transmission towers are sufficient to handle the expected 275 MW of electricity or if additional transmission lines would be required, and at what dollar cost and environmental impact.
Materials and Waste	• Does the FutureGen process generate ash like a normal lignite/Powder River Basin coal burning process? If not, how is it different? What happens to the mercury that generally resides in the lignite/coal? Is it captured for commercial use or disposal or is it somehow utilized in the process? Are there landfill operations needed with the FutureGen process? If so, how would that be handled? • The EIS should evaluate the impact of accumulating piles of ash/slag and sulfur generated by the gasification process until a market outlet for these products is found. • The EIS should evaluate if there is any real market for coal slag, and if the market is large enough to handle all that is expected to be produced. Slag contains silicates and mineral oxides, some of which are hazardous. If not appropriately handled, this would be an "emission" but of the solid rather than aerosolized type. How and where would it be disposed of if required, and at what impact?" • The EIS should include the types and amounts of various chemicals that would be used and stored.
Health and Safety	• With the current situation of globalized terrorism, locating this type of facility in a community would make it vulnerable to a terrorist attack. What plans would be put into place to protect the plant and local citizens? How much in additional resources would be required for police and fire support, and at what cost to taxpayers? Or would this public protection be just left to chance? • The site is located adjacent to a major highway. What is the risk of plant explosion or other accident, and what risks are posed to travelers and local citizens?
Community Services	• The EIS should evaluate how much the FutureGen Project could affect access to social and community services and resources and facilitate movement of emergency services.
Socioeconomics	• The EIS should evaluate how much development and what type of development had occurred before and would occur due to the FutureGen Project. • The EIS should evaluate how much the FutureGen Project would affect commercial/residential growth. • The EIS should evaluate the impact that the FutureGen Project could have on economic growth, including jobs, tax base and land values.

Table B-6. Summary of Comments Received

Resource Area	Comment
Risk Assessment	• What leaks from the aquifer system exist or could occur (thousands of oil/gas wells and water wells have been drilled over the past 50 years in Texas and the Gulf Coast) where the FutureGen Project would be located? • What is the potential for CO_2 injection to pressurize fluids already injected into or that naturally exist underground and what would their fate be? • What continuous monitoring program is needed to detect leaks for carbon sequestration systems? What mechanism would ensure that the long-term monitoring program needed for carbon sequestration would exist for an adequate time? • How would DOE ensure that CO_2 storage areas are leak-tight for hundreds/thousands of years? • What is the likelihood that injecting CO_2 underground would reverse subsidence? It is our understanding that subsidence is permanent due to the compression of clay layers underground. • What is the risk that CO_2-generated acids would weaken the concrete in well casings in the carbon sequestration area? • What are the effects of single/multiple existing wells (water, oil, gas, salt water injection, municipal waste, hazardous waste) in the carbon sequestration area? How many of these wells are unplugged in the FutureGen Project area? • How long would the well casings in the carbon sequestration area remain leak free? • How would one predict when CO_2 migration/movement would stop (threshold of immobility) in relation to property boundaries on the surface of the carbon sequestration area? • Who would require that models are continually updated using monitoring results and updated scientific information for carbon sequestration? • The EIS should address what would happen in the event of a pipeline leak or rupture.

APPENDIX C
FEDERAL AND STATE REGULATORY AND PERMITTING REQUIREMENTS

This section identifies and summarizes statutes, regulations, Executive Orders, and permitting requirements potentially applicable to construction and operation of the proposed FutureGen Project.

C.1 FEDERAL ENVIRONMENTAL STATUTES AND REGULATIONS

C.1.1 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

DOE prepared this EIS according to Council on Environmental Quality regulations (40 CFR Parts 1500 through 1508) which implement the procedural requirements of the National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4321 *et seq.*). NEPA requires agencies of the federal government to study the environmental impacts of major federal actions significantly affecting the quality of the human environment.

NEPA establishes an environmental policy for the nation, provides an interdisciplinary framework for environmental planning by federal agencies, and contains procedures to ensure that federal agency decision-makers take environmental factors into account. Under NEPA, Congress authorizes and directs federal agencies to carry out their regulations, policies, and programs as fully as possible in accordance with the statute's policies on environmental protection.

C.1.2 CLEAN AIR ACT (CAA)

The Clean Air Act (CAA), as amended (42 USC 7401 *et seq.*) establishes National Ambient Air Quality Standards (NAAQS) set by EPA for certain pervasive pollutants: SO_2, CO, O_3, NO_2, Pb, and PM (i.e., both PM_{10} and $PM_{2.5}$). NAAQS are expressed as concentrations of the criteria pollutants in the ambient air, which is the outdoor air to which the general public has access [40 CFR 50.1(e)]. Primary standards are set to protect the public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards are set to protect public welfare, including protection against decreased visibility plus damage to animals, crops, vegetation, and buildings. Table C.1-1 lists the NAAQS.

The CAA contains emission limiting programs and permit programs to protect the nation's air quality. Regulations implementing the CAA are found in 40 CFR Parts 50 through 95 and are summarized in Table C.1-2. The CAA also establishes New Source Performance Standards, 40 CFR Part 60, that establish requirements for new or modified sources such as design standards, equipment standards, work practices, or operational standards. The New Source Performance Standards are technology-based standards applicable to new and modified stationary sources of regulated air emissions. Where the NAAQS emphasize air quality in general, the New Source Performance Standards focus on particular sources of approximately 70 industrial source categories or sub-categories of sources (e.g., fossil fuel-fired generators, grain elevators, steam generating units) that are designated by size and type of process.

Under the CAA, a new major source is required to obtain a Prevention of Significant Deterioration (PSD) Construction Permit and a Title V Operating Permit. The States of Texas and Illinois have been delegated the authority to issue these permits to assure compliance with all CAA requirements.

Table C.1-1. National Ambient Air Quality Standards

Pollutant	Averaging Times	Primary Standards	Secondary Standards
SO_x	Annual (Arithmetic Mean)	0.03 ppm	None
	24-hour [1]	0.14 ppm	None
	3-hour [1]	None	0.5 ppm (1300 µg/m^3)
NO_2	Annual (Arithmetic Mean)	0.053 ppm (100 µg/m^3)	Same as Primary
PM_{10}	Annual [2] (Arithmetic Mean)	Revoked	None
	24-hour [3]	150 µg/m^3	None
$PM_{2.5}$	Annual [4] (Arithmetic Mean)	15.0 µg/m^3	Same as Primary
	24-hour [5]	35 µg/m^3	None
CO	8-hour [1]	9 ppm (10 mg/m^3)	None
	1-hour [1]	35 ppm (40 mg/m^3)	None
O_3	8-hour [6]	0.08 ppm (235 µg/m^3)	Same as Primary
Pb	Quarterly Average	1.5 µg/m^3	Same as Primary

[1] Not to be exceeded more than once per year.
[2] Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the agency revoked the annual PM_{10} standard in 2006 (effective December 17, 2006).
[3] Not to be exceeded more than once per year on average over 3 years.
[4] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
[5] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).
[6] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
Source: EPA, 2006

Table C.1-2. Air Quality Regulations

Regulation	Citation	Description
Prevention of Significant Deterioration (PSD)	40 CFR Part 52.21 35 IAC Part 201 30 TAC Chapter 116	The PSD is a pre-construction review and permit process for construction and operation of a new or modified major stationary source in attainment areas. A major source is a source for which the amount of any one regulated pollutant emitted equal to or greater than thresholds of 100 tons per year (tpy) for sources which are part of the 28 categories defined by the PSD rule. Additionally, the emissions from a major source are significant if they exceed the significant emissions rates defined in the PSD. The required PSD review consists of the following elements: • An ambient air quality impact analysis to demonstrate that the potential emissions from the proposed project will not cause or contribute to a violation of the applicable PSD increments and NAAQS. • An assessment of the direct and indirect effects of the proposed project on general growth, soil, vegetation, and visibility. Additionally, a source that might impact a Class I federal area must undergo additional review. • A case-by-case Best Available Control Technology (BACT) demonstration, which takes into account energy, environmental, and economic impacts as well as technical feasibility. • An ambient air quality monitoring program for up to one year may be required if no other representative data are available and if the project impacts are greater than a monitoring ***de minimis*** level. • Public comment, including an opportunity for a public hearing. The proposed Mattoon, Tuscola, Jewett, and Odessa Power Plant Sites and the sequestration sites would be subject to the PSD regulations containing sources identified in one of the 28 PSD categories. It would be defined as a major source because it would have the potential to emit pollutants above the significance thresholds. The proposed power plant would have the potential to emit more than 100 tons (91 metric tons) annually of more than one criteria pollutant.

Table C.1-2. Air Quality Regulations

Regulation	Citation	Description
New Source Performance Standards (NSPS)	40 CFR Part 60 35 IAC Part 203 30 TAC Chapter 122	The federal NSPS are technology-based standards applicable to new and modified stationary sources of regulated air emissions. Where the NAAQS emphasize air quality in general, the NSPS focus on particular sources of pollutants. The NSPS program sets uniform emission limitations for approximately 70 industrial source categories or sub-categories of sources (e.g., fossil fuel-fired generators, grain elevators, steam generating units) that are designated by size as well as type of process. The standards that would potentially apply to the proposed Mattoon, Tuscola, Jewett, and Odessa Power Plant Sites are as follows: • Subpart A – General Provisions, which provides for general notification, record keeping, and monitoring requirements. • Subpart Da – Standards of Performance for Electric Utility Steam Generating Units For Which Construction is Commenced After September 18, 1978; which applies to any electric utility combined cycle gas turbine that combusts more than 250 MMBtu/hour (73 MW) heat input of fossil fuel in the steam generator. As amended in February 2006, this provision is applicable to combined cycle units that burn 75 percent or more (by heat input) synthetic-coal gas. • Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units, which covers the supplementary fired heat recovery steam generator (HRSG) and natural gas-fired auxiliary boiler because its heat input will be greater than 100 MMBtu/hr (29.2 MW). Subpart GG - Standards of Performance for Stationary Combustion Turbines: The air pollution emission standards, (40 CFR Part 60.332 and 60.333) limit flue gas concentrations of NO_X to a value of no more than 75 ppm (based on the turbine heat rate and the fuel-bound nitrogen) and SO_2 to 150 ppm or 0.8% sulfur in fuel. 40 CFR Part 60, Subpart GG also requires monitoring of fuel sulfur and nitrogen content, and allows for the development of a custom schedule to monitor these parameters. The proposed emissions are well below compliance levels for Subpart GG. • Subpart HHHH – Emission Guidelines and Compliance Times for Coal-Fired Electric Steam Generating Units: Subpart HHHH was included as part of the Clean Air Mercury Rule promulgated on March 15, 2005 (70 FR 28606). See Section 2.5.1 Power Plant and Research User Facility for a description of the power plant process. • Subpart Y – Standards of Performance for Coal Preparation Plants: Coal handling capacity at the IGCC power station will exceed 200 tons (181 metric tons) per day, and is therefore subject to this NSPS. Additionally, the provisions of this subpart require the installation of a continuous emission monitoring system (CEMS) to monitor fuel consumption and water-to-fuel ratio. A determination of the applicability will not be made until more detailed plant design parameters have been established.

Table C.1-2. Air Quality Regulations

Regulation	Citation	Description
National Emissions Standards for Hazardous Air Pollutants (NESHAP)	40 CFR Parts 61 and 63 35 IAC Part 201 30 TAC Chapter 113	Non-criteria pollutants that can cause serious health and environmental hazards are termed hazardous air pollutants (HAPs) or air toxics. The 1970 CAA Amendments required EPA to promulgate national emissions standards for hazardous air pollutants to protect the public health and welfare with an ample margin of safety. Due to the difficulty in establishing health risks for HAPS, EPA identified and regulated only eight pollutants: asbestos, benzene, beryllium, inorganic arsenic, mercury, radionuclides, and vinyl chloride. The 1990 CAA Amendments, Section 112, changed the regulatory approach for controlling HAPs, basing it instead on available control technology. Subsequently, a list of 188 compounds to be controlled as HAPS was developed. The 1990 CAA Amendments define two types of NESHAP emissions standards: maximum achievable control technology (MACT) and generally available control technology (GACT). Unlike the health-based standards established under the initial NESHAPs, the MACT standards are technology-based emission limits that take into account available methodologies for controlling emissions of targeted HAPs from each source category. In general, a source is subject to a MACT standard if it is in a source category regulated under 40 CFR 63 and it is part of a facility that is defined as a major source for HAPs. A source is defined as a major source for HAPs if it emits a single HAP in excess of 10 tons (9.1 metric tons) per year or an aggregate emission rate of over 25 tons (22.7 metric tons) per year of any combination of regulated HAPs. GACTs are less stringent emission standards based on the use of more standard technologies and work practices. The FutureGen Project would be required to comply with 40 CFR 63, Subpart Da. It would be a source that emits mercury, a regulated HAP. However it would not emit mercury in annual quantities that exceed the thresholds for a major source and would not be subject to MACT or GACT provisions.
Clean Air Interstate Rule (CAIR)	Section 110 of the CAA Amendments 35 IAC Part 225 30 TAC Chapter 101, Subchapter H, Division 7. 30 TAC Chapter 122.	On March 10, 2005, EPA issued the CAIR, a rule that will achieve the largest reduction in air pollution of SO_2 and NO_X. The goal of the rule is to permanently cap emissions of SO_2 and NO_X from electric generating units (EGU) in the eastern United States so as to address $PM_{2.5}$ and ground-level O_3 transport. CAIR would achieve large reductions of SO_2 and NO_X emissions across 28 states (including Illinois and Texas) and the District of Columbia. When fully implemented, CAIR is expected to reduce SO_2 emissions in these states by over 70 percent and NO_X emissions by over 60 percent from 2003 levels. CAIR is expected to help sources in Illinois reduce emissions of SO_2 by 34 percent and NO_X by 55 percent, by 2015 and is expected to help sources in Texas reduce emissions of SO_2 by 39 percent and NO_X by 25 percent, by 2015. Illinois has proposed new rules under 35 IAC Part 225 to govern the SO_2 annual, NO_X annual, and NO_X ozone season portions of the CAIR cap and trade program. These proposed rules were submitted to the Illinois Pollution Control Board on May 30, 2006. The FutureGen Project would be subject to the CAIR provisions, which are applicable to all electric generating units in Illinois. On July 12, 2006, the TCEQ adopted the CAIR rules and plans, and adopted an alternate NO_X allowance allocation methodology. The rules apply to stationary, fossil fuel-fired boilers or fossil fuel-fired combustion turbines serving a generator with nameplate capacity of more than 25 megawatts-electrical (MWe) and producing electricity for sale. The rules also apply to cogeneration units serving a generator with nameplate capacity of more than 25 MWe and supplying in any calendar year more than one-third of the unit's potential electric output capacity or 747.7 billion Btu (219,000 megawatt-hours [MWh]), whichever is greater, to any utility power distribution system for sale.

Table C.1-2. Air Quality Regulations

Regulation	Citation	Description
Clean Air Mercury Rule (CAMR)	Section 111 of the CAA Amendments 35 IAC Part 225 30 TAC Chapter 101, Subchapter H, Division 8. 30 TAC Chapter 122	In December 2000, EPA announced that it was "appropriate and necessary" to regulate and control emissions of mercury and other air toxics from coal- and oil-fired electric utilities under Section 111 of the CAA Amendments (i.e., the MACT requirements). In January 2004, under the CAA, EPA was given the authority to regulate power plant mercury emissions by establishing performance standards or MACT, whichever the agency deems most appropriate. On March 15, 2005, EPA revised and reversed its December 2000 finding and issued the CAMR, which creates performance standards and establishes permanent, declining caps on mercury emissions from coal-fired power plants. The CAMR establishes "standards of performance" limiting mercury emissions from new and existing coal-fired power plants, and creates a market-based cap-and-trade program. New coal-fired power plants ("new" means construction starting on or after January 30, 2004) will have to meet stringent new source performance standards in addition to being subject to the caps. The FutureGen Project, if sited in Illinois, would be subject to the CAMR provisions, which are applicable to all sites in Illinois. On November 2, 2006, the Illinois Pollution Control Board approved the proposed rule for control of mercury emissions from coal-fired electrical generating facilities. The proposal adopted by the Board includes a mercury emissions standard of 0.0080 lb/GWh or a 90 percent reduction from input mercury by mid-year 2009, a temporary technology based standard, and a multi-pollutant control system. The rule will now be submitted to the Joint Committee on Administrative Rules (JCAR) for final review. The FutureGen Project, if sited in Texas, would be subject to the CAMR provisions, which are applicable to all sites in Texas. On July 12, 2006, TCEQ adopted the CAIR and CAMR rules and plans. In October 2005 (70 FR 62200), EPA agreed to reconsider certain aspects of its determination that regulation of electric utility steam generating units under Section 111 of CAA was neither necessary nor appropriate, which would have removed coal- and oil-fired utility units from the list of source categories. However, EPA declined to issue a stay, and the CAMR remains in effect. The CAMR is a closely related action to the CAIR, which is discussed above. Together, the CAMR and the CAIR are expected to create a multi-pollutant strategy to reduce emissions throughout the United States.

Table C.1-2. Air Quality Regulations

Regulation	Citation	Description
Acid Rain Program	40 CFR Parts 72 through 78	The EPA established a program to control emissions that contribute to the formation of acid rain. The overall goal of the Acid Rain Program is to achieve significant environmental and public health benefits through reductions in emissions of SO_2 and NO_X, the primary causes of acid rain. The acid rain regulations are applicable to "affected units" as defined in the regulations. The objectives of the program are achieved through a system of marketable allowances, which are used by utility units to cover their SO_2 emissions. One allowance means that an affected utility unit may emit up to 1 ton of SO_2 during a given year. Utilities cannot emit more tons of SO_2 than they hold in allowances. Allowances may be bought, sold, or traded, and any allowances that are not used in a given year may be banked and used in the future. Owners or operators of an affected unit are subject to the following Acid Rain Program requirements: • Acid Rain Permit Application, which must be submitted at least 24 months prior to the date of initial operation of the unit. • SO_2 emission allowances, which are to be secured on an annual basis. • NO_X emission limitations. • Acid Rain Compliance Plan. • Continuous emissions monitoring requirements for NO_X, SO_2, and opacity. The proposed FutureGen Project would be subject to the Acid Rain Program requirements because it meets the definition of an affected unit under 40 CFR72.6(3)(i).
Compliance Assurance Monitoring (CAM) Rule	40 CFR Part 64 35 IAC Part 201 30 TAC Chapter 122	The CAM Rule applies to facilities that have emission units located at major sources subject to Title V air quality permitting and that use control devices to achieve compliance with emission limits. It requires that these facilities monitor the operation and maintenance of their control equipment to evaluate the performance of their control devices and report if they meet established emission standards. If these facilities find that their control equipment is not working properly, the CAM rule requires them to take action to correct any malfunctions and to report such instances to the appropriate enforcement agency (i.e., State and local environmental agencies). The FutureGen Project would be a major source that would require an operating permit and would need to demonstrate compliance with the CAM Rule.

Table C.1-2. Air Quality Regulations

Regulation	Citation	Description
Regional Haze Rule	40 CFR Part 55, §§ 51.300 through 51.309 30 TAC Chapter 101, Subchapter H, Division 7. 30 TAC Chapter 122. Proposed TX BART Rules	In July 1999, EPA published the Regional Haze Rule to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas. By December 2007, states must submit to U.S. EPA a Regional Haze State Implementation Plan (SIP) that identifies sources that cause or contribute to visibility impairment in these areas. The Regional Haze SIP must also include a demonstration of reasonable progress toward reaching the 2018 visibility goal for each of the state's Class I areas. The Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the CAA. Those older sources that could contribute to visibility impairment in Class I areas may be required to install emissions controls. The regional haze rule requires each state's SIP to require emission controls known as best available retrofit technology (BART), for certain industrial facilities emitting air pollutants that reduce visibility by causing or contributing to regional haze. Because both the proposed Mattoon and Tuscola power plants would be new facilities, they would not have to meet the BART requirement. However, under the PSD requirements, a new source of criteria and air toxics emissions has to be analyzed to determine its impacts on Class I area visibility. The proposed plant sites would be located more than 186 miles (300 km) from the nearest Class I area subject to the regional haze rule. Therefore, both sites would not be required to conduct a Class I area impact analysis under the Regional Haze Rule. Currently, the TCEQ is developing state versions of the BART rule and CAIR to comply with Federal Clean Air Act requirements. The Texas BART rule is scheduled for proposal in August 2006 and adoption in January 2007. The Texas CAIR was proposed in Spring 2006 and adopted by the TCEQ in July 2006. Because both the proposed Jewett and Odessa power plants would be a new facility, they would not have to meet the BART requirement. However, under the PSD requirements, a new source of criteria and air toxics emissions has to be analyzed to determine its impacts on Class I area visibility. The proposed plant sites would be located more than 186 miles (300 km) from the nearest Class I area subject to the regional haze rule. Therefore, both sites would not be required to conduct a Class I area impact analysis under the Regional Haze Rule.

Table C.1-2. Air Quality Regulations

Regulation	Citation	Description
Chemical Accident Provisions	40 CFR Part 68 and Section 112(r) of the CAA Amendments 35 IAC Part 201 30 TAC Chapter 122	This regulation applies to stationary sources having more than a threshold quantity of the specific regulated toxic and flammable chemicals. It is intended to prevent accidental releases to the air and to mitigate the consequences of any such releases by focusing prevention measures on chemicals that pose the greatest risk to the public and the environment. Stationary sources covered by this regulation must develop and implement a risk management program that includes a hazard assessment, a prevention program, and an emergency response program. These elements are to be described in a risk management plan that must be submitted to EPA as well as state and local emergency planning authorities. The plan must also be made available to the public by the date that a regulated substance is first present in a process above a threshold quantity. Under the Illinois Accidental Release Prevention Program, the FutureGen Project, if sited in Illinois, would be required to comply with the Chemical Accident Provisions if there were a potential to emit hydrogen sulfide above the accidental release threshold quantities. Because the Alliance has indicated that a 19 percent aqueous ammonia solution would be used (which is below the 20 percent applicability threshold), the ammonia stored on site would not be subject to the accidental release provisions. Under the Texas Accidental Release Prevention Program, the FutureGen Project, if sited in Texas, would be required to comply with the Chemical Accident Provisions if there were a potential to store either hydrogen sulfide or ammonia above the accidental release threshold quantities. Because the Alliance has indicated that a 19% aqueous ammonia solution would be used, which is below the 20% applicability threshold, the ammonia stored on site would not be subject to the accidental release provisions.
General Conformity Rule	40 CFR, Parts 6, 51 and 93 30 TAC Chapter 101.30	An area that does not meet (or contributes to ambient air quality in a nearby area that does not meet) the primary or secondary NAAQS for a pollutant is referred to as a nonattainment area. The CAA requires states to submit to the EPA a State Implementation Plan (SIP) for attainment of the NAAQS in nonattainment areas. The 1977 and 1990 amendments to the CAA require comprehensive plan revisions for areas where one or more of the standards have yet to be attained. The 1990 Amendments to the CAA required federal actions to show conformance with the SIP. Federal actions are those projects that are funded by federal agencies and include the review and approval of a proposed action through the NEPA process. Conformance with the SIP means conformity to the approved SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS, and achieving expeditious attainment of such standards. The need to demonstrate conformity is applicable only to areas that are not in compliance with the NAAQS or areas that were previously in nonattainment for one or more pollutants and are currently designated as maintenance areas. A federal action will fall under the jurisdiction of either the General Conformity Rule or the Transportation Conformity Rule. The Transportation Conformity Rule covers highway and transit projects. The proposed FutureGen Project is a federal action under the jurisdiction of the General Conformity Rule. However, all four proposed plant sites and sequestration sites are located regions that are in attainment for all criteria pollutants. Therefore, a project located at these sites would not be subject to the General Conformity Rule.

C.1.3 CLEAN WATER ACT (CWA)

The Clean Water Act (CWA) of 1977, as amended (33 USC 1251 *et seq.*) focuses on improving the quality of water resources by providing a comprehensive framework of standards, technical tools, and financial assistance to address the many causes of pollution and poor water quality, including municipal and industrial wastewater discharges and polluted runoff from urban and rural areas. Under provisions of the CWA, an applicant for a federal license or permit to conduct any activity that may result in a discharge to navigable waters must provide the federal agency with a Section 401 certification. The certification, made by the state in which the discharge originates, declares that the discharge will comply with applicable provisions of the CWA, including water quality standards. Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects, infrastructure development, and conversion of wetlands to uplands for farming and forestry. A federal permit is required to discharge dredged or fill material into wetlands and other waters.

C.1.4 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

The Resource Conservation and Recovery Act (RCRA), as amended (42 USC 6901 *et seq.*) regulates the treatment, storage, and disposal of hazardous wastes. The plant is expected to generate small volumes of hazardous maintenance-related waste, and would be a conditionally exempt small quantity generator under federal and state hazardous waste regulations. The proposed power plant would obtain a generator identification number and would temporarily store small volumes of wastes onsite in secure containers prior to transport offsite to an authorized treatment, storage, recycling, or disposal facility.

C.1.5 NATIONAL HISTORIC PRESERVATION ACT (NHPA)

The National Historic Preservation Act of 1966 (NHPA), as amended (16 USC 470 *et seq.)* and its implementing regulations, 36 CFR 800, requires DOE to consult with the State Historic Preservation officer (SHPO) prior to construction to ensure that no historical properties would be affected by the proposed project. DOE must also afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed project.

C.1.6 ARCHAEOLOGICAL RESOURCES PROTECTION ACT

The Archaeological Resources Protection Act, as amended (16 USC 470aa *et seq.*) requires a permit for excavation or removal of archaeological resources from publicly held or Native American lands. The Act requires that excavations further archaeological knowledge in the public interest, and that the resources removed remain the property of the United States.

C.1.7 AMERICAN INDIAN RELIGIOUS FREEDOM ACT

The American Indian Religious Freedom Act of 1978 (42 USC 1996) reaffirms Native American religious freedom under the First Amendment of the U.S. Constitution, and establishes policy to protect and preserve the inherent and Constitutional right of Native Americans to believe, express, and exercise their traditional religions. This law ensures the protection of sacred locations and access of Native Americans to those sacred locations and traditional resources that are integral to the practice of their religions. It also establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by construction and operation of the proposed facilities.

C.1.8 NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION ACT

The Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001) directs the Secretary of the Interior to guide the repatriation of Federal archaeological collections and collections that are culturally affiliated with Native American tribes and held by museums that receive Federal funding. Actions required by this law include establishing a review committee with monitoring and policy-making responsibilities, developing regulations for repatriation including procedures for identifying lineal descent or cultural affiliation needed for claims, overseeing museum programs designed to meet the inventory requirements and deadlines of this law, and developing procedures for handling unexpected discoveries of graves or grave artifacts during activities on Federal or tribal land. DOE would follow the provisions of this Act if any excavations associated with the proposed construction led to unexpected discoveries of Native American graves or grave artifacts.

C.1.9 ENDANGERED SPECIES ACT

The Endangered Species Act of 1973 (ESA), as amended (16 USC 1531 *et seq.*) establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants; and the preservation of the ecosystems on which they depend. Section 7, "Interagency Cooperation," requires any federal agency authorizing, funding, or carrying out any action to ensure that the action is not likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of critical habitat of such species. Regulations implementing the applicable interagency consultation process of the Endangered Species Act are codified at 50 CFR Part 402.

C.1.10 FISH AND WILDLIFE CONSERVATION ACT

The Fish and Wildlife Conservation Act of 1980 (16 USC 2901 *et seq.*) encourages federal agencies to conserve and promote conservation of non-game fish and wildlife species and their habitats. In addition, the Fish and Wildlife Coordination Act (16 USC 661 *et seq.*) requires federal agencies undertaking projects affecting water resources to consult with the U.S. Fish and Wildlife Service (FWS) and the state agency responsible for fish and wildlife resources. These agencies are to be sent copies of this EIS and their comments will be considered.

C.1.11 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

The National Pollutant Discharge Elimination System (33 USC 1342 *et seq.*), authorized under the CWA, requires sources to obtain permits to discharge effluents and stormwaters to surface waters. Regulations implementing the NPDES program are found in 40 CFR 122. Under this program, permit modifications are required if discharge effluents are altered. The CWA authorizes EPA to delegate permitting, administrative and enforcement duties to state governments, while EPA retains oversight responsibilities. The States of Texas and Illinois have been delegated NPDES authority and therefore would issue the NPDES permit. The proposed project involves discharge to surface waters and would be subject to NPDES requirements.

C.1.12 NOISE CONTROL ACT

Section 4 of the Noise Control Act of 1972, as amended (42 USC 4901 *et seq.*) directs Federal agencies to carry out programs in their jurisdictions "to the fullest extent within their authority" and in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare.

C.1.13 FARMLAND PROTECTION POLICY ACT

The Farmland Protection Policy Act (7 USC 4201 *et seq.*) directs federal agencies to identify and quantify adverse impacts of federal programs on farmlands. The Act's purpose is to minimize the number of federal programs that contribute to the unnecessary and irreversible conversion of agricultural land to non-agricultural uses.

C.1.14 EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT

Under Subtitle A of the Emergency Planning and Community Right-to-Know Act of 1986 (42 USC 1001 *et seq.*), which is also known as Superfund Amendments and Reauthorization Act, Title III; and Executive Order 13148, "Greening the Government through Leadership in Environmental Management," Federal agencies must provide information on hazardous and toxic chemicals to state emergency response commissions, local emergency planning committees, and the U.S. Environmental Protection Agency. The goal of providing this information about inventories of specific chemicals used or stored, and descriptions of releases that could occur at work sites is to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. This act, implemented at 40 CFR Parts 302 through 372, requires agencies to provide reports on material safety data sheets, emergency and hazardous chemical inventory, and toxic chemical releases to appropriate local, state, and federal agencies. These regulations also require facilities that store, dispense, use, or handle extremely hazardous materials in excess of specified thresholds to report quantity data to specific agencies and organizations. The plant would manufacture, process, or otherwise use a number of substances subject to the Act's reporting requirements, such as some trace amounts of metals and mercury.

C.1.15 OCCUPATIONAL SAFETY AND HEALTH ACT

Compliance with the Occupational Safety and Health Act of 1970, as amended (29 USC 651 *et seq.*) would be required. Specifically, the construction and general industry rules in 29 CFR Parts 1910 and 1926 apply. Plant employees would be instructed in worker protection and safety procedures, and would be provided appropriate personal protective equipment pursuant to the plant's safety program.

C.1.16 SAFE DRINKING WATER ACT

The Safe Drinking Water Act (42 USC 300 *et seq.*) gives the U.S. Environmental Protection Agency the responsibility and authority to regulate public drinking water supplies by establishing drinking water standards, delegating authority for enforcement of drinking water standards to the states, and protecting aquifers from hazards such as injection of wastes and other materials into wells. The State agencies responsible for enforcement are the Illinois Environmental Protection Agency and the Texas Commission on Environmental Quality. Drinking water regulations for this program are codified at 40 CFR 141, Title 35 of the Illinois Administrative Code, and 30 TAC Chapter 290.

C.1.17 POLLUTION PREVENTION ACT

The Pollution Prevention Act of 1990 (42 USC 13101 *et seq.*) establishes a national policy for waste management and pollution control that focuses first on source reduction, and then on environmentally safe waste recycling, treatment, and disposal. Two executive orders provide guidance to agencies to implement the Pollution Prevention Act. Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition," directs Federal agencies to incorporate waste prevention and recycling in each agency's daily operations and work to increase and expand markets for recovered materials through preference and demand for environmentally preferable products and services. Executive Order 13148, "Greening the Government through Leadership in Environmental Management," makes the head of each Federal agency responsible for ensuring that all necessary actions are taken to integrate environmental accountability into agency day-to-day decision-making and long-term planning across all agency missions, activities, and functions.

DOE requires specific goals to reduce the generation of waste. DOE would implement a pollution prevention plan by incorporating such waste-reducing activities as ordering construction materials in correct sizes and number, resulting in very small amounts of waste; and implementing best management practices to reduce the volume of waste generated and reuse waste wherever possible.

C.1.18 NOTICE TO THE FEDERAL AVIATION ADMINISTRATION

The Federal Aviation Administration must be notified if any structures more than 200 feet high would be constructed at the proposed site pursuant to 14 CFR Part 77. The FAA would then determine if the structures would or would not be an obstruction to air navigation. It is anticipated that the proposed power plant would include a 250-foot stack.

C.2 EXECUTIVE ORDERS

Executive Order 11514, “Protection and Enhancement of Environmental Quality,” directs federal agencies to continuously monitor and control activities to protect and enhance the quality of the environment. The Order also requires agencies to develop procedures to ensure the fullest practical provision of timely public information and the understanding of Federal plans and programs with potential environmental impacts, and to obtain the views of interested parties. DOE promulgated regulations (10 CFR Part 1021) and issued DOE Order 451.1B, *National Environmental Policy Act Compliance Program*, to ensure compliance with this Executive Order. Because the Proposed Action is a Federal action that requires NEPA analysis, DOE must comply with Order 451.1B.

Executive Order 11988, “Floodplain Management,” directs federal agencies to establish procedures to ensure that they consider potential effects of flood hazards and floodplain management for any action undertaken. Agencies are to avoid impacts to floodplains to the extent practical. Executive Order 11990, “Protection of Wetlands,” requires federal agencies to avoid short and long term impacts to wetlands if a practical alternative exists. Compliance with Floodplain and Wetland Environmental Review Requirements at 10 CFR Part 1022 establishes DOE procedures for compliance with these two Executive Orders.

For a proposed floodplain or wetland action, DOE shall prepare a floodplain or wetland assessment. If DOE finds that no practicable alternative to locating or conducting the action in the floodplain or wetland is available, then before taking the action DOE shall design or modify its action in order to minimize potential harm to or within the floodplain or wetland, consistent with the policies set forth in Executive Order 11988 and Executive Order 11990. DOE is also required to provide opportunity for public review after issuance of a notice of a proposed floodplain action or a notice of proposed wetland action.

Executive Order 12856, “Right to Know Laws and Pollution Prevention Requirements,” directs federal agencies to establish programs to provide the public with important information on the hazardous and toxic chemicals in their communities, and establish emergency planning and notification requirements to protect the public in the event of a release of extremely hazardous substances.

Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” directs federal agencies to identify disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.

Executive Order 13112, “Invasive Species,” directs federal agencies to prevent the introduction of or to monitor and control invasive (non-native) species, to provide for restoration of native species, to conduct research, to promote educational activities, and to exercise care in taking actions that could promote the introduction or spread of invasive species.

Executive Order 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds,” requires federal agencies to avoid or minimize the negative impacts of their action on migratory birds, and to take active steps to protect birds and their habitats. For actions having or likely to have a negative impact on migratory bird populations, work with the FWS to develop an agreement to conserve migratory birds. Federal agencies must avoid or minimize impacts to migratory bird populations, take reasonable steps that include restoring and enhancing habitat, prevent or abate pollution affecting birds, and incorporate migratory bird conservation into agency planning processes whenever possible. The Executive Order also requires environmental analyses of federal actions to evaluate effects of those actions on migratory birds, to control the spread and establishment in the wild of exotic animals and plants that could harm migratory birds and their habitats, and either to provide advance notice of actions that could result in the take of migratory birds or to report annually to the FWS on the numbers of each species taken during the conduct of agency actions.

Executive Order 13423, “Strengthening Federal Environmental, Energy, and Transportation Management,” directs Federal agencies to “…conduct their environmental, transportation, and energy-related activities…in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner.”

C.3 STATE ENVIRONMENTAL STATUTES AND REGULATIONS

C.3.1 ILLINOIS REGULATORY REQUIREMENTS

C.3.1.1 State Endangered Species and Natural Areas Review

State agencies and local governments which authorize, fund or perform actions altering environmental conditions must consult with the Illinois Department of Natural Resources pursuant to 520 ILCS 10 and 525 ILCS 30, in order to avoid or minimize adverse impacts.

C.3.1.2 Farmland Conversion Impact

Because both the Mattoon and Tuscola, IL proposed sites are on agricultural land, DOE would be required to follow the procedures in the Farmland Conversion Impact, 7 CFR 658, to (a) identify and take into account the adverse effects of its program on the preservation of farmland; (b) consider alternative actions, as appropriate, that could lessen adverse effects; and (c) ensure that its program, to the extent practicable, is compatible with State and units of local government, as well as private programs and policies to protect farmland.

C.3.1.3 State Wetland Review

A state wetland review conducted by the Illinois Department of Natural Resources pursuant to 20 ILCS 830 would be required if it is determined that wetlands are present on either the proposed site or on transmission or pipeline corridors.

C.3.1.4 Consultation under the National Historic Preservation Act

The National Historic Preservation Act, 16 USC 470 *et seq.,* would require DOE to consult with the Illinois Historic Preservation Agency in order to fulfill the requirements under Section 106 of the Act.

C.3.1.5 Notice to the Illinois Department of Transportation, Aeronautics Division

The Illinois Department of Transportation, Aeronautics Division must be notified if any structures more than 200 feet high would be constructed at the proposed site pursuant to 92 IAC Part 16. It is anticipated that the proposed power plant would include a 250-foot stack.

C.3.2 TEXAS REGULATORY REQUIREMENTS

C.3.2.1 State Endangered Species

Endangered Species are regulated under Chapter 68 of the Texas Parks and Wildlife Code and 31 TAC Chapter 65, Subchapter G. Texas Parks and Wildlife Department regulations prohibit the taking, possession, transportation, or sale of any of the animal species designated by state law as endangered or threatened without the issuance of a permit. State laws and regulations prohibit commerce in threatened and endangered plants, and the collection of listed plant species from public land without a permit issued by the Texas Parks and Wildlife Department. Although it is unlikely that construction and operations of the proposed facilities would disturb an endangered species, DOE would comply with all applicable requirements.

C.3.2.2 Consultation under the National Historic Preservation Act

The National Historic Preservation Act, 16 USC 470 *et seq.,* would require DOE to consult with the Texas Historical Commission in order to fulfill the requirements under Section 106 of the Act.

C.3.2.3 Solid Waste Management, On-Site Disposal of Nonhazardous Industrial Solid Waste

The Texas Commission on Environmental Quality would regulate any solid, non-product waste generated. The regulations would include proper waste classification, notification and reporting under 30 TAC Ch. 335. Any hazardous waste generated and disposed or treated on site would be subject to permitting. Texas does not require a permit for nonhazardous industrial solid waste that is disposed of within the site boundaries of the industrial plant generating the waste unless the disposal site is greater than 50 miles (80 kilometers) from the point of generation.

C.3.2.4 Registration with the Public Utility Commission of Texas

Power generation plants operating within the State of Texas must register with the Public Utility Commission of Texas pursuant to Public Utility Commission Substantive Rule Section 25.109.

C.3.2.5 Surface Casing Letters

The Texas Water Code Sections 27.015 and 27.033 requires a letter from the Texas Railroad Commission addressed to the Texas Commission on Environmental Quality concluding that drilling or using the underground injection control, disposal well and injection of industrial wastes will not endanger or injure any known oil or gas reservoir. Likewise, the regulation requires a letter from the Texas

Commission on Environmental Quality addressed to the Texas Railroad Commission concluding that drilling and injecting oil and gas waste into the subsurface stratum will not endanger the freshwater strata in the area, and that the formation or stratum to be used for the disposal is not freshwater sand.

C.4 FEDERAL AND STATE PERMITTING

Table C.1-3 lists all potentially applicable federal and state permitting requirements to construct and operate the proposed facilities.

Table C.1-3. Permit or Approval Requirements to Construct and Operate the Proposed Facilities

Permit or Approval	Description
Federal	
Acid Rain Permit 40 CFR Part 72	Required for utility units exceeding threshold limits specified in the regulation cited. This permit is a part of the larger Title V permit, issued pursuant to the Clean Air Act.
Airspace Obstruction Control Permit 14 CFR Part 77	An Airspace Obstruction Control Permit would be required if the proposed facilities were built in Tuscola, IL. The Tuscola airport is located less than 1 mile (1.6 kilometers) from the northern border of the proposed plant site. The Illinois Department of Transportation, Aeronautics Division has been granted the authority to issue the permit.
Clean Air Act, Title I, IV, and V 40 CFR Parts 50 – 96	Establishes NAAQS set by the EPA for certain pervasive pollutants. Applicable Titles: Title I—Air Pollution Prevention and Control. A Prevention of Significant Deterioration permit would be required if the plant would have the potential to emit 100 tons per year or more of a pollutant subject to regulation under the Clean Air Act. Regulated air pollutants include SO_2, NO_x, and CO. Title IV—Acid Deposition Control. An Acid Deposition Control permit would be required. This title establishes limitations on SO_2 and NO_x emissions. This Title requires that emissions of SO_2 from utility sources be limited to the amounts of allowances held by the sources. Title V—Permitting. An Operating Permit is required if the plant falls within 40 CFR 70.3 designations. This Title provides the basis for the Operating Permit Program and establishes permit conditions, including monitoring and analysis, inspections, certification, and reporting. A Title V permit would also cover any requirements established under the Clean Air Interstate Rule or the Clean Air Mercury Rule. Authority for implementation of the permitting program has been delegated to the states of Illinois and Texas.

Table C.1-3. Permit or Approval Requirements to Construct and Operate the Proposed Facilities

Permit or Approval	Description
Clean Water Act, Title IV 40 CFR Parts 104 – 140	Focuses on improving the quality of water resources by providing a comprehensive framework of standards, technical tools, and financial assistance to address the many causes of pollution and poor water quality, including municipal and industrial wastewater discharges, polluted runoff from urban and rural areas, and habitat destruction. Applicable Sections: Section 401—Certification. Provides states with the opportunity to review and approve, condition, or deny all Federal permits or licenses that might result in a discharge to state or tribal waters, including wetlands. The major Federal permit subject to Section 401 review is a Section 404 permit. Every applicant for a Section 404 permit must request state certification that the proposed activity will not violate state or Federal water quality standards. Section 402—NPDES Permit. Requires sources to obtain permits to discharge effluents and stormwaters to surface waters. A pollution prevention plan is required. The CWA authorizes EPA to delegate permitting, administrative, and enforcement duties to stage governments, while EPA retains oversight responsibilities. Illinois and Texas have been delegated NPDES authority and therefore would issue the NPDES permit. Section 404—Permits for Dredged or Fill Material. Regulates the discharge of dredged or fill material in the jurisdictional wetlands and waters of the United States. The USACE has been delegated the responsibility for authorizing these actions.
Notice to the Federal Aviation Administration 14 CFR Part 77	The FAA must be notified if any structures more than 200 ft. high would be constructed at the proposed site pursuant to 14 CFR Part 77. The FAA would then determine if the structures would or would not be an obstruction to air navigation.
Pretreatment Authorization for Discharge of Wastewater to Municipal Collection System 40 CFR Part 403	A permit is required if wastewater is to be discharged to a municipal water treatment facility.
Resource Conservation and Recovery Act (RCRA) of 1976 40 CFR Parts 239 through 299	Regulates the treatment, storage, and disposal of hazardous wastes. Project participants would be required to identify any residues that require management as hazardous waste under RCRA (40 CFR Part 261). For some waste streams, this includes testing waste samples using the toxic characteristic leaching procedure or other procedures that measure hazardous waste characteristics. Applicable Title: Title II—Solid Waste Disposal (known as the Solid Waste Disposal Act), regulates the disposal of solid wastes. Title II, Subtitle C—Hazardous Waste Management, provides for a regulatory system to ensure the environmentally sound management of hazardous wastes from the point of origin to the point of final disposal. Title II, Subtitle D—State or Regional Solid Waste Plans. Illinois and Texas have been delegated the authority to issue RCRA permits.

Table C.1-3. Permit or Approval Requirements to Construct and Operate the Proposed Facilities

Permit or Approval	Description
Rivers and Harbor Act Permit 33 CFR Part 322	Permit for structures or work in or affecting navigable waters of the United States.
Sales Tap Approval 18 CFR 157.211	Approval would be required to tap into or modify existing interstate gas pipelines.
Underground Injection Control Permit 40 CFR Part 144	The Safe Drinking Water Act was established to protect all underground sources of drinking water. A sequestration well would require a permit issued according to 40 CFR Part 144 requirements. The states of Texas and Illinois have been granted the authority to issue these permits.
Illinois State Permitting	
Accommodation of Utilities on Right-of-Way 92 IAC Part 530	A public entity acting in the capacity of a utility must obtain a permit issued by an officer of the elected governing body.
Air Construction Permit 35 IAC Parts 201 and 203	Applicable if a Title I Prevention of Significant Deterioration permit under the federal CAA is not required.
Air Operating Permit 35 IAC Part 201, 203 and 205	Applicable to minor sources if a Title V operating permit under the federal CAA is not required.
Certificate of Public Convenience and Necessity Section 3-105 and 8-406 of the Illinois Public Utilities Act	A certificate would be required if the plant is determined to be a public utility.
Interconnection Agreement	If an interconnection agreement is required with an owner of a transmission system, approval by the Illinois Commerce Commission may be required.
NPDES Permit 35 IAC Part 309	Requires sources to obtain permits to discharge effluents and stormwaters to surface waters.
NPDES General Construction Stormwater Permit 35 IAC, Subtitle C, Chapter 1	Requires sources to submit a notice of intent for coverage under Permit No. ILR10, applicable to stormwater discharge from construction sites disturbing 1 acre or more of land.
NPDES General Industrial Stormwater Permit 35 IAC Subtitle C, Chapter 1	Requires sources to submit a notice of intent for coverage under Permit No. ILR00, applicable to stormwater discharges associated with industrial activity.
Permit for Groundwater Monitoring Wells 77 IAC 920	The Illinois Department of Pubic Health, Environmental Health Division and local health departments review water well installation plans, issue permits for new well construction, and inspect wells.
Permit for Nonhazardous Onsite Waste Disposal Facility 35 IAC Parts 812 and 813	The Illinois Environmental Protection Agency (IEPA) could require a permit under 35 IAC Parts 812 and 813 if it determines that the disposal facility is environmentally significant. If the IEPA decides that a permit is not necessary, the operator would be subject to the reporting requirements of 35 IAC Part 815.
Potable Water Supply Connection Permits ILCS, Chapter 415	A permit would be required to connect to a public potable water supply.

Table C.1-3. Permit or Approval Requirements to Construct and Operate the Proposed Facilities

Permit or Approval	Description
Prevention of Significant Deterioration (PSD) Permit 40 CFR 52.21	Required if the plant would have the potential to emit 100 tons per year or more of a pollutant subject to regulation under the CAA. Regulated pollutants include SO_2, NO_x, and CO. A PSD Permit would be issued by the state or local air pollution control agency.
RCRA Permit Program 35 IAC 702 and 703	A RCRA permit would be required for treatment and storage of hazardous waste if the waste quantities and storage durations exceed applicable thresholds. It is anticipated that hazardous waste management would occur under generator accumulation standards, subject to notification and reporting requirements but exempt from permitting.
Underground Injection Control Permit 35 IAC Parts 704 and 730	A CO_2 injection well could be either a Class I or Class V well. Expected upcoming guidance from the Environmental Protection Agency will affect this determination.
Wastewater Facility Construction Approval ILCS, Chapter 415	Construction of wastewater treatment equipment would require an approval from the Illinois Environmental Protection Agency.
City of Tuscola and Douglas County, IL Permitting (Tuscola Site)	
Construction and Building Permits Tuscola Code of Ordinances, Chapters 150 through 153	Permits would be required for new building construction, any new installation or alteration of electrical equipment, any new heating unit, and any new plumbing.
Permit required for any connection to a public sewer Tuscola Code of Ordinances, Chapter 51	A permit would be needed to connect to the City of Tuscola sewer system.
City of Mattoon and Coles County, IL Permitting (Mattoon Site)	
Construction and Building Permits Mattoon Code of Ordinances Chapters 150, 151, 152 and 156	Building permits would be required. The City of Mattoon has adopted the International Building Code, the International Fire Code, the International Mechanical Code, the International Maintenance Code, the National Electric Code, and the Illinois State Plumbing Code.
Permit required for any connection to a public sewer Mattoon Code of Ordinances § 50.046	A permit would be needed to connect to the City of Mattoon sewer system.
Permit required to take water from the City of Mattoon's water plant or distribution system Mattoon Code of Ordinances § 51.016	A permit and a meter issued by the Public Works Director of the City of Mattoon would be required to take water from the City's distribution system.
Permit Required for Building Occupancy Mattoon Code of Ordinances § 159.67	A permit must be issued by the Building/Code Official stating that the building and use comply with all of the building and health laws.
Private sewage disposal system permit Mattoon Code of Ordinances § 50.026	A permit would be required for a private sewage disposal system issued by the Superintendent of the City of Mattoon.
Texas State Permitting	
Air Construction Permit 30 TAC Ch. 106	Applicable if it is determined that a Title I Prevention of Significant Deterioration permit under the federal CAA would not be required.

Table C.1-3. Permit or Approval Requirements to Construct and Operate the Proposed Facilities

Permit or Approval	Description
Air Operating Permit 30 TAC Ch. 122	Applicable to minor sources if it is determined that a Title V operating permit under the federal CAA would not be required.
Hydrostatic Test Water Discharge Permit Texas Water Code, Section 26.040	If hydrostatic test water is discharged, a Texas Pollutant Discharge Elimination System General Permit No. TXG670000 would be required.
NPDES General Construction Stormwater Permit Texas Water Code, Section 26.040	NPDES permit for stormwater discharge required for construction sites disturbing 1 acre or more of land.
NPDES General Industrial Stormwater Permit Texas Water Code, Section 26.040	Permit for stormwater discharges associated with industrial activity.
Permit for Groundwater Withdrawal and Monitoring Wells Texas Water Code, Chapter 36	Permits would be required from the Mid-East Texas Groundwater Conservation District if it is determined that groundwater from Leon or Freestone counties is needed for the plant.
Prevention of Significant Deterioration (PSD) Permit 40 CFR 52.21	Required if the plant would have the potential to emit 100 tons per year or more of a pollutant subject to regulation under the CAA. Regulated pollutants include SO_2, NO_x, and CO. A PSD Permit would be issued by the state or local air pollution control agency.
Registration with the Public Utility Commission of Texas Public Utility Commission Substantive Rule, Section 25.109	Power generation companies must register with the Public Utility Commission of Texas.
RCRA Permit Program 30 TAC Ch. 305	A RCRA permit would be required for treatment and storage of hazardous waste if the waste quantities and storage durations exceed applicable thresholds. It is anticipated that hazardous waste management would occur under generator accumulation standards, subject to notification and reporting requirements but exempt from permitting.
Solid Waste Management, On-Site Disposal of Nonhazardous Industrial Solid Waste 30 TAC Ch. 335	Any hazardous waste generated and disposed or treated on site would be subject to permitting under this chapter.
Underground Injection Control Permit 30 TAC Ch. 331 and Railroad Commission of Texas (RRC) 16 TAC 3.9 and 3.46	A CO_2 injection well would be a Class V well in Texas. Authorization from the Texas Council on Environmental Quality is required for injection below the base of usable quality water and that is not projective of oil, gas, or geothermal resources. Authorization from the Railroad Commission of Texas is required for injection into a reservoir that is productive of oil, gas, or geothermal resources.
Septic Permit for Onsite Sewage Facility Texas Health and Safety Code, Ch. 366 and 30 TAC Ch. 285	A permit would be required for an onsite sewage facility.

APPENDIX D
RISK ASSESSMENT METHODOLOGY

There are numerous human-health and ecological issues associated with the construction and operation of any large coal-fueled electric power generation facility. The FutureGen Project would represent a technological advancement in power generation that integrates advanced coal gasification technology, the production of hydrogen from coal, electric power generation, and carbon dioxide (CO_2) capture and geologic storage. Carbon capture and storage technology is an innovative method for reducing greenhouse gas emissions, but the new technology comes with added design and operational complexities and potential health, safety and environmental risks. The FutureGen Project Risk Assessment (TetraTech, 2007) addressed the potential human-health and environmental effects associated with the capture of CO_2 and other trace gases at the power plant, gas transportation via pipeline to the geologic storage site, and subsurface storage. The risk assessment was conducted to support the preparation of an Environmental Impact Statement (EIS) for the FutureGen Project. The technical approach and methodology employed in this risk assessment are described below.

The approach to risk analysis for CO_2 capture and sequestration in geologic formations is still evolving. However, a substantial amount of information exists on the assessment and management of releases associated with the geologic storage of CO_2 from natural-gas storage, deep injection of hazardous waste, and the injection of either gaseous or supercritical CO_2 in hydrocarbon reservoirs for enhanced oil recovery. There are also numerous projects underway at active CO_2 injection sites to determine the long-term fate of CO_2 injected into deep geological formations. The FutureGen Project Risk Assessment relied heavily on the technical approaches and findings from these previous and ongoing projects. However, the FutureGen Project Risk Assessment was based largely on site-specific information. The risk assessment also utilized a common set of performance characteristics and hazard scenarios to provide a basis for comparing the four candidate sites.

The risk assessment was conducted according to a work plan reviewed by a panel of carbon capture/storage and risk assessment experts. The approved work plan provided a detailed description of the approach applied to the analysis of the identified pre- and post-injection risk issues. There were five primary elements outlined in the risk assessment:

- Conceptual Site Models (CSMs)
- Toxicity Assessment
- Risk Evaluation for the Capture and Transport of Gaseous Emissions (Pre-Injection)
- Risk Evaluation for the Storage of CO_2 and Hydrogen Sulfide (H_2S) in Subsurface Reservoirs (Post-Injection)
- Risk Screening and Performance Assessment

A central task in the FutureGen Project Risk Assessment was the development of the conceptual site models (CSMs) for the four proposed locations. Potential exposure pathways of gas release during capture, transport and storage were identified. The chemicals involved in the capture and sequestration process and their potential short-term and long-term health effects were identified and discussed. Then, detailed descriptions for each of the four candidate sites were provided. These descriptions included population and community characteristics, general surface features, aquatic and terrestrial ecology, and the geologic features that were critical to the determination of the feasibility of subsurface injection and sequestration of gaseous emissions from the power plant.

A toxicity assessment was conducted to review chemical toxicity data and to identify chemicals of potential concern that could cause adverse human-health and environmental effects. These data provided the basis for the comparison of estimated exposures and the assessment of potential risks. CO_2 was the main chemical in this analysis, but toxicity data were also compiled and evaluated for other chemicals, including H_2S, carbon monoxide, methane, mercury, and cyanide. The most important outcome of this analysis was the selection of benchmark concentrations for chemicals of potential concern. These benchmarks, developed for each potential exposure scenario and several different effect levels, served as the basis for the evaluation of potential risk to human populations and identified ecological receptors.

The risks associated with the capture and transport of gaseous emissions, prior to injection into the geologic reservoirs, were evaluated separately from the post-injection or subsurface phases of the FutureGen Project. The surface portion of the risk assessment evaluated the potential risks associated with the plant and aboveground facilities for separating, compressing and transporting CO_2 to the injection site. Failures of the engineered system evaluated included: pipeline rupture, pipeline puncture (i.e., releases through a small hole), and rupture of the wellhead injection equipment. Accidental releases from the pipeline or wellhead, although expected to be infrequent, could potentially affect the general public in the vicinity of a release. The carbon dioxide pipeline failure frequency was calculated based on data contained in the on-line library of the Office of Pipeline Safety (http://ops.dot.gov/stats/IA98.htm). Accident data from 1994-2006 indicated that 31 accidents occurred during this time period. DOE chose to categorize the two accidents with the largest carbon dioxide releases (4000 barrels and 7408 barrels) as rupture type releases, and the next four highest releases (772 barrels to 3600 barrels) as puncture type releases. For comparison, 5 miles (8 km) of FutureGen pipeline would contain about 6500 barrels, depending on the pipeline diameter. Based on data in Gale and Davison (2004), the rupture and puncture failure frequencies were calculated to be 5.92×10^{-5}/(km-yr) and 1.18×10^{-4}/(km-yr), respectively, assuming the total length of pipeline involved was approximately 1616 miles (2600 km). The annual pipeline failure frequencies used in this assessment were calculated based on the site-specific pipeline lengths. The failure rate of wellhead equipment during operation was estimated as 2.02×10^{-5} per well per year based on natural gas injection-well experience from an IEA GHG Study (Papanikolau et al., 2006).

Simulation models were used to estimate the emission of CO_2 for the aboveground release scenarios when the gas is in a supercritical state. The SLAB model developed by the Lawrence Livermore National Laboratory and approved by U.S. EPA was used to simulate denser-than-air gas releases for both horizontal jet and vertically elevated jet scenarios. The model simulations were conducted for the case with CO_2 at 95 percent and H_2S at 100 parts per million by volume (ppmv). The state of the contained captured gas prior to release is important with respect to temperature, pressure, and the presence of other constituents. Release of CO_2 under pressure would likely cause rapid expansion and then reduction in temperature and pressure, which can result in formation of solid-phase CO_2, as explained in Appendix C-III of the risk assessment. The estimated quantity of solid-phase formed was 26 percent of the volume released; therefore 74 percent of the volume released from a pipeline rupture or puncture was used as input to the SLAB model for computing atmospheric releases of CO_2 and H_2S. Carbon dioxide is heavier than air and subsequent atmospheric transport and dispersion can be substantially affected by the temperature and density state of the initially released CO_2. The meteorological conditions at the time of the release would also affect the behavior and potential hazard of such a release.

The potential effects of CO_2 and H_2S releases from pipeline ruptures and punctures were evaluated using an automated "pipeline-walk" analysis. The "pipeline-walk" analysis was developed to determine impacts of pipeline accidents along the entire length of the proposed CO_2 pipelines. The analysis examined each pipeline at 300-meter (984-foot) intervals, starting at the power plant and ending at the injection site. Site specific meteorological data were applied and an accident (rupture or puncture) computer simulation model (SLAB model) was run for 112 defined atmospheric states to determine the potential impact zone. At each 300-meter interval, population density information from the 2000 Census was applied to each of the impact zones to provide a weighted-average or expected number of persons affected. The total number of persons reported as affected by a release at each interval was determined by multiplying the number of individuals in each segment of the impact zone by the proportion of time (relative importance) of each of the 112 atmospheric states. The methodology is described in detail in Section 4.4.2 and Appendix C-IV of the risk assessment) The predicted concentrations in air were used to estimate the potential for exposure and any resulting impacts on plant workers, nearby residents, sensitive receptors, and ecological receptors.

The post-injection risk assessment presents the analysis of potential impacts from the release of CO_2 and H_2S after the injection into subsurface reservoirs. A key aspect of this analysis was the compilation of a database that included the site characteristics and results from studies performed at other CO_2 storage locations, and from sites with natural CO_2 accumulations and releases.

The analog-site database includes information on leakage of CO_2 from existing injection sites and natural releases. Information has been obtained on four existing injection sites, 16 natural CO_2 sites in sedimentary rock formations, and 17 sites in volcanic or geothermal areas. The types of information collected include: description of the zone with CO_2, physical characteristics of the primary and secondary seals and secondary porous zone (if present), information on shallow groundwater and surface water, nearby faults, numbers of nearby wells, the amount of CO_2 released from leakage or a natural event, the conditions present at that time, and any known effects. Not all information was pertinent for a given site and not all the information could be obtained.

This database was used for characterizing the nature of potential risks associated with surface leakage through cap-rock seal failures, faults, fractures or wells. CO_2 leakage from the target reservoirs was estimated using a combination of relevant industry experience, natural analog studies, modeling, and expert judgment. Both qualitative and quantitative analyses were conducted to evaluate risks from potential releases. A qualitative risk screening of the four candidate sites was presented based upon a systems analysis of the site features and scenarios portrayed in the CSM. Risks were qualitatively weighted and prioritized using procedures identified in a health, safety, and environmental risk screening and ranking framework for geologic CO_2 storage site selection. More detailed evaluations were conducted by estimating potential gas emission rates and durations from the analog database for a series of release scenarios and using the results of model simulations of subsurface leakage presented in the final Environmental Information Volumes.

Three scenarios could potentially cause acute effects: upward leakage through the CO_2 injection wells; upward leakage through the deep oil and gas wells; and upward leakage through undocumented, abandoned, or poorly constructed wells. Six scenarios could potentially cause chronic effects: upward leakage through caprock and seals by gradual failure; release through existing faults due to effects of increased pressure; release through induced faults due to effects of increased pressure (local over-pressure); upward leakage through the CO_2 injection wells; upward leakage through the deep oil and gas wells; and upward leakage through undocumented, abandoned, or poorly constructed wells. For the chronic-effects case for the latter three well scenarios, the gas emission rates were estimated to be at a lower rate for a longer duration. The atmospheric transport of released gas from these potential post-injection releases was estimated through modeling using a U.S. Environmental Protection Agency-approved screening model. The predicted concentrations in air were used to estimate the potential for exposure and any resulting impacts on workers, nearby residents, sensitive receptors, and ecological receptors. Other scenarios including catastrophic failure of the caprock and seals above the sequestration reservoir and fugitive emissions were discussed, but not evaluated in a quantitative manner.

The risk screening and performance assessment section of the risk assessment presents comparisons for each site to appropriate health-effects criteria for CO_2 and H_2S. Risk ratios (i.e., the ratio between the predicted atmospheric gas concentration and the benchmark health-effects criteria) were calculated for both human and ecological receptors. A risk ratio less than one indicates that the effect is unlikely to occur. Higher risk ratios generally represent the potential for higher levels of health concern, although regulatory derived toxicity values include safety factors to ensure protection of sensitive individuals. Probabilities for each of the identified exposure scenarios were calculated from the best data presently available for annual frequencies and for site-specific factors that affect the outcomes at each site. A range of probabilities associated with the identified exposure scenarios was presented and discussed.

APPENDIX E
AIR MODELING PROTOCOL

Air quality analyses are performed to determine whether emissions from construction and operation of a proposed new source, in conjunction with other applicable emissions increases and decreases from existing sources (i.e., modeled existing source impacts plus measured background), will cause or contribute to a violation of any applicable national ambient air quality standards (NAAQS) or Prevention of Significant Deterioration (PSD) increments.

E.1 FUTUREGEN PROJECT DESIGN CASES

The Alliance in consultation with DOE developed an initial conceptual design for the generation of electricity from coal with capture and sequestration of CO_2. To provide bounding conditions for the EIS analysis, a range of outputs were developed based on the four technology cases: Cases 1, 2, 3A and 3B. These cases share many components and processes in common (such as coal receiving and storage, oxygen supply, gas cleanup, and power generation), with the primary difference being the type of gasifier technology used (FG Alliance, 2007). Cases 1, 2, and 3A are stand-alone alternatives that are capable of meeting the design requirements of the project. The Alliance is considering a design in which an optional case, Case 3B, is coupled with either Case 1, 2, or 3A. Case 3B is a smaller, side-stream power train that would enable more research and development (R&D) activities than the main train of the power plant (Cases 1, 2, and 3A). Case 3A is similar to Case 1, except the gasifier output is greater.

One goal of the FutureGen Project is to demonstrate gasification technology over a range of different coal types. Therefore, the facility would be designed to use bituminous, sub-bituminous, and lignite coals. For developing the performance boundary, the Alliance assumed for each technology design case the most stringent operating condition using three coal types: Powder River Basin (PRB) sub-bituminous, Illinois Basin (Illinois) bituminous, and Northern Appalachia Pittsburgh (Pittsburg) bituminous. To provide a conservative assessment of impacts, the Alliance's assumptions and quantities for air emissions represent the upper bound of the range of possible impacts. The upper bound for air emissions was derived by assuming facility operations would result in the highest emission rate for individual pollutants (e.g., nitrogen dioxide [NO_2]) selected from among Cases 1, 2, and 3A plus Case 3B, including any unplanned restart emissions as a result of plant upset. Therefore, while used to develop the performance boundary, the aggregate upper bound is worse than any single technology case under consideration. Table E-1 provides a summary of the air emissions for each technology design case.

> **Plant upset** is a serious malfunction of any part of the IGCC process train and usually results in a sudden shutdown of the combined-cycle unit's gas turbine and other plant components.

Table E-1. Stack Emissions for Each Technology Case Per Coal Type [1]

	Case 1			Case 2			Case 3A			Case 3B		
	Pittsburgh	**Illinois**	**PRB**	**Pittsburgh**	**Illinois**	**PRB**	**Pittsburgh**	**Illinois**	**PRB**	**Pittsburgh**	**Illinois**	**PRB**
Coal Data												
Sulfur (wt% dry)	2.3	3.1	0.3	2.3	3.1	0.3	2.3	3.1	0.3	2.3	3.1	0.3
mass Sulfur (lb/hr)	5204.4	7761.8	897.9	4939.1	7630.0	1129.9	4826.5	7453.3	1095.2	2260.7	3492.4	493.1
mass SO_2 (lb/hr)	10408.8	15523.7	1795.9	9878.2	15260.1	2259.9	9653.0	14906.5	2190.4	4521.4	6984.8	986.3
Coal Input (lb/hr)	224745	248370	281167	213287	244153	353809	208425	238577	342790	97625	111791	154349
Coal HHV (Btu/lb)	13001	11505	8567	13001	11505	8567	13001	11505	8567	13001	11505	8567
Coal Input (MMBtu/hr)	2922	2857	2409	2773	2809	3031	2710	2745	2937	1269	1286	1322
Emission Rates (lb/MMBtu)												
SO_X	0.0003	0.0004	0.0001	0.0005	0.0008	0.0001	0.0005	0.0008	0.0001	0.0066	0.0099	0.0014
NO_X	0.0448	0.0438	0.0383	0.0447	0.0438	0.0409	0.0499	0.0492	0.0448	0.0496	0.0476	0.0499
PM_{10}	0.0063	0.0065	0.0075	0.0067	0.0068	0.006	0.0069	0.0069	0.0062	0.007	0.0084	0.0044
CO	0.0454	0.0445	0.0389	0.0453	0.0445	0.0415	0.0506	0.0499	0.0454	0.0201	0.0193	0.0203
VOC	0.0015	0.0014	0.0012	0.0015	0.0014	0.0013	0.0016	0.0016	0.0015	0.0028	0.0027	0.0028
Hg	0.7153	0.5386	0.5799	0.7153	0.5386	0.5799	0.7153	0.5386	0.5799	0.7153	0.5386	0.5799

Table E-1. Stack Emissions for Each Technology Case Per Coal Type [1]

	Case 1			Case 2			Case 3A			Case 3B		
	Pittsburgh	Illinois	PRB	Pittsburgh	Illinois	PRB	Pittsburgh	Illinois	PRB	Pittsburgh	Illinois	PRB
Emission Rates (lb/hr)												
SO_X	0.9	1.1	0.2	1.4	2.25	0.3	1.4	2.2	0.3	8.4	12.7	1.9
NO_X	130.9	125.2	92.3	124.0	123.0	124.0	135.2	135.0	131.6	63.0	61.2	66.0
PM_{10}	18.4	18.6	18.1	18.6	19.1	18.2	18.7	18.9	18.2	8.9	10.8	5.8
CO	132.7	127.2	93.7	125.6	125.0	125.8	137.1	137.0	133.3	25.5	24.8	26.8
VOC	4.38	4.0	2.9	4.2	3.9	3.9	4.3	4.39	4.41	3.6	3.5	3.7
Hg	0.00209	0.00154	0.00140	0.00198	0.00151	0.00176	0.00194	0.00148	0.00170	0.00091	0.00069	0.00077
Emission Rates (tons/yr)												
SO_X	3.3	4.3	0.9	5.2	8.37	1.1	5.0	8.2	1.1	31.2	47.4	6.9
NO_X	487.3	466.0	343.5	461.5	458.1	461.5	503.4	502.8	489.8	234.4	227.9	245.7
PM_{10}	68.5	69.1	67.3	69.2	71.1	67.7	69.6	70.5	67.8	33.1	40.2	21.7
CO	493.9	473.4	348.8	467.7	465.4	468.3	510.5	509.9	496.4	95.0	92.4	99.9
VOC	16.3	14.9	10.8	15.5	14.6	14.7	16.1	16.4	16.4	13.2	12.9	13.8
Hg	0.0078	0.0057	0.0052	0.0074	0.0056	0.0065	0.0072	0.0055	0.0063	0.0034	0.0026	0.0029

[1] Based on maximum operation load of 85 percent (i.e., 7446 hours per year).
Source: FG Alliance, 2007.

E.2 MODELED EMISSIONS RATES AND ASSUMPTIONS

The proposed FutureGen Project's estimated maximum annual air emissions (see Table E-2) represent an upper bound for assessing potential impacts for this EIS. The estimates are based on performance data from numerous manufacturer vendors and are not representative of a complete coal-to-product integrated design. Because the FutureGen Project would serve as a research and development (R&D) platform, DOE and the Alliance estimate that the power plant availability would be 85 percent. Full-scale testing, research, and operation would be conducted for a period of four years (i.e., the R&D period); however operation of the plant for commercial use could continue for decades.

Table E-2. FutureGen Project's Estimated Maximum Air Emissions (tons per year)

Air Pollutant	Maximum Emissions of Case 1, 2, or 3A [1]	Maximum Emissions of Case 3B [2]	Maximum Unplanned Restart Emissions	FutureGen Project's Estimated Maximum Air Emissions [3]
Sulfur Oxides (SO_X)	8.37	47.40	487[5]	543
Nitrogen Oxides (NO_X) [4]	503.4	245.7	9	758
Particulate Matter ($PM_{10}/PM_{2.5}$)	71	40	0	111
Carbon Monoxide (CO)	510	100	1	611
Volatile Organic Compounds (VOCs)	16	14	0	30
Mercury (Hg)	0.008	0.003	0	0.011

[1] Cases 1, 2, or 3A represent the main train of the power plant.
[2] Case 3B represents a smaller, side-steam power train.
[3] Equal the sum of the maximum emissions of Case 1, 2, or 3A plus maximum emissions of Case 3B plus the maximum unplanned restart emissions. Based on maximum operating load of 100 percent and 85 percent plant availability.
[4] NO_x emissions from coal combustion are primarily nitric oxide (NO); however, for the purpose of the air dispersion modeling it was assumed that all NO_x emissions are nitrogen dioxide (NO_2). One of the technologies being considered for the FutureGen Project is post-combustion selective catalytic reduction (SCR), which would reduce the annual NO_2 emissions in this base case to 249 tons per year.
[5] SO_x emissions from coal combustion systems are predominantly in the form of sulfur dioxide (SO_2). SO_2 emissions would be higher during restarts since the syngas flow to the flare would not have been processed for sulfur recovery.
Source FG Alliance, 2007.

The proposed FutureGen Project's estimated maximum air emissions include emissions from steady-state, planned startups, and unplanned restarts conditions. Steady-state is the normal operating condition of the proposed power plant, when the system is operating properly. The maximum steady-state air emissions are the maximum air emissions of the Cases 1, 2, and 3A (i.e., the main train of the power plant) plus the maximum air emissions for Case 3B (i.e., the smaller, side-steam power train).

During unplanned restarts, there are intermittent increases of emissions due to the need to flare process gases for a short period of time. Although unplanned restart events cannot be predicted, the Alliance has conceptually categorized these emissions by unit operations that would likely cause the event and they include: the air separation unit trip; the gasifier trip, the acid gas removal system trip, the claus unit trip, and the power island trip. Table E-3 provides the number of unplanned restarts associated with these five events that would be likely for the first through the fourth year of operations, as well as DOE estimated restarts for the years after the R&D period.

Table E-3. Potential Unplanned Restart Events Per Year During the R&D Operations Phase

Affected Units	Year One	Year Two	Year Three	Year Four	Year Five and beyond
Air Separation Unit	6	4	3	3	1
Gasifier (including coal prep)	8	2	2	1	0
Acid Gas Removal system (including shift unit & CO_2 compressor)	7	6	5	5	1
Claus Unit	1	0	0	0	0
Power Island	7	6	4	4	1
Total each year	**29**	**18**	**14**	**13**	**3**

Source: FG Alliance, 2006e.

The Alliance estimates that the first year of the R&D period would have the most unplanned restarts; therefore, the first year served as the upper-bound for modeling analysis. During the fifth year, it is assumed that the R&D period would come to an end and normal operations would begin.

To estimate air quality impacts associated with unplanned restarts emissions, DOE developed a "worst case" profile based on the occurrence of a single plant upset mode following prolonged steady state operations with an immediate return to steady-state emissions. The steady-state and unplanned restart emissions used for the air dispersion modeling analysis are provided in Table E-4. The modeled emissions rates are the same for each of the four proposed power plant sites. Variances in actual emissions resulting from ambient operating conditions at each proposed site were not factored into the emission estimate. Unplanned restarts air emissions during plant upset tend to be very high compared to those during steady-state operation because of the mass emissions rates occurring instantaneously during a short period (i.e., minutes or hours). Assumptions used for the duration of plant upset events are provided in Table E-5. The modeled scenario (Year One) is likely overly conservative in that a given plant upset event may require some time where the facility would be completely or partially idled. In the case where the facility was idled, there would be some period (pre-restart) when facility emissions would be less than steady state and the impact to air quality would likely be lower than the modeled scenario.

Table E-4. Estimates of Modeled Air Emissions Rates

Pollutant	Total Annual[1]	Steady State[2]	Unplanned Restarts[3, 4]	Total Annual[1]	Steady State[2]	Unplanned Restarts[3, 4]
	tons per year			grams per second[5]		
SO_2	543	55.77	487.30	18.38	1.89	2,792.74
NO_2	758	749.06	8.79	25.65	25.35	50.66
PM_{10}	111	111	0	3.77	3.77	0
CO	611	610.4	0.93	20.69	20.66	20.66
Hg	0.011	0.011	0	0.00038	0.00038	0

[1] Emission rates used to model impacts for pollutants annual averaging periods.
[2] Steady-state emissions are expected during normal plant operating conditions. Also used to model impacts of criteria pollutants that have NAAQS for short-term averaging period (i.e., 1-hour, 3-hour, 8-hour, and 24-hour) during normal plant operating conditions.
[3] Maximum unplanned restart emissions based on Model Increment 2 because of the maximum mass emissions rate produced during that period of plant upset (see Table E-5). Also used to model impacts of criteria pollutants that have NAAQS for short-term averaging periods during plant upset conditions.
[4] Zero indicates no unplanned restart emissions.
[5] Grams per second converted from tons per year based on duration of plant upset as presented in Table E-5.
Source: FG Alliance, 2007.

Because design parameters for the proposed power plant are limited, surrogate data from similar existing or permitted units were used to fill data gaps. Table E-5 summarizes the input parameters that were used in the air dispersion modeling analysis.

Table E-5. Air Quality Modeling Basis for the Proposed FutureGen Power Plant Operations Impact Analysis

Parameter	Modeling Basis
1. Technology design cases	• Case 1 • Case 2 • Case 3A • Case 3B Case 1, 2, or 3A would be the main train for the power plant. Case 3B would be a smaller, side-steam power train, which is being considered as an option coupled with Case 1, 2, or 3A.

Table E-5. Air Quality Modeling Basis for the Proposed FutureGen Power Plant Operations Impact Analysis

Parameter	Modeling Basis
2. Stack input parameters	Modeling based on an exhaust stack located at the center of the site. The stack parameters are : • Stack 250 feet (76 m) (FG Alliance, 2006). • Stack velocity: 65 ft/sec (19.8 m/sec) (ECT, 2006). • Volumetric flow: 137,919.087 ft^3/hr (based on modeling of combined exhaust flows from Case I-3A plus Case 3B design using the ASPEN model). • Stack gas temperature: 300 °F (148.9 ^oC) (based on modeling of combined exhaust flows from Case I-3A plus Case 3B design using the ASPEN model). • Stack inside diameter: 27.4 feet (8.4 m) (calculated based on stack gas exit velocity and model output volumetric flow). • Ambient temperature: 59 ^oF (15.0 ^oC) (best engineering judgment). • Exhaust gas ambient temperatures (for SCREEN 3): Assume 20^{o}F, 59^{o}F, 70^{o}F, and 95^{o}F (-6.7^{o}C, 15^{o}C, 21^{o}C, and 35.0^{o}C).
3. Model used	AERMOD A detailed air dispersion analysis was performed using region-specific meteorological data.
4. Receptor grids	A Cartesian grid system was used with hypothetical fence-line receptors and approximate locations of sensitive receptors.
5. Meteorological data	AERMOD – Representative 5-year hourly surface and upper air meteorological data processed with AERMET, EPA's meteorological data processor.
6. Land type	Assessed from land-use data.
7. Terrain data	USGS 7.5-minute Digital Elevation Model (DEM) files.
8. Terrain elevation	Determined by AERMAP, EPA's terrain data preprocessor, with USGS DEM files.
9. Sensitive receptor	From sensitive receptor list provided by the Alliance for each site (FG Alliance, 2006).
10. Operating hours and fuel firing loads	Unplanned restarts and steady state hours based on an 85% plant availability, or 7446 hours per year. Modeling based on 100% base load.

Table E-5. Air Quality Modeling Basis for the Proposed FutureGen Power Plant Operations Impact Analysis

<table>
<tr><th>Parameter</th><th>Modeling Basis</th></tr>
<tr><td>11. Plant operation scenario</td><td>Power plant operation is assumed to produce normal emissions at a steady-state and suddenly ramping up to higher emissions because of unplanned restart (as a result of plant upset) for a short period and then dropping back down to steady-state emissions (see 12 below).

The unplanned restart emissions are developed based on the duration and emissions associated with trip of the gasifier or the acid gas removal (AGR) system. These two plant upset modes, assumed to have the same profile, result in the highest instantaneous emissions rates of all plant upset modes, and represent the longest duration, with the exception of one plant upset mode (air separation unit [ASU] trip). While the ASU trip would be significantly longer (70 hours of warming the gasifier with modest amounts of natural gas), the long duration of minimal plant emissions prior to restart is expected to have a reduced impact on ambient air quality compared to a plant upset mode following prolonged steady state emissions. Furthermore, based on the estimated frequency of occurrence, gasifier and AGR trips combined represent approximately half of all plant upset modes in any given year.</td></tr>
<tr><td>12. Plant upset duration (hours)</td><td>
<table>
<tr><th></th><th>SO_2</th><th>NO_2</th><th>CO</th></tr>
<tr><td>ASU Trip</td><td>2</td><td>4</td><td>70</td></tr>
<tr><td>Gasifier Trip</td><td>2</td><td>4</td><td>0.5</td></tr>
<tr><td>AGR Trip</td><td>2</td><td>4</td><td>0.5</td></tr>
<tr><td>Claus Trip</td><td>2</td><td>0</td><td>0</td></tr>
<tr><td>Power Island Trip</td><td>0</td><td>1.5</td><td>0.5</td></tr>
</table>
</td></tr>
<tr><td>13. Modeled Emissions Rates</td><td>FutureGen Project's estimate of maximum air emissions (FG Alliance, 2007) (Year One operations) was used to develop annual, steady-state, and unplanned restart emissions. The modeling increments 1, 2, and 3 depict emission rates associated with the start of a plant upset mode, restarting the gasifier, and bringing the rest of the components online, respectively. From this analysis, Modeling Increment 2 represents the maximum emission interval.

<table>
<tr><th></th><th>Steady State</th><th>Modeling Increment 1</th><th>Modeling Increment 2</th></tr>
<tr><td>Time Interval</td><td>t_0</td><td>t_1</td><td>t_{1+2hr}</td></tr>
<tr><td>SO_2, g/sec</td><td>2</td><td>2</td><td>2,793</td></tr>
<tr><td>NO_2, g/sec</td><td>25</td><td>34</td><td>51</td></tr>
<tr><td>PM_{10}, g/sec</td><td>4</td><td>1</td><td>4</td></tr>
<tr><td>CO, g/sec</td><td>21</td><td>15</td><td>21</td></tr>
</table>

<table>
<tr><th></th><th>Modeling Increment 3</th><th>Steady State</th></tr>
<tr><td>Time Interval</td><td>$t_{1+2.5hr}$</td><td>t_{1+4hr}</td></tr>
<tr><td>SO_2, g/sec</td><td>2</td><td>2</td></tr>
<tr><td>NO_2, g/sec</td><td>51</td><td>25</td></tr>
<tr><td>PM_{10}, g/sec</td><td>4</td><td>4</td></tr>
<tr><td>CO, g/sec</td><td>21</td><td>21</td></tr>
</table>

Maximum unplanned restart emissions (Table E-4) are based on Modeling Increment 2.</td></tr>
</table>

Table E-5. Air Quality Modeling Basis for the Proposed FutureGen Power Plant Operations Impact Analysis

Parameter	Modeling Basis
14. Steady-state and unplanned restart emissions profile	The steady-state and unplanned restart emissions modeling profile are as follow: t_0 = 0.0 hours (see first steady-state column above) • steady state (main train + smaller, side-steam power train) plant emissions t_1 = approximately 12.0 hours (model run to reach steady state downwind concentrations) (see “Modeling Increment 1” above). • Main train system, gasifier or AGR shutdown = start of plant upset. • Shut down of all main train systems, side-steam power train system continues to operate at steady-state. • Start Natural Gas burners only to keep main train gasifier warm. • For main train system, begin only emissions of CO + NO_2, both at plant upset rates (w/o main train steady-state emissions) • Side-steam power train system continues uninterrupted (full steady-state emissions) t_{1+2hr} = 14.0 hours (see “Modeling Increment 2” above) • Restart main train gasifier + turbine. • Turn off natural gas burners. • Begin steady-state emissions + NO_2 at plant upset rate + SO_2 at plant upset rate. • Side-steam power train system continues uninterrupted (full steady-state emissions). $t_{1+2.5\ hr}$ = 14.5 hours (see “Modeling Increment 3” above) • Restart main train AGR. • Begin steady-state emissions + NO_X at plant upset rates. • Side-steam power train system continues uninterrupted (full steady-state emissions). $t_{1+4.0hr}$ = 16.0 hours (see last “steady state” column above) • Assume the system has no SCR to restart. • Begin steady-state only emissions. • Begin CO_2 capture. • End of emissions associated with plant upset.

E.3 AIR MODELING ANALYSIS

DOE conducted a refined air modeling using detailed meteorological, terrain and other input data to provide accurate estimates of emissions impacts using the EPA’s AERMOD dispersion modeling system. EPA recommends the AERMOD as a preferred air dispersion model for use in a wide variety of regulatory applications. The AERMOD modeling system consists of meteorological and terrain preprocessing programs (AERMET and AERMAP, respectively) in addition to the main AERMOD dispersion model. The following are three key surface characteristics required by AERMET:

- Albedo is defined as the fraction of total incident solar radiation reflected by the surface. Typical values range from 0.1 for thick deciduous forests to 0.90 for fresh snow.
- Bowen ratio is the ratio of the sensible heat flux (H) to the latent (evaporative) heat flux (E). It is an indicator of surface moisture and is used for determining planetary boundary layer parameters for convective conditions. According to AERMET user manual, midday values of the Bowen ratio range from 0.1 over water to 10.0 over desert terrain.
- Surface roughness length is related to the height of obstacles to the wind flow (i.e., a measure of the roughness of surface cover) and is, in principle, the height at which the mean horizontal wind speed is zero. Values range from less than 0.001 meter over a calm water surface to 1 meter or more over a forest or urban area.

AERMOD is a comprehensive steady-state plume model system that incorporates air dispersion dynamics based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. As recommended by EPA's Guideline on Air Quality Models (GAQM), which is available as Appendix W of 40 CFR 51, the model was executed using EPA's default regulatory options. The concentration calculation option was selected. Based on predominant land use in the project area, rural dispersion coefficient was specified. Also, the concentration results were obtained for ground level receptors. The modeling was performed using "ISC-AERMOD VIEW" software package, which is an interface for the ISC and AERMOD models developed by Lakes Environmental Software, Inc.

E.3.1 AERMOD MODELING APPROACH

Due to lack of full information on proposed site buildings and structures, building downwash was not included in the modeling. The stack parameters defined in Table E-5 were used for model input assuming all emissions where exhausted from a single HRSG stack. Other modeling variables are described in Table E-5. Modeling for nitrogen oxide (NO_X) was performed conservatively assuming 100 percent conversion to NO_2. The model was separately executed for NO_2, SO_2, and PM_{10} using a nominal 1 g/sec unit emission rate and the unit emission impacts were adjusted to reflect annual emission rates for average annual operating periods of each pollutant. There is no annual averaging period for CO. For short-term averaging period for CO and PM_{10}, the nominal 1 g/s unit emission rate was also used and the higher of the steady-state or unplanned restart emissions rates were adjusted to determine impact. There is no short-term averaging period for NO_2.

Because of the increase in emissions during unplanned restart for a short duration, for SO_2, the short-term averaging periods (3-hrs and 24-hrs) were modeled using a variable emissions modeling tool in AERMOD. Additionally, since worst-case emissions and associated worst-case impacts during worst-case meteorological conditions are highly unlikely, short-term impacts from unplanned restart SO_2 emisisons were modeled to determine if an exceedance of short-term standards would occur. The n^{th} worst-case results were compared to the PSD increments and NAAQS standards.

Should the modeled concentrations exceed these standards, the probability of this potential exceedance is then calculated by determining the n^{th} maximum concentration using the following equation:

$$\textbf{\% Compliance} = (7446 * 5 - n) / (7446 * 5)$$

Impacts from unplanned restarts were modeled assuming that unplanned restart emissions occur over a two hour period. The remainder of the time would consist of steady state operations (1 hour for the 3-hour average and 22 hours for the 24-hour average period).

E.3.2 AERMOD INPUT PARAMETERS

Actual meteorology and terrain elevations are incorporated in the model to provide more accurate impacts. Meteorological data was obtained from National Climatic Data Center (NCDC)/National Weather Service (NWS) weather stations. United States Geological Surveys (USGS) 7.5 minute DEM files were used to assign appropriate terrain elevations for both source and receptor locations within the modeling domain. USGS 7.5 Minute Quadrangle maps were used as site base maps. These model input parameters are further described below.

E.3.2.1 Meteorological Input Data

Mattoon and Tuscola, Illinois

For the modeling for the proposed Mattoon Power Plant, a representative and recent 5-year record (2001 to 2005) of hourly surface meteorological data was obtained from the NCDC weather station at Mattoon/Charleston Coles County Airport (WMO No. 725317). The weather station is located in Mattoon and the data is therefore considered to be highly representative of the Mattoon project site. The upper air data was obtained from the upper air soundings taken by the National Weather Service in Lincoln, Illinois.

For the modeling for the proposed Tuscola Power Plant, a representative and recent 5-year record (2001 to 2005) of hourly surface meteorological data was obtained from the NCDC weather station at University of Illinois/Willard Airport at Champaign (WMO No. 725315). The weather station is located approximately 16 miles from Tuscola and the data is therefore considered to be reasonably representative of the Tuscola project site. The upper air data was obtained from the upper air soundings taken by the National Weather Service in Lincoln, Illinois (WMO No. 745600).

The meteorological data was first checked to ensure greater than 90% completeness for all parameters, per EPA requirements. Subsequently, missing data gaps were filled within a tolerable time interval based on EPA guidance procedures. Using AERMET (AERMOD's meteorological preprocessor), both surface and upper air multi-year data files were merged to create a single meteorological data file. In conjunction with site-specific characteristics, the file was then partitioned into a "surface" and "profile" files, which together provide a representative record of prevailing meteorology in the site vicinity. The three AERMET characteristics were determined based on the meteorological data station at which the surface data was collected (e.g., Mattoon/Charleston Coles County Airport for the Mattoon site), per Illinois EPA guidance. Values for seasonal averages of Albedo, Bowen Ratio, and Surface Roughness were computed for each sector, with values weighted by the fraction of land uses within each sector. Table E-6 and E-7 are calculation spreadsheets showing details of the surface characteristics determination. It should be noted that due to the proximity of the data station to the project site, the characteristics can reasonably be assumed to be equally applicable. Using high resolution satellite imagery, circles were constructed around the weather station. Each circle was scaled to a diameter of 6 km, following standard land-use analysis methodology. The circles were then divided into 12 equal sectors (each 30 degrees of arc). Each sector was analyzed for the relative contributions of land use as determined from the map details.

Jewett and Odessa, Texas

The Texas Commission on Environmental Quality's (TCEQ) Emissions Banking Modeling Team (EBMT) has prepared AERMOD meteorological data sets that are required to be used for air dispersion modeling in the state of Texas. The data sets are available by county and comprise a one-year (usually 1988) surface and upper air hourly data record and a similar five-year data set.. These AERMOD data sets have already been pre-processed by AERMET (AERMOD's meteorological processor) to produce "surface" and "profile" files, which together provide a reasonably representative record of prevailing meteorology in the site vicinities. The proposed Jewett Power Plant Site is spread over three counties, namely Leon, Freestone and Limestone counties. However, based on an initial review of the site plan and USGS topographic maps, the majority of the site will be located within Freestone County. Therefore, the meteorological data set for Freestone County was used for AERMOD modeling. The data used for the modeling for the proposed Jewett Power Plant site comprised NCDC surface hourly records from Waco, TX, and upper air data from Longview, TX. The proposed Odessa Power Plant site is located in Ector County. Therefore, the meteorological data set for Ector County was used for AERMOD modeling. The data for the proposed Odessa Power Plant site comprised NCDC surface hourly records from Midland, TX, and upper air data also from Midland.

The data record spanned the five-year period 1987 to 1991, and the processed files corresponding to "medium" surface roughness were selected based on a review of land use types in the vicinity of the project site and are shown in Tables E-8 (Jewett) and E-9 (Odessa). The preprocessed meteorological data sets provided by TCEQ incorporate appropriate values of the above three surface characteristics.

Table E-6. Mattoon Land Use Surface Characterization

KMTO	Urban (Commercial)	Urban (Residential)	Grassland	Cultivated Land	Water	Deciduous Forest	Swamp	Coniferous Forest
Sector 1 (0-30 degrees)		0.02	0.06	0.9		0.02		
Sector 2 (30-60 degrees)		0.05	0.1	0.82		0.03		
Sector 3 (60-90 degrees)		0.05	0.02	0.9		0.03		
Sector 4 (90-120 degrees)		0.05	0.05	0.85		0.05		
Sector 5 (120-150 degrees)		0.01	0.02	0.87		0.1		
Sector 6 (150-180 degrees)		0.05	0.1	0.05		0.8		
Sector 7 (180-210 degrees)		0.15	0.15	0.1		0.6		
Sector 8 (210-240 degrees)		0.05	0.05	0.85		0.05		
Sector 9 (240-270 degrees)		0.03	0.04	0.9		0.03		
Sector 10 (270-300 degrees)		0.02	0.03	0.9		0.05		
Sector 11 (300-330 degrees)		0.05	0.1	0.84		0.01		
Sector 12 (330-360 degrees)		0.01	0.1	0.87		0.02		
Average	**0**	**0.045**	**0.06833333**	**0.7375**	**0**	**0.14916667**	**0**	**0**

Table E-6. Mattoon Land Use Surface Characterization

Seasonal Land Use Parameters by Sector							
Winter	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Spring**	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.593	1.5	0.029006	Sector 1 (0-30 degrees)	0.142	0.328	0.06
Sector 2 (30-60 degrees)	0.6145	1.575	0.04871	Sector 2 (30-60 degrees)	0.1504	0.372	0.0861
Sector 3 (60-90 degrees)	0.0445	0.15	0.040002	Sector 3 (60-90 degrees)	0.0142	0.079	0.056
Sector 4 (90-120 degrees)	0.0725	0.225	0.050005	Sector 4 (90-120 degrees)	0.022	0.105	0.0775
Sector 5 (120-150 degrees)	0.0655	0.195	0.055002	Sector 5 (120-150 degrees)	0.017	0.088	0.106
Sector 6 (150-180 degrees)	0.4775	1.425	0.42501	Sector 6 (150-180 degrees)	0.121	0.65	0.83
Sector 7 (180-210 degrees)	0.4425	1.35	0.375015	Sector 7 (180-210 degrees)	0.12	0.63	0.6825
Sector 8 (210-240 degrees)	0.0725	0.225	0.050005	Sector 8 (210-240 degrees)	0.022	0.105	0.0775
Sector 9 (240-270 degrees)	0.0495	0.15	0.030004	Sector 9 (240-270 degrees)	0.015	0.067	0.047
Sector 10 (270-300 degrees)	0.05	0.15	0.035003	Sector 10 (270-300 degrees)	0.0142	0.067	0.0615
Sector 11 (300-330 degrees)	0.0825	0.24	0.03001	Sector 11 (300-330 degrees)	0.0262	0.097	0.04
Sector 12 (330-360 degrees)	0.0735	0.195	0.01501	Sector 12 (330-360 degrees)	0.0218	0.064	0.03
Average	**0.2198333**	**0.615**	**0.09856517**	**Average**	**0.05715**	**0.221**	**0.17950833**

Table E-6. Mattoon Land Use Surface Characterization

Seasonal Land Use Parameters by Sector							
Summer	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Autumn**	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.1964	0.544	0.222	Sector 1 (0-30 degrees)	0.18	0.75	0.0716
Sector 2 (30-60 degrees)	0.2036	0.624	0.248	Sector 2 (30-60 degrees)	0.1892	0.839	0.0935
Sector 3 (60-90 degrees)	0.0152	0.125	0.066	Sector 3 (60-90 degrees)	0.0166	0.15	0.0492
Sector 4 (90-120 degrees)	0.023	0.155	0.095	Sector 4 (90-120 degrees)	0.025	0.2	0.0655
Sector 5 (120-150 degrees)	0.0172	0.066	0.137	Sector 5 (120-150 degrees)	0.0178	0.14	0.0852
Sector 6 (150-180 degrees)	0.122	0.42	1.075	Sector 6 (150-180 degrees)	0.125	1	0.666
Sector 7 (180-210 degrees)	0.123	0.6	0.87	Sector 7 (180-210 degrees)	0.129	1.05	0.5565
Sector 8 (210-240 degrees)	0.023	0.155	0.095	Sector 8 (210-240 degrees)	0.025	0.2	0.0655
Sector 9 (240-270 degrees)	0.0156	0.101	0.058	Sector 9 (240-270 degrees)	0.017	0.13	0.0394
Sector 10 (270-300 degrees)	0.0146	0.079	0.078	Sector 10 (270-300 degrees)	0.0156	0.12	0.0503
Sector 11 (300-330 degrees)	0.0272	0.183	0.048	Sector 11 (300-330 degrees)	0.0302	0.21	0.034
Sector 12 (330-360 degrees)	0.022	0.106	0.041	Sector 12 (330-360 degrees)	0.0242	0.14	0.022
Average	0.0669	0.263166667	0.25275	**Average**	0.066216667	0.41075	0.149891667

Table E-6. Mattoon Land Use Surface Characterization

Seasonal Land Use Parameters by Sector			
Annual	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.27785	0.7805	0.10565
Sector 2 (30-60 degrees)	0.289425	0.8525	0.144075
Sector 3 (60-90 degrees)	0.022625	0.126	0.0778
Sector 4 (90-120 degrees)	0.035625	0.17125	0.097
Sector 5 (120-150 degrees)	0.029375	0.12225	0.1008
Sector 6 (150-180 degrees)	0.211375	0.87375	0.774
Sector 7 (180-210 degrees)	0.203625	0.9075	0.696
Sector 8 (210-240 degrees)	0.035625	0.17125	0.097
Sector 9 (240-270 degrees)	0.024275	0.112	0.0586
Sector 10 (270-300 degrees)	0.0236	0.104	0.0662
Sector 11 (300-330 degrees)	0.041525	0.1825	0.063
Sector 12 (330-360 degrees)	0.035375	0.12625	0.032
Average	**0.102525**	**0.819979**	**0.23545208**

Table E-7. Tuscola Land Use Characterization

Champaign (KCMI) Fractional Land Use								
Sector	**Urban (Commercial)**	**Urban (Residential)**	**Grassland**	**Cultivated Land**	**Water**	**Deciduous Forest**	**Swamp**	**Coniferous Forest**
Sector 1 (0-30 degrees)		0.05	0.1	0.6		0.25		
Sector 2 (30-60 degrees)		0.05	0.1	0.82		0.03		
Sector 3 (60-90 degrees)		0.05	0.05	0.87		0.03		
Sector 4 (90-120 degrees)		0.01	0.09	0.87		0.03		
Sector 5 (120-150 degrees)		0.01	0.09	0.87		0.03		
Sector 6 (150-180 degrees)		0.01	0.09	0.87		0.03		
Sector 7 (180-210 degrees)		0.01	0.09	0.87		0.03		
Sector 8 (210-240 degrees)		0.01	0.09	0.87		0.03		
Sector 9 (240-270 degrees)		0.01	0.09	0.87		0.03		
Sector 10 (270-300 degrees)		0.02	0.05	0.9		0.03		
Sector 11 (300-330 degrees)		0.05	0.1	0.84		0.01		
Average	**0**	**0.03166667**	**0.08666667**	**0.836667**	**0**	**0.045**	**0**	**0**

Table E-7. Tuscola Land Use Characterization

Seasonal Land Use Parameters by Sector							
Winter	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Spring**	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.5625	1.5	0.15601	Sector 1 (0-30 degrees)	0.139	0.445	0.298
Sector 2 (30-60 degrees)	0.5665	1.455	0.04791	Sector 2 (30-60 degrees)	0.1392	0.348	0.0837
Sector 3 (60-90 degrees)	0.0625	0.195	0.040005	Sector 3 (60-90 degrees)	0.0196	0.091	0.0575
Sector 4 (90-120 degrees)	0.0725	0.195	0.020009	Sector 4 (90-120 degrees)	0.0212	0.067	0.0395
Sector 5 (120-150 degrees)	0.0725	0.195	0.020009	Sector 5 (120-150 degrees)	0.0212	0.067	0.0395
Sector 6 (150-180 degrees)	0.0725	0.195	0.020009	Sector 6 (150-180 degrees)	0.0212	0.067	0.0395
Sector 7 (180-210 degrees)	0.0725	0.195	0.020009	Sector 7 (180-210 degrees)	0.0212	0.067	0.0395
Sector 8 (210-240 degrees)	0.0725	0.195	0.020009	Sector 8 (210-240 degrees)	0.0212	0.067	0.0395
Sector 9 (240-270 degrees)	0.0725	0.195	0.020009	Sector 9 (240-270 degrees)	0.0212	0.067	0.0395
Sector 10 (270-300 degrees)	0.052	0.15	0.025005	Sector 10 (270-300 degrees)	0.0154	0.061	0.0425
Sector 11 (300-330 degrees)	0.0825	0.24	0.03001	Sector 11 (300-330 degrees)	0.0262	0.097	0.04
Sector 12 (330-360 degrees)	0.1	0.315	0.05501	Sector 12 (330-360 degrees)	0.0332	0.147	0.065
Average	**0.15508333**	**0.41875**	**0.03950033**	**Average**	**0.04165**	**0.13258333**	**0.06864167**

Table E-7. Tuscola Land Use Characterization

Seasonal Land Use Parameters by Sector							
Summer	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Autumn**	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.176	0.555	0.48	Sector 1 (0-30 degrees)	0.167	0.87	0.256
Sector 2 (30-60 degrees)	0.1876	0.584	0.232	Sector 2 (30-60 degrees)	0.1748	0.783	0.0895
Sector 3 (60-90 degrees)	0.0206	0.149	0.069	Sector 3 (60-90 degrees)	0.0226	0.18	0.0495
Sector 4 (90-120 degrees)	0.0214	0.101	0.053	Sector 4 (90-120 degrees)	0.0234	0.14	0.0299
Sector 5 (120-150 degrees)	0.0214	0.101	0.053	Sector 5 (120-150 degrees)	0.0234	0.14	0.0299
Sector 6 (150-180 degrees)	0.0214	0.101	0.053	Sector 6 (150-180 degrees)	0.0234	0.14	0.0299
Sector 7 (180-210 degrees)	0.0214	0.101	0.053	Sector 7 (180-210 degrees)	0.0234	0.14	0.0299
Sector 8 (210-240 degrees)	0.0214	0.101	0.053	Sector 8 (210-240 degrees)	0.0234	0.14	0.0299
Sector 9 (240-270 degrees)	0.0214	0.101	0.053	Sector 9 (240-270 degrees)	0.0234	0.14	0.0299
Sector 10 (270-300 degrees)	0.0158	0.089	0.054	Sector 10 (270-300 degrees)	0.0172	0.12	0.0345
Sector 11 (300-330 degrees)	0.0272	0.183	0.048	Sector 11 (300-330 degrees)	0.0302	0.21	0.034
Sector 12 (330-360 degrees)	0.0352	0.283	0.073	Sector 12 (330-360 degrees)	0.0392	0.31	0.059
Average	**0.04923333**	**0.20408333**	**0.10616667**	**Average**	**0.04928333**	**0.27608333**	**0.05849167**

Table E-7. Tuscola Land Use Characterization

Seasonal Land Use Parameters by Sector			
Annual	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.261125	0.8425	0.3225
Sector 2 (30-60 degrees)	0.267025	0.7925	0.138275
Sector 3 (60-90 degrees)	0.031325	0.15375	0.079
Sector 4 (90-120 degrees)	0.034625	0.12575	0.0406
Sector 5 (120-150 degrees)	0.034625	0.12575	0.0406
Sector 6 (150-180 degrees)	0.034625	0.12575	0.0406
Sector 7 (180-210 degrees)	0.034625	0.12575	0.0406
Sector 8 (210-240 degrees)	0.034625	0.12575	0.0406
Sector 9 (240-270 degrees)	0.034625	0.12575	0.0406
Sector 10 (270-300 degrees)	0.0251	0.105	0.049
Sector 11 (300-330 degrees)	0.041525	0.1825	0.063
Sector 12 (330-360 degrees)	0.0519	0.26375	0.113
Average	**0.0738125**	**0.7985**	**0.13629167**

Table E-8. Jewett Land Use Characterization

Sector	Urban (Commercial)	Urban (Residential)	Grassland	Cultivated Land	Water	Deciduous Forest	Swamp	Coniferous Forest
Sector 1 (0-30 degrees)	0	0.15	0.35	0.2	0	0.3	0	0
Sector 2 (30-60 degrees)	0	0.05	0.95	0	0	0	0	0
Sector 3 (60-90 degrees)	0	0	0.85	0	0.15	0	0	0
Sector 4 (90-120 degrees)	0	0.02	0.98	0	0	0	0	0
Sector 5 (120-150 degrees)	0	0.05	0.79	0	0.01	0.15	0	0
Sector 6 (150-180 degrees)	0	0.05	0.35	0	0	0.6	0	0
Sector 7 (180-210 degrees)	0	0.01	0.8	0	0.1	0.09	0	0
Sector 8 (210-240 degrees)	0	0.1	0.45	0	0.01	0.44	0	0
Sector 9 (240-270 degrees)	0	0.05	0.2	0	0.05	0.7	0	0
Sector 10 (270-300 degrees)	0	0.7	0.1	0	0	0.2	0	0
Sector 11 (300-330 degrees)	0	0.3	0.65	0	0	0.05	0	0
Sector 12 (330-360 degrees)	0	0.5	0.3	0	0	0.2	0	0
Average	**0**	**0.165**	**0.5641667**	**0.016666667**	**0.027**	**0.2275**	**0**	**0**

Table E-8. Jewett Land Use Characterization

Seasonal Land Use Parameters by Sector			
Winter	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.5325	1.5	0.227035
Sector 2 (30-60 degrees)	0.5875	1.5	0.025095
Sector 5 (120-150 degrees)	0.5685	1.5	0.10008
Sector 6 (150-180 degrees)	0.5275	1.5	0.325035
Average	**0.525333333**	**1.5**	**0.1964758**

Table E-8. Jewett Land Use Characterization

Seasonal Land Use Parameters by Sector							
Spring	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Summer**	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.148	0.56	0.3985	Sector 1 (0-30 degrees)	0.163	0.77	0.54
Sector 2 (30-60 degrees)	0.178	0.43	0.0725	Sector 2 (30-60 degrees)	0.179	0.86	0.12
Sector 3 (60-90 degrees)	0.171	0.355	0.042515	Sector 3 (60-90 degrees)	0.168	0.695	0.085015
Sector 4 (90-120 degrees)	0.1792	0.412	0.059	Sector 4 (90-120 degrees)	0.1796	0.824	0.108
Sector 5 (120-150 degrees)	0.1684	0.472	0.214501	Sector 5 (120-150 degrees)	0.1692	0.778	0.299001
Sector 6 (150-180 degrees)	0.142	0.61	0.6425	Sector 6 (150-180 degrees)	0.143	0.56	0.84
Sector 7 (180-210 degrees)	0.1682	0.403	0.13501	Sector 7 (180-210 degrees)	0.1664	0.697	0.20201
Sector 8 (210-240 degrees)	0.149	0.589	0.512501	Sector 8 (210-240 degrees)	0.1508	0.693	0.667001
Sector 9 (240-270 degrees)	0.133	0.625	0.735005	Sector 9 (240-270 degrees)	0.133	0.475	0.955005
Sector 10 (270-300 degrees)	0.14	0.88	0.555	Sector 10 (270-300 degrees)	0.154	1.54	0.62
Sector 11 (300-330 degrees)	0.165	0.595	0.2325	Sector 11 (300-330 degrees)	0.171	1.135	0.28
Sector 12 (330-360 degrees)	0.148	0.76	0.465	Sector 12 (330-360 degrees)	0.158	1.3	0.54
Average	**0.157483333**	**0.557583333**	**0.338711**	**Average**	**0.16125**	**0.860583333**	**0.4380027**

Table E-8. Jewett Land Use Characterization

Seasonal Land Use Parameters by Sector							
Autumn	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Annual**	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Sector 1 (0-30 degrees)	0.169	1.09	0.3285	Sector 1 (0-30 degrees)	0.253125	0.98	0.4485
Sector 2 (30-60 degrees)	0.199	1.05	0.0345	Sector 2 (30-60 degrees)	0.285875	0.96	0.088
Sector 3 (60-90 degrees)	0.191	0.865	0.008515	Sector 3 (60-90 degrees)	0.2675	0.85375	0.034015
Sector 4 (90-120 degrees)	0.1996	1.02	0.0198	Sector 4 (90-120 degrees)	0.28835	0.939	0.0592
Sector 5 (120-150 degrees)	0.1864	1.041	0.152901	Sector 5 (120-150 degrees)	0.273125	0.94775	0.216601
Sector 6 (150-180 degrees)	0.151	1.05	0.5085	Sector 6 (150-180 degrees)	0.240875	0.93	0.604
Sector 7 (180-210 degrees)	0.1866	0.92	0.08501	Sector 7 (180-210 degrees)	0.267425	0.88	0.12301
Sector 8 (210-240 degrees)	0.1622	1.091	0.406501	Sector 8 (210-240 degrees)	0.24725	0.96825	0.514001
Sector 9 (240-270 degrees)	0.14	1.005	0.587005	Sector 9 (240-270 degrees)	0.225875	0.90125	0.688005
Sector 10 (270-300 degrees)	0.17	1.7	0.511	Sector 10 (270-300 degrees)	0.21725	1.405	0.884
Sector 11 (300-330 degrees)	0.19	1.3	0.1965	Sector 11 (300-330 degrees)	0.2615	1.1325	0.371
Sector 12 (330-360 degrees)	0.174	1.5	0.413	Sector 12 (330-360 degrees)	0.23375	1.265	0.692
Average	0.176566667	1.136	0.2709777	**Average**	0.255158333	1.013541667	0.3935277

Table E-9. Odessa Land Use Characterization

Sector	Urban (Commercial)	Urban (Residential)	Grassland	Cultivated Land	Water	Deciduous Forest	Swamp	Coniferous Forest	Desert Schrubland
Sector 1 (0-30 degrees)	0	0.05		0	0	0	0	0	0.85
Sector 2 (30-60 degrees)		0.05				0			0.95
Sector 3 (60-90 degrees)		0.01				0			0.99
Sector 4 (90-120 degrees)		0.07				0			0.93
Sector 5 (120-150 degrees)		0.15				0			0.85
Sector 6 (150-180 degrees)		0.25				0			0.75
Sector 7 (180-210 degrees)		0.25				0			0.75
Sector 8 (210-240 degrees)		0.2				0			0.8
Sector 9 (240-270 degrees)		0.15							0.85
Sector 10 (270-300 degrees)		0.02							0.98
Sector 11 (300-330 degrees)		0.01				0			0.99
Sector 12 (330-360 degrees)		0.01				0			0.99
Average	**0**	**0.101666667**	**0**	**0**	**0**	**0**	**0**	**0**	**0.89**

Table E-9. Odessa Land Use Characterization

Seasonal Land Use Parameters by Sector			
	Albedo	**Bowen Ratio**	**Surface Roughness**
Winter			
Sector 1 (0-30 degrees)	0.4	5.175	0.1525
Sector 2 (30-60 degrees)	0.445	5.775	0.1675
Sector 3 (60-90 degrees)	0.449	5.955	0.1535
Sector 4 (90-120 degrees)	0.443	5.685	0.1745
Sector 5 (120-150 degrees)	0.435	5.325	0.2025
Sector 6 (150-180 degrees)	0.425	4.875	0.2375
Sector 7 (180-210 degrees)	0.425	4.875	0.2375
Sector 8 (210-240 degrees)	0.43	5.1	0.22
Sector 9 (240-270 degrees)	0.435	5.325	0.2025
Sector 10 (270-300 degrees)	0.448	5.91	0.157
Sector 11 (300-330 degrees)	0.449	5.955	0.1535
Sector 12 (330-360 degrees)	0.449	5.955	0.1535
Average	**0.436083333**	**5.4925**	**0.184333**
Spring			
Sector 1 (0-30 degrees)	0.262	2.6	0.28
Sector 2 (30-60 degrees)	0.292	2.9	0.31
Sector 3 (60-90 degrees)	0.2984	2.98	0.302
Sector 4 (90-120 degrees)	0.2888	2.86	0.314
Sector 5 (120-150 degrees)	0.276	2.7	0.33
Sector 6 (150-180 degrees)	0.26	2.5	0.35
Sector 7 (180-210 degrees)	0.26	2.5	0.35
Sector 8 (210-240 degrees)	0.268	2.6	0.34
Sector 9 (240-270 degrees)	0.276	2.7	0.33

Table E-9. Odessa Land Use Characterization

Seasonal Land Use Parameters by Sector			
	Albedo	**Bowen Ratio**	**Surface Roughness**
Sector 10 (270-300 degrees)	0.2968	2.96	0.304
Sector 11 (300-330 degrees)	0.2984	2.98	0.302
Sector 12 (330-360 degrees)	0.2984	2.98	0.302
Average	**0.281233333**	**2.771666667**	**0.317833**
Summer			
Sector 1 (0-30 degrees)	0.246	3.5	0.28
Sector 2 (30-60 degrees)	0.274	3.9	0.31
Sector 3 (60-90 degrees)	0.2788	3.98	0.302
Sector 4 (90-120 degrees)	0.2716	3.86	0.314
Sector 5 (120-150 degrees)	0.262	3.7	0.33
Sector 6 (150-180 degrees)	0.25	3.5	0.35
Sector 7 (180-210 degrees)	0.25	3.5	0.35
Sector 8 (210-240 degrees)	0.256	3.6	0.34
Sector 9 (240-270 degrees)	0.262	3.7	0.33
Sector 10 (270-300 degrees)	0.2776	3.96	0.304
Sector 11 (300-330 degrees)	0.2788	3.98	0.302
Sector 12 (330-360 degrees)	0.2788	3.98	0.302
Average	**0.265466667**	**3.763333333**	**0.317833**
Autumn			
Sector 1 (0-30 degrees)	0.247	5.2	0.28
Sector 2 (30-60 degrees)	0.275	5.8	0.31
Sector 3 (60-90 degrees)	0.279	5.96	0.302
Sector 4 (90-120 degrees)	0.273	5.72	0.314
Sector 5 (120-150 degrees)	0.265	5.4	0.33

Table E-9. Odessa Land Use Characterization

Seasonal Land Use Parameters by Sector			
	Albedo	**Bowen Ratio**	**Surface Roughness**
Sector 6 (150-180 degrees)	0.255	5	0.35
Sector 7 (180-210 degrees)	0.255	5	0.35
Sector 8 (210-240 degrees)	0.26	5.2	0.34
Sector 9 (240-270 degrees)	0.265	5.4	0.33
Sector 10 (270-300 degrees)	0.278	5.92	0.304
Sector 11 (300-330 degrees)	0.279	5.96	0.302
Sector 12 (330-360 degrees)	0.279	5.96	0.302
Average	**0.2675**	**5.543333333**	**0.317833**
Annual			
Sector 1 (0-30 degrees)	0.28875	4.11875	0.273125
Sector 2 (30-60 degrees)	0.3215	4.59375	0.299375
Sector 3 (60-90 degrees)	0.3263	4.71875	0.269875
Sector 4 (90-120 degrees)	0.3191	4.53125	0.314125
Sector 5 (120-150 degrees)	0.3095	4.28125	0.373125
Sector 6 (150-180 degrees)	0.2975	3.96875	0.446875
Sector 7 (180-210 degrees)	0.2975	3.96875	0.446875
Sector 8 (210-240 degrees)	0.3035	4.125	0.41
Sector 9 (240-270 degrees)	0.3095	4.28125	0.373125
Sector 10 (270-300 degrees)	0.3251	4.6875	0.27725
Sector 11 (300-330 degrees)	0.3263	4.71875	0.269875
Sector 12 (330-360 degrees)	0.3263	4.71875	0.269875
Average	**0.312570833**	**0.165208333**	**0.101667**

E.3.2.2 Background Ambient Air Quality

Based on EPA guidance, Guidelines on Data Handling Conventions for the PM NAAQS, to determine representative background data for both PM_{10} and $PM_{2.5}$ 24-hour and annual averaging period, the monitored data are averaged over a period of 3 years (2003 to 2005) (EPA, 1999). For all other pollutants and corresponding averaging periods, the highest of the second-highest values each year for a period of 3 years (2003 to 2005) is used.

Mattoon and Tuscola, Illinois

Mattoon is located in Coles County, Illinois and Tuscola is located in Douglas County. Both counties are part of the East Central Illinois Intrastate Air Quality Control Region (AQCR). The nearest ambient monitors to the sites and the pollutants monitored at these locations are listed below. The stations selected are in proximity to the Mattoon and Tuscola sites.

- Sulfur Dioxide - Decatur
- Nitrogen Dioxide - East St. Louis
- PM_{10} - Peoria
- $PM_{2.5}$ - Champaign
- Carbon Monoxide - Peoria

Table E-10 presents the representative yet conservative background for the criteria pollutants for the proposed Mattoon and Tuscola sites.

Table E-10. Background Concentration for the Proposed Mattoon and Tuscola Power Plant

Pollutant	Averaging Period	Station	Second Highest Concentrations for each Year (1) ($\mu g/m^3$)				
			2003	2004	2005	Average 3-yr Value	Highest Value
Sulfur Dioxide	Annual	Decatur	7.85	10.47	10.47	n/a	10.47
	24-hour	Decatur	70.67	60.2	54.99	n/a	70.67
	3-hour	Decatur	123.03	96.85	102.12	n/a	123.03
Nitrogen Dioxide	Annual	East St. Louis	30.09	30.09	28.21	n/a	30.09
	1-hour	East St. Louis	165.41	109.07	99.66	n/a	165.41
PM_{10}	Annual	Peoria	25	22	31	26	n/a
	24-hour	Peoria	55	42	75	57.3	n/a
$PM_{2.5}$	Annual	Champaign	13.1	10.4	14	12.5	n/a
	24-hour	Champaign	32.8	24.3	38.7	31.9	n/a
Carbon Monoxide	8-hour	Peoria	3,321.05	3,435.57	3,457.93	n/a	3,457.93
	1-hour	Peoria	5,611.43	4,466.24	5,264.66	n/a	5,611.43

n/a = not applicable.
Source: Illinois Annual Air Quality Reports, 2003, 2004, 2005.

Jewett, Texas

Jewett is located in northwestern Leon County, Texas and is part of the Austin-Waco Intrastate Air Quality Control Region (AQCR 212). The nearest ambient monitors to the site and the pollutants monitored at these locations are listed below. The stations selected are in proximity to the Jewett site.

- Sulfur Dioxide - Dallas (Hinton St)
- Nitrogen Dioxide - Dallas North (Nuestra Drive)
- PM_{10} - Dallas (South Akard)
- $PM_{2.5}$ - Houston (Aldine)
- Carbon Monoxide - Fort Worth

Table E-11 presents the representative yet conservative background for these criteria pollutants for the proposed Jewett site.

Table E-11. Background Concentration for the Proposed Jewett Power Plant

Pollutant	Averaging Period	Station	Second Highest Concentrations for each Year (μg/m^3)				
			2003	2004	2005	Average 3-yr Value	Highest Value
Sulfur Dioxide	Annual	Dallas Hinton St.	2.62	2.62	2.62	n/a	2.62
	24-hour	Dallas Hinton St.	10.47	13.09	10.47	n/a	13.09
	3-hour	Dallas Hinton St.	23.56	28.79	34.03	n/a	34.03
Nitrogen Dioxide	Annual	Dallas North	26.34	22.58	24.46	n/a	26.34
	1-hour	Dallas North	122.29	101.6	112.88	n/a	122.29
PM10	Annual	Dallas South Akard	28	23	27	26.3	n/a
	24-hour	Dallas South Akard	63	55	47	55.0	n/a
PM2.5	Annual	Houston Aldine	13.8	13.5	13.8	13.7	n/a
	24-hour	Houston Aldine	31	30	27	29.3	n/a
Carbon Monoxide	8-hour	Fort Worth	1,832.30	1,946.82	1,717.79	n/a	1,946.82
	1-hour	Fort Worth	4,008.17	3,321,05	2,977.49	n/a	4,008.17

n/a = not applicable.
Source: TCEQ, 2005 and EPA AirDatabase.

Odessa, Texas

Odessa is located in Ector County, Texas and is part of the Midland-Odessa-San Angelo Intrastate Air Quality Control Region (AQCR 218). The nearest ambient monitors to the site and the pollutants monitored at these locations are listed below.

- Sulfur Dioxide - El Paso, TX
- Nitrogen Dioxide - Hobbs, NM
- PM_{10} - Hobbs, NM
- $PM_{2.5}$ - Odessa, TX
- Carbon Monoxide - El Paso, TX

Table E-12 presents the representative yet conservative background for these criteria pollutants for the proposed Odessa site.

Table E-12. Background Concentration for the Proposed Odessa Power Plant

Pollutant	Averaging Period	Station	Second Highest Concentrations for each Year (1) (µg/m³)				
			2003	2004	2005	Average 3-yr Value	Highest Value
Sulfur Dioxide	Annual	El Paso, TX.	5.24	2.62	2.62	n/a	5.24
	24-hour	El Paso, TX.	10.47	7.85	13.09	n/a	13.09
	3-hour	El Paso, TX.	52.35	34.03	31.41	n/a	52.35
Nitrogen Dioxide	Annual	Hobbs, NM	ND	15.05	13.17	n/a	15.05
	1-hour	Hobbs, NM	ND	77.14	92.19	n/a	92.19
PM10	Annual	Hobbs, NM	26	15	13	18	n/a
	24-hour	Hobbs, NM	88	48	18	51.3	n/a
PM2.5	Annual	Odessa, TX	7.8	7.6	7.7	7.7	n/a
	24-hour	Odessa, TX	18	22	21	20.3	n/a
Carbon Monoxide	8-hour	El Paso, TX.	3,902.01	3,323.94	3,757.49	n/a	3,902.01
	1-hour	El Paso, TX.	7,225.95	6,792.39	6,069.80	n/a	7,225.95

ND = no data.
n/a = not applicable.
Source: TCEQ, 2005 and EPA AirDatabase.

E.3.2.3 Terrain Input Data

USGS 7.5-minute DEM data were used with the AERMOD terrain preprocessing model (AERMAP) to determine appropriate site terrain elevations in accordance with EPA's Guideline on Air Quality Models' (GAQM) recommendations for AERMOD. According to the GAQM, *flat* terrain is terrain equal to the elevation of the stack base, *simple* terrain is terrain lower than the height of the stack top, and *complex* terrain is terrain exceeding the height of the stack being modeled. Terrain input data for the proposed power plant sites are provided in Table E-13.

Table E-13. 7.5 Minute DEM Terrain Input Data for Proposed Power Plant Sites

Mattoon, IL[1]	Tuscola, IL[1]	Jewett, TX[2]	Odessa, TX[3]
Cadwell	Ivesdale	Teague South	Red Lakes
Arthur	Tolono	Dew	Douro
Arcola	Villa Grove NW	Lanely	Odessa SW
Sullivan	Atwood	Farrar	Metz
Cooks Mill	Tuscola	Donie	Penwell
Humboldt	Villa Grove	Buffalo	Clark Brothers Ranch
Windsor	Arthur	Round Prairie	Penwell SW
Mattoon West	Arcola	Jewett	Penwell SE
	Hindsburg	Robbins	Doodle Bug Well

[1] Portions of the modeling terrain for which 7.5 minute DEMs were not found were covered using Decatur 1–degree DEM.
[2] Portions of the modeling terrain for which 7.5 minute DEMs were not found were covered using "Waco" 1–degree DEM.
[3] Portions of the modeling terrain for which 7.5 minute DEMs were not found were covered using "Pecos" 1–degree DEM.

E.3.2.4 Receptor Grid

AERMOD requires receptor data consisting of location coordinates and ground-level elevations (see Table E-14). The discrete Cartesian and discrete sensitive receptors are based on the following tier and spacing distances in accordance with IEPA, TCEQ, and USEPA guidelines:

Table E-14. Receptor Grid Tier and Spacing Distance

Mattoon, IL	Tuscola, IL	Jewett, TX	Odessa, TX
• Refined receptor grid consists of 10,730 discrete points beyond the fence line • Fence line receptors at 50 meter spacing • Near-field Cartesian receptors from source location (center of the site) and extending out to 3,500 meters at 100 meter spacing (can also be described as extending from fence line to approximately 2,800 meters beyond) • Intermediate-field Cartesian receptors between 3,500 meters and extending out to 7,500 meters at 250 meter spacing • Far-field Cartesian receptors from 7,500 meters and extending out to 15,000 meters at 500 meter spacing • 17 sensitive receptors (schools, hospitals, etc.) modeled as discrete Cartesian receptors • Additional discrete Cartesian receptors to ensure full coverage of the sensitive receptor map domain	• Refined receptor grid consists of 11,588 discrete points beyond the fence line • Fence line receptors at 50 meter spacing • Near-field Cartesian receptors from source location (center of the site) and extending out to 3,500 meters at 100 meter spacing (can also be described as extending from fence line to approximately 3,000 meters beyond) • Intermediate-field Cartesian receptors between 4,000 meters and extending out to 7,000 meters at 250 meter spacing • Far-field Cartesian receptors from 7,000 meters and extending out to 15,000 meters at 500 meter spacing • 20 sensitive receptors (schools, hospitals, etc.) modeled as discrete Cartesian receptors • Additional discrete Cartesian receptors to ensure full coverage of the sensitive receptor map domain	• Refined receptor grid consists of 8,147 discrete points beyond the fence line • Fence line receptors at 50 meter spacing • Near-field Cartesian receptors from source location (center of the site) and extending out to 4,000 meters at 100 meter spacing (can also be described as extending from fence line to approximately 3,000 meters beyond) • Intermediate-field Cartesian receptors between 4,000 meters and extending out to 8,000 meters at 500 meter spacing • Far-field Cartesian receptors from 8,000 meters and extending out to 18,000 meters at 1,000 meter spacing • 5 sensitive receptors (schools, hospitals, etc.) modeled as discrete Cartesian receptors • Additional discrete Cartesian receptors to ensure full coverage of the sensitive receptor map domain	• Refined receptor grid consists of 8,147 discrete points beyond the fence line • Fence line receptors at 50 meter spacing • Near-field Cartesian receptors from source location (center of the site) and extending out to 3,500 meters at 100 meter spacing (can also be described as extending from fence line to approximately 3,000 meters beyond) • Intermediate-field Cartesian receptors between 3,500 meters and extending out to 7,500 meters at 500 meter spacing • Far-field Cartesian receptors from 7,500 meters and extending out to 18,000 meters at 1,000 meter spacing • 4 sensitive receptors (schools, hospitals, etc.) modeled as discrete Cartesian receptors • Additional discrete Cartesian receptors to ensure full coverage of the sensitive receptor map domain

E.3.3 AERMOD MODELING RESULTS

The AERMOD results for each site are provided below.

Mattoon, Illinois

The AERMOD results for the proposed Mattoon Power Plant project are provided in Table E-15.

Table E-15. Predicted Maximum Concentration Increases from Proposed Mattoon Power Plant ($\mu g/m^3$) [1]

Pollutant	Averaging Period	Maximum Annual Concentration Increase	Maximum Short-Term Concentration Increase
SO_2 (Normal Operating Scenario)[2]	3-hour	--	0.7172
	24-hour	--	0.2625
	Annual	0.18	--
SO_2 (Plant Upset Scenario) [3, 4, 5]	3-hour	--	511.82
	24-hour	--	88.00
	Annual	0.18	--
NO_2[6]	Annual	0.26	--
PM_{10}	24-hour	--	0.52
	Annual	0.04	--
$PM_{2.5}$ [7]	24-hour	--	0.52
	Annual	0.04	--
CO	1-hour	--	11.33
	8-hour	--	5.01

[1] Because the FutureGen Project would be a R&D project, DOE assumes that the maximum plant availability would be 85 percent.
[2] The normal operating scenario is based on steady-state emissions and is a period when the plant is operating without flaring, sudden restarts, or other upset conditions.
[3] The plant upset scenario is based on unplanned restart emissions. Most of the unplanned restart emissions would be SO_2. NO_2 and CO emissions would be higher during normal operation. There are no PM_{10}, $PM_{2.5}$ emissions during plant upset scenarios. See Table E-4.
[4] The 3-hr SO2 concentration is based on the 85th maximum concentration reading (out of 14,600 readings) of 5-yr meteorological data. The probability of concentration greater than 511.82 $\mu g/m^3$ during the 3-hr averaging period is less than 0.23 percent.
[5] The 24-hr SO2 concentration is based on the 1st maximum concentration reading (out of 1,825 readings) of 5-yr meteorological data. The probability of concentrations greater than 88.00 $\mu g/m^3$ during the 24-hr averaging period is zero.
[6] There are no short-term NAAQS for NO_2.
[7] $PM_{2.5}$ emissions are assumed to be the same as PM_{10}.
$\mu g/m^3$ = micrograms per cubic meter.
Source: FG Alliance, 2007 and EPA, 1990.

Tuscola, Illinois

The AERMOD results for the proposed Tuscola Power Plant project are provided in Table E-16.

Table E-16. Predicted Maximum Concentration Increases from Proposed Tuscola Power Plant ($\mu g/m^3$) [1]

Pollutant	Averaging Period	Maximum Annual Concentration Increase	Maximum Short-Term Concentration Increase
SO_2 (Normal Operating Scenario)[2]	3-hour	--	0.5355
	24-hour	--	0.1967
	Annual	0.05	--
SO_2 (Plant Upset Scenario) [3, 4, 5]	3-hour	--	511.96
	24-hour	--	67.00
	Annual	0.05	--
NO_2 [6]	Annual	0.07	--
PM_{10}	24-hour	--	0.39
	Annual	0.01	--
$PM_{2.5}$ [7]	24-hour	--	0.39
	Annual	0.01	--
CO	1-hour	--	9.47
	8-hour	--	4.73

[1] Because the FutureGen Project would be a R&D project, DOE assumes that the maximum plant availability would be 85 percent.
[2] The normal operating scenario is based on steady-state emissions and is a period when the plant is operating without flaring, sudden restarts, or other upset conditions.
[3] The plant upset scenario is based on unplanned restart emissions. Most of the unplanned restart emissions would be SO_2. NO_2 and CO emissions would be higher during normal operation. There are no PM_{10}, $PM_{2.5}$ emissions during plant upset scenarios. See Table E-4.
[4] The 3-hr SO_2 concentration is based on the 82nd maximum concentration reading (out of 14,600 readings) of 5-yr meteorological data. The probability of concentrations greater than 511.94 $\mu g/m^3$ during the 3-hr averaging period is less than 0.22 percent.
[5] The 24-hr SO_2 concentration is based on the 1st maximum concentration reading (out of 1,825 readings) of 5-yr meteorological data. The probability of concentrations greater than 67.00 $\mu g/m^3$ during the 24-hr averaging period is zero.
[6] There are no short-tern NAAQS for NO_2.
[7] $PM_{2.5}$ emissions are assumed to be the same as PM_{10}.
$\mu g/m^3$ = micrograms per cubic meter.
Source: FG Alliance, 2007 and EPA, 1990.

Jewett, Texas

The AERMOD results for the proposed Jewett Power Plant project are provided in Table E-17.

Table E-17. Predicted Maximum Concentration Increases from Proposed Jewett Power Plant ($\mu g/m^3$) [1]

Pollutant	Averaging Period	Maximum Annual Concentration Increase	Maximum Short-Term Concentration Increase
SO_2 (Normal Operating Scenario)[2]	3-hour	--	0.8195
	24-hour	--	0.4152
	Annual	0.48	--
SO_2 (Plant Upset Scenario) [3, 4, 5]	3-hour	--	511.91
	24-hour	--	89.50
	Annual	0.48	--
NO_2 [6]	Annual	0.67	--
PM_{10}	24-hour	--	0.83
	Annual	0.10	--
$PM_{2.5}$ [7]	24-hour	--	0.83
	Annual	0.10	--
CO	1-hour	--	10.45
	8-hour	--	7.88

[1] Because the FutureGen Project would be a R&D project, DOE assumes that the maximum plant availability would be 85 percent.
[2] The normal operating scenario is based on steady-state emissions and is a period when the plant is operating without flaring, sudden restarts, or other upset conditions.
[3] The plant upset scenario is based on unplanned restart emissions. Most of the unplanned restart emissions would be SO_2. NO_2 and CO emissions would be higher during normal operation. There are no PM_{10}, $PM_{2.5}$ emissions during plant upset scenarios. See Table E-4.
[4] The 3-hr SO_2 concentration is based on the 618th maximum concentration reading (out of 14,600 readings) of 5-yr meteorological data. The probability of concentration greater than 511.91 $\mu g/m^3$ during the 3-hr averaging period is less than 1.66 percent.
[5] The 24-hr SO_2 concentration is based on the 88th maximum concentration reading (out of 1,825 readings) of 5-yr modeling data. The probability of concentrations greater than 89.00 $\mu g/m^3$ during the 24-hr averaging period is 0.20 percent.
[6] There are no short-term NAAQS for NO_2.
[7] $PM_{2.5}$ emissions are assumed to be the same as PM_{10}.
$\mu g/m^3$ = micrograms per cubic meter.
Source: FG Alliance, 2007 and EPA, 1990.

Odessa, Texas

The AERMOD results for the proposed Odessa Power Plant project are provided in Table E-18.

Table E-18. Predicted Maximum Concentration Increases from Proposed Odessa Power Plant ($\mu g/m^3$) [1]

Pollutant	Averaging Period	Maximum Annual Concentration Increase	Maximum Short-Term Concentration Increase
SO_2 (Normal Operating Scenario)[2]	3-hour	--	0.5425
	24-hour	--	0.1884
	Annual	0.25	--
SO_2 (Plant Upset Scenario) [3, 4, 5]	3-hour	--	511.98
	24-hour	--	73.00
	Annual	0.25	--
NO_2 [6]	Annual	0.35	--
PM_{10}	24-hour	--	0.38
	Annual	0.05	--
$PM_{2.5}$ [7]	24-hour	--	0.38
	Annual	0.05	--
CO	1-hour	--	8.42
	8-hour	--	4.85

[1] Because the FutureGen Project would be a R&D project, DOE assumes that the maximum plant availability would be 85 percent.
[2] The normal operating scenario is based on steady-state emissions and is a period when the plant is operating without flaring, sudden restarts, or other upset conditions.
[3] The plant upset scenario is based on unplanned restart emissions. Most of the unplanned restart emissions would be SO_2. NO_2 and CO emissions would be higher during normal operation. There are no PM_{10}, $PM_{2.5}$ emissions during plant upset scenarios. See Table E-4.
[4] The 3-hr SO_2 is based on the 33rd maximum concentration reading (out of 14,600 readings) of 5-yr meteorological data. The probability of concentration greater than 511.98 $\mu g/m^3$ during the 3-hr averaging period is less than 0.09 percent.
[5] The 24-hr SO_2 is based on the 1st maximum concentration reading (out of 1,825 readings) of 5-yr modeling data. The probability of concentrations greater than 73.00 $\mu g/m^3$ during the 24-hr averaging period is zero.
[6] There are no short-term NAAQS for NO_2.
[7] $PM_{2.5}$ emissions are assumed to be the same as PM_{10}.
$\mu g/m^3$ = micrograms per cubic meter.
Source: FG Alliance, 2007 and EPA, 1990.

APPENDIX F
ALOHA SIMULATION OF AQUEOUS AMMONIA SPILLS

The Areal Locations of Hazardous Atmospheres (ALOHA), version 5.4, model was used to simulate the volatilization and air dispersion of 19 percent aqueous ammonia (NH_3) spills. ALOHA was jointly developed by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency. The U.S. Department of Energy's Office of Environmental, Safety, and Health have designated ALOHA as one of six toolbox codes for safety analysis (DOE, 2004). The ALOHA model provides all of the thermodynamic parameter values needed to simulate spills of both anhydrous NH_3 and aqueous NH_3 solutions up to 30 percent. The user enters site specific information concerning the spill volume, the type of spill, and meteorological information.

Three types of 19 percent aqueous NH_3 spills were simulated: a 400-pound (181-kilograms) leak from a valve, an uncontained 23.1-ton (21-metric ton) (6,000-gallon [22,712-liters]) spill from a delivery truck, and a 52-ton (47-metric ton) spill from a storage tank that is surrounded by a 3-foot (0.9-meter) high berm. Each spill is simulated in the ALOHA model as a puddle-evaporation scenario in which the area and mass of aqueous NH_3 are specified. The leaking valve scenario assumes a puddle thickness of 0.4 inch (1 centimeter); the uncontained truck spill assumes a puddle thickness of 4 inches (10 centimeters); and the contained tank spill assumes a puddle thickness of a 3-foot (0.9-meter) berm. A summary of the parameter values used to model the NH_3 spills is given in Table F-1.

Table F-1. Summary of ALOHA Information Used With the 19 Percent Aqueous NH_3 Spill Simulations

	Leaking Valve Scenario	Truck Spill Scenario	Containment Spill Scenario
Description	400-pound (181-kilogram) spill	23-ton (21-metric ton) spill	52-ton (47-metric tons spill
Source type	Evaporating puddle	Evaporating puddle	Evaporating puddle
Source dimensions (length x width)	14.5 feet x 14.5feet (4.43meter x 4.43meter)	49.5 feet x 49.5 feet (15.1 meter x 15.1 meter)	24.5 feet x 24.5 feet (7.47 meter x 7.47 meter)
Source area (square feet [square meters])	211 (19.6)	2,454 (228)	601 (55.8)
Puddle Depth (inch [centimeter])	0.4 (1)	4 (10)	36 (92)
Terrain option	Simple terrain	Simple terrain	Simple terrain
Urban/rural option	Open country	Open country	Open country
Cloud cover	0	0	0
Humidity	50 percent	50 percent	50 percent
Highest daily maximum temperatures	97, 101,104, and 106°F (36, 38, 40 and 41°C)	97, 101,104, and 106°F (36, 38, 40 and 41°C)	97, 101,104, and 106°F (36, 38, 40 and 41°C)
Stability class	Pasquill F	Pasquill F	Pasquill F
Wind speed (feet/second [meter/second])	5 (1.5)	5 (1.5)	5 (1.5)

°F = degree Fahrenheit; ^{0}C = degree Celsius

F.1 WORST-CASE METEOROLOGICAL CONDITIONS

As specified in 40 CFR Part 68.22 for off-site consequence-analysis parameter values (EPA, 1999), the worst-case release analyses are to be based on a wind speed of 5 feet/second (1.5 meters/second), an F atmospheric stability class, and the highest daily maximum temperature in the previous three years. The maximum temperatures are: Tuscola-97°F (36°C), Mattoon-101°F (38°C), Jewett-104°F (40°C), and Odessa-106°F (41°C). The maximum radii to nine different predicted NH_3 concentration levels, down wind of the spills, are predicted for each of the three spill scenarios and for each of the four sites. The nine NH_3 concentration levels are: 30; 110; 160; 220; 390; 550; 1,100; 1,600; and 2,700 parts per million volume (ppmv). These concentrations represent various health-effects criteria levels used in the risk assessment for NH_3 spills (EPA, 2007) (see Section 4.17 for explanation of AEGLs). ALOHA predicts the maximum radius at which each of these concentrations can travel down wind of the spill within the first hour after the spill occurs. Table F-2 presents the predicted maximum radii for the worst-case analysis of the Jewett Site; Table F-3 presents the results for the worst-case analysis at the Tuscola Site; Table F-4 presents the results for the worst-case analysis at the Odessa Site; and, Table F-5 presents the results for the worst-case analysis at the Mattoon Site.

Table F-2. Predicted Maximum Radii for Jewett Site Worst-Case Analysis[1]

Maximum NH_3 (ppmv)	400-pound (181-kilogram) Release[2] (feet [meters])	23-ton (21-metric ton) Release[3] (feet [meters])	52-ton (47-metric ton) Release[4] (feet [meters])
30	2,858 (871)	15,092 (4,600)	8,530 (2,600)
110	1,545 (471)	6,890 (2,100)	3,937 (1,200)
160	1,296 (395)	5,577 (1,700)	3,140 (957)
220	1,122 (342)	4,921 (1,500)	2,618 (798)
390	879 (268)	3,608 (1,100)	1,900 (579)
550	755 (230)	2,907 (886)	1,572 (479)
1,100	548 (167)	1,969 (600)	1,079 (329)
1,600	456 (139)	1,591 (485)	879 (268)
2,700	344 (105)	1,178 (359)	659 (201)

[1] ALOHA predicted maximum radii to specific NH_3 concentrations due to releases from an evaporating puddle (evaporating puddle, ground, and air at 104°F (40°C) at Jewett, TX, for the worst-case meteorological conditions of 4.9 feet/second (1.5 meters/second) wind speed and Pasquill stability class F.
[2] Initial emission rate of 3.84 kg/min.
[3] Initial emission rate of 41.0 kg/min.
[4] Initial emission rate of 13.3 kg/min.
ppmv = parts per million volume.

Table F-3. Predicted Maximum Radii for Tuscola Site Worst-Case Analysis[1]

Maximum NH_3 (ppmv)	400-pound (181-kilogram) Release[2] (feet [meters])	23-ton (21-metric ton) Release[3] (feet [meters])	52-ton (47-metric ton) Release[4] (feet [meters])
30	2,687 (819)	14,108 (4,300)	7,546 (2,300)
110	1,447 (441)	6,234 (1,900)	3,281 (1,000)
160	1,211 (369)	5,249 (1,600)	2,740 (835)
220	1,050 (320)	4,265 (1,300)	2,287 (697)
390	817 (249)	3,159 (963)	1,667 (508)
550	702 (214)	2,602 (793)	1,381 (421)
1,100	505 (154)	1,752 (534)	948 (289)
1,600	417 (127)	1,414 (431)	771 (235)
2,700	315 (96)	1,043 (318)	577 (176)

[1] ALOHA predicted maximum radii to specific NH_3 concentrations due to releases from an evaporating puddle (evaporating puddle, ground, and air at 97°F (36°C) at Tuscola, IL, for the worst-case meteorological conditions of 4.9 feet/second (1.5 meters/second) wind speed and Pasquill stability class F.
[2] Initial emission rate of 3.24 kg/min.
[3] Initial emission rate of 33.4 kg/min.
[4] Initial emission rate of 10.5 kg/min.
ppmv = parts per million volume.

Table F-4. Predicted Maximum Radii for Odessa Site Worst-Case Analysis[1]

Maximum NH_3 (ppmv)	400-pound (181-kilogram) Release[2] (feet [meters])	23-ton (21-metric ton) Release[3] (feet [meters])	52-ton (47-metric ton) Release[4] (feet [meters])
30	2,950 (899)	15,584 (4,750)	9,186 (2,800)
110	1,595 (486)	7,874 (2,400)	4,265 (1,300)
160	1,339 (408)	6,562 (2,000)	3,281 (1,000)
220	1,155 (352)	5,577 (1,700)	2,756 (840)
390	906 (276)	3,937 (1,200)	1,998 (609)
550	778 (237)	3,281 (1,000)	1,654 (504)
1,100	568 (173)	2,277 (694)	1,132 (345)
1,600	472 (144)	1,841 (561)	925 (282)
2,700	361 (110)	1,362 (415)	692 (211)

[1] ALOHA predicted maximum radii to specific NH_3 concentrations due to releases from an evaporating puddle (evaporating puddle, ground, and air at 106°F (41°C) at Odessa, TX, for the worst-case meteorological conditions of 4.9 feet/second (1.5 meters/second) wind speed and Pasquill stability class F.
[2] Initial emission rate of 4.05 kg/min.
[3] Initial emission rate of 52.6 kg/min.
[4] Initial emission rate of 14.3 kg/min.
ppmv = parts per million volume.

Table F-5. Predicted Maximum Radii for Mattoon Site Worst-Case Analysis[1]

Maximum NH_3 (ppmv)	400-pound (181-kilograms) Release[2] (feet [meters])	23-tons (21-metric tons) Release[3] (feet [meters])	52-tons (47-metric tons) Release[4] (feet [meters])
30	2,805 (855)	14,764 (4,500)	8,202 (2,500)
110	1,513 (461)	6,890 (2,100)	3,609 (1,100)
160	1,266 (386)	5,577 (1,700)	2,969 (905)
220	1,096 (334)	4,593 (1,400)	2,477 (755)
390	856 (261)	3,281 (1,000)	1,798 (548)
550	735 (224)	2,785 (849)	1,490 (454)
1,100	532 (162)	1,880 (573)	1,024 (312)
1,600	443 (135)	1,519 (463)	833 (254)
2,700	335 (102)	1,125 (343)	627 (191)

[1] ALOHA predicted maximum radii to specific NH_3 concentrations due to releases from an evaporating puddle (evaporating puddle, ground, and air at 101°F (38°C) at Mattoon, IL, for the worst-case meteorological conditions of 4.9 feet/second (1.5 meters/second) wind speed and Pasquill stability class F.
[2] Initial emission rate of 3.58 kg/min.
[3] Initial emission rate of 37.5 kg/min.
[4] Initial emission rate of 11.9 kg/min.
ppmv = parts per million volume.

The highest predicted NH_3 concentrations are associated with the 23.1-ton (21-metric ton) truck spill scenario. The 52-ton (47-metric ton) tank spill scenario involves a much larger volume of aqueous NH_3, but the truck spill has the largest spill area (2,454 square feet (228 square meters) versus 601 square feet (55.8 square meters) for the tank spill). The larger the spill area, the greater the mass of NH_3 that is available to evaporate per unit time.

When comparing the same spill scenario for all sites, the only difference used in the simulations was the maximum ambient temperature. The Tuscola site was simulated with a maximum daily temperature of 97°F (36°C) (see Table F-3) and the Odessa site was simulated with a maximum daily temperature of 106°F (41°C) (see Table F-4). There is approximately a 5 percent difference in the travel distance for the NH_3 plume between sites for the same spill scenario. There is little difference among the four sites when comparing the worst-case meteorological conditions. The biggest factor is the type of spill scenario, and the uncontained truck-spill scenario results in the highest potential NH_3 exposures.

F.2 ALOHA SENSITIVITY ANALYSIS FOR 7 DIFFERENT WIND/STABILITY CONDITIONS FOR THE TRUCK SPILL SCENARIO

The effect of different meteorological conditions on the predicted air concentrations of NH_3 resulting from the 23.1-ton (21-metric ton) truck spill was examined. The results presented in Tables F-2 to F-5 were based on the conservative assumption of calm wind conditions at the four sites, defined as a wind speed of 4.9 feet/second (1.5 meters/second) and a Pasquill stability class F. Class F stability corresponds to very stable atmospheric conditions and limited vertical mixing of the NH_3 plume. Hence, the NH_3 plume can travel down wind much further at higher concentrations compared to NH_3 plumes that are subject to greater vertical mixing.

The effect of meteorological conditions on predicted NH_3 concentrations is presented for the 23.1-ton (21-metric ton) truck spill scenario in Table F-6. The Jewett site was selected as a representative site, but the simulation results apply to all four sites. Data for the seven wind speed/stability classes were obtained from the Jewett wind-rose data set in the EIS. The model results in Table F-6 show that for the F/1.5 stability class/wind-condition, elevated NH_3 concentrations extend at least three times further from the source than for the D/8 stability class. The A/2 stability class simulation shows the greatest mixing and the shortest travel distance for elevated NH_3 concentrations. The A stability-class category indicates very unstable air and substantial vertical mixing of the NH_3 plume within the upper air stream. The more unstable the air, the more quickly the NH_3 plume becomes diluted.

Table F-6. Effect of Meteorological Conditions on Predicted NH_3 Concentrations for the 23.1-Ton (21-metric ton) Truck Spill Scenario[1]

Maximum NH_3 (ppmv)	F	A	A	B	B	C	D
	1.5 (20.8 percent)[2]	1 (6.5 percent)	2 (8.7 percent)	3 (27.9 percent)	4 (14.3 percent)	6 (13.4 percent)	8 (8.4 percent)
30	15,092 feet (4,600 meters)	1,289 feet (393 meters)	1,240 feet (378 meters)	1,834 feet (559 meters)	2,024 feet (617 meters)	3,068 feet (935 meters)	5,249 feet (1,600 meters)
110	6,890 (2,100)	669 (204)	643 (196)	948 (289)	1,053 (321)	1,568 (478)	2,493 (760)
160	5,577 (1,700)	554 (169)	528 (161)	784 (239)	873 (266)	1,289 (393)	2,001 (610)
220	4,921 (1,500)	469 (143)	453 (138)	666 (203)	741 (226)	1,096 (334)	1,667 (508)
390	3,608 (1,100)	351 (107)	335 (102)	499 (152)	551 (168)	810 (247)	1,201 (366)
550	2,907 (886)	292 (89)	279 (85)	417 (127)	463 (141)	679 (207)	988 (301)
1,100	1,969 (600)	200 (61)	194 (59)	289 (88)	322 (98)	469 (143)	666 (203)
1,600	1,591 (485)	164 (50)	154 (47)	230 (70)	262 (80)	381 (116)	535 (163)
2,700	1,178 (359)	-	-	171 (52)	194 (59)	282 (86)	390 (119)

[1] ALOHA predicted maximum radii to specific NH_3 concentrations due to releases from ground puddles (Puddle, ground, and air at 104°F [40°C]) for the 23.1 ton (21 metric ton) release at Jewett, TX. Wind speed/stability-class are obtained from Jewett wind rose data.
[2] Percent of time in stability class.

Table F-7 shows how the truck spill scenario varies between the four sites under the worse-case F/1.5 wind condition. As discussed, there is approximately a 5 percent difference in the predicted characteristics of the NH_3 plume between sites. These differences are only due to the different maximum daily temperatures at each site. Table F-8 compares the predicted NH_3-concentration radii under the second most conservative set of meteorological conditions at each site. At each site, the lengths of the ammonia-concentration radii are almost one-third the lengths of the radii for the worst-case, F stability class condition. There is little different among sites, but large variations at each site for different meteorological conditions and different spill scenarios.

Table F-7. Truck Spill Scenario Across Four Sites[1]

Site	Tuscola	Mattoon	Jewett	Odessa
Stability Class Wind speed (feet/second [meters/second])	F 4.9 (1.5)	F 4.9 (1.5)	F 4.9 (1.5)	F 4.9 (1.5)
Highest daily maximum temperature (°F [°C])	97 (36)	101 (38)	104 (40)	106 (41)
Percent of time for calm wind	4.14 percent	8.14 percent	20.8 percent	4.8 percent
Maximum NH_3 (ppmv)				
30	14,108 feet (4,300 meters)	14,764 feet (4,500 meters)	15,092 feet (4,600 meters)	15,584 feet (4,750 meters)
110	6,234 (1,900)	6,890 (2,100)	6,890 (2,100)	7,874 (2,400)
160	5,249 (1,600)	5,577(1,700)	5,577 (1,700)	6,562 (2,000)
220	4,265 (1,300)	4,593 (1,400)	4,921 (1,500)	5,577 (1,700)
390	3,159 (963)	3,281 (1,000)	3,609 (1,100)	3,937 (1,200)
550	2,602 (793)	2,785 (849)	2,907 (886)	3,281 (1,000)
1,100	1,752 (534)	1,879 (573)	1,969 (600)	2,277 (694)
1,600	1,414 (431)	1,519 (463)	1,591 (485)	1,841 (561)
2,700	1,043 (318)	1,125 (343)	1,178 (359)	1,362 (415)

[1] ALOHA predicted maximum radii to specific NH_3 concentrations due to releases from an evaporating puddle at Tuscola, Mattoon, and Odessa for the 23.1-ton (21-metric ton) truck release scenario using the worst-case meteorological conditions of 4.9 feet/second (1.5 meters/second) wind speed and Pasquill stability class F. The percent of time for the worst-case condition, which is called calm wind, is obtained from each site's wind rose data.
°F = degree Fahrenheit; ^{0}C = degree Celsius

Table F-8. Predicted NH_3-Concentration Radii Under the Second Most Conservative Set of Meteorological Conditions at Each Site[1]

Site	Tuscola	Mattoon	Jewett	Odessa
Stability Class Wind speed (feet/second [meters/second])	D 39.4 (12)	D 39.4 (12)	D 26.2 (8)	D 26.2 (8)
Highest daily maximum temperature (°F [°C])	97 (36)	101 (38)	104 (40)	106 (41)
Percent of time for each combination	2.15 percent	0.27 percent	8.43 percent	20.89 percent
Maximum NH_3 (ppmv)				
30	4,593 feet (1,400 meters)	4,921 feet (1,500 meters)	5,249 feet (1,600 meters)	5,249 feet (1,600 meters)
110	2,126 (648)	2,270 (692)	2,493 (760)	2,589 (789)

Table F-8. Predicted NH_3-Concentration Radii Under the Second Most Conservative Set of Meteorological Conditions at Each Site[1]

160	1,709 (521)	1,824 (556)	2,001 (610)	2,080 (634)
220	1,424 (434)	1,522 (464)	1,667 (508)	1,729 (527)
390	1,027 (313)	1,099 (335)	1,201 (366)	1,247 (380)
550	846 (258)	906 (276)	988 (301)	1,027 (313)
1,100	571 (174)	607 (185)	666 (203)	692 (211)
1,600	456 (139)	489 (149)	535 (163)	558 (170)
2,700	325 (99)	351 (107)	390 (119)	407 (124)

[1] ALOHA predicted maximum radii to specific NH_3 concentrations due to releases from an evaporating puddle at Tuscola, Mattoon, and Odessa for the 23.1-ton (21-metric ton) release scenario using the second worst wind speed/stability class combinations. Meteorological data were obtained from each site's wind rose data.
°F = degree Fahrenheit; ^{0}C = degree Celsius

F.3 REFERENCES

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