Prepared for:
Department of State

Keystone Pipeline Project







Preliminary Final Biological Assessment

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Acronyms and Abbreviations

°F	degrees Fahrenheit
API	American Petroleum Institute
AWBP	Aransas-Wood Buffalo National Park Population
BA	Biological Assessment
BHE	BHE Environmental, Inc.
bpd	barrels per day
CFR	Code of Federal Regulations
CMR Plan	Construction Mitigation and Reclamation Plan
CWS	Canadian Wildlife Service
dbh	diameter at breast height
DNR	Department of Natural Resources
DOS	Department of State
ERP	Emergency Response Plan
ESA	Endangered Species Act
FR	Federal Register
HDD	horizontal directional drill
I-80	Interstate 80
KDWP	Kansas Department of Wildlife and Parks
Keystone	TransCanada Keystone Pipeline, L.P.
km	kilometer
MDC	Missouri Department of Conservation
MP	milepost
NLAA	May affect, not likely to adversely affect
NRC	National Response Center
NRCS	Natural Resource Conservation Service
OPS	Office of Pipeline Safety

PHMSA	Pipeline Hazardous Materials and Safety Administration
REX-West	Rockies Express-West
ROW	right-of-way
SCADA	Supervisory Control and Data Acquisition
SPCC Plan	Spill Prevention, Control, and Countermeasure Plan
U.S.	United States
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMA	Wildlife Management Area

1.0 Introduction

1.1 Section 7 Process

The Department of State (DOS) is the lead federal agency for the evaluation of anticipated impacts of the proposed Keystone Pipeline Project (project). Federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS), are required to ensure that any action they authorize, fund, or carry out will not adversely affect a federally listed species or species proposed for federal listing. A Biological Assessment (BA) is required under Section 7(c) of the Endangered Species Act (ESA), if listed species or their critical habitat may be present in the area affected by any aspect of the project.

1.2 Consultation History

Construction and operation of the project may affect habitats and populations of species protected under the federal ESA and by individual state legislation. The DOS appointed TransCanada Keystone Pipeline, L.P. (Keystone) and its subcontractors to act as its designated non-federal representatives for Section 7 Consultation in a letter dated January 5, 2007. During 2006, Keystone, on behalf of the DOS, initiated consultation with the USFWS, and state natural heritage programs and wildlife agencies to identify species and habitats of concern. After receiving lists of species and habitats, Keystone developed field survey protocols, target survey areas, and survey schedules. These protocols were submitted to the USFWS and state agencies for review. No agencies objected to the proposed protocols; agency comments received on the protocols were incorporated into survey protocols. Agency coordination documentation and survey protocols were filed by Keystone with the DOS in September and November 2006, and in January, March, and September 2007.

Biological field surveys along the project right-of-way (ROW) were initiated in spring 2006. These surveys were conducted along the project ROW that was filed with the DOS in September 2006. Additional surveys were conducted along the project in late 2006 and 2007, to accommodate route alignment modifications that were filed with the DOS in November 2006; and in January, March, and September 2007. Due to access denials by private landowners, some surveys have not been completed. If necessary, additional species-specific field surveys would be conducted prior to construction, in coordination with the USFWS.

The following provides a summary of Keystone's agency correspondence, species specific survey information, and continued consultation with the USFWS regarding coordination of biological surveys and determination of biological impacts for the project:

- January 2006, Multiple Agencies: Keystone sent initial consultation letters to the USFWS, state wildlife agencies, and state natural heritage programs to request their input on identifying prominent terrestrial and aquatic resource issues or concerns that may occur within or adjacent to the project area, focusing on species that are either sensitive (e.g., federally listed), have high economic value (e.g., big game, waterfowl), or are considered important resources (e.g., raptors, fish). The consultation letters included an overview project map and a compact disk containing electronic files of the project ROW. The letters also requested input into survey requirements for species and habitats, including preferred survey methodology and acceptable survey efforts.
- February 15, 2006, USFWS – Grand Island Field Office: Project representatives met with the USFWS in Grand Island, Nebraska, to discuss construction aspects of the project, as well as environmental impacts of concern to the USFWS. During this meeting, Keystone was informed that the USFWS Nebraska Field Office would be the lead field office for the USFWS for the project.

- April 28, 2006, USFWS: Keystone received a consultation letter from the USFWS regarding sensitive habitats, federally listed or candidate species, and other species of concern (e.g., migratory birds) potentially occurring along the project. Keystone incorporated this information into project planning for sensitive species and habitats, and developed survey schedules and protocols to be implemented along the Keystone Mainline beginning in the fall of 2006.
- June 8, 2006, USFWS: Keystone received a supplemental consultation letter from the USFWS regarding federal easements in North Dakota and South Dakota crossed by the Keystone Mainline. The USFWS was particularly concerned with construction impacts in several ecologically sensitive areas. Keystone incorporated the information into route realignments and alternatives to avoid, where necessary and feasible, disturbance of the ecologically sensitive areas along the Keystone Mainline.
- June 14, 2006, Multiple Agencies: Project representatives met with staff from the USFWS Marion Field Office, and other state and federal agencies at Carlyle Lake, Illinois. The primary purpose of the meeting was to address questions agency representatives might have regarding the crossing of the Carlyle Lake Wildlife Management Area (WMA), and to obtain input on environmental issues such as recommended threatened and endangered species surveys. Survey recommendations for the Indiana bat, decurrent false aster, massasauga rattlesnake, migratory birds, and bald eagle and raptors were discussed during the meeting. Keystone incorporated recommendations into the biological survey plan.
- June 26, 2006, USFWS – Nebraska Field Office: Keystone sent the USFWS – Nebraska Field Office and each state wildlife agency a consultation package that included state-specific special status species tables compiled from data received from each state and the USFWS, with brief descriptions of species habitat, miles of potential habitat crossed by the project, and approximate mileposts where potential habitat was identified along the project . Topographic maps (1:100,000-scale) identifying potentially sensitive habitat along the project were included in the consultation package.
- July 18, 2006, USFWS – Nebraska Field Office: Keystone held an agency meeting with the USFWS Nebraska Field Office in Grand Island, Nebraska, to discuss issues pertaining to wildlife, special status species, migratory birds, and sensitive habitat that could potentially occur along the project. The goal of this meeting was to verify Keystone's habitat assessment approach, species occurrence information, discuss required field surveys, and review the information that was sent to the USFWS in the June 26, 2006, consultation package. The USFWS concurred with Keystone's approach to identifying special status species habitat, and Keystone incorporated comments from the meeting regarding additional survey recommendations and protocols for special status species surveys along the project.
- October 16, 2006, Missouri Department of Conservation (MDC) and Illinois Department of Natural Resources (DNR): Keystone sent study plans for the massasauga rattlesnake, western fox snake, and Kirtland's snake to the MDC and Illinois DNR for concurrence and approval to move forward with the habitat surveys for these species. The study plans included detailed, state-specific survey protocols for the habitat assessment surveys. Concurrence from both the MDC and Illinois DNR was received.
- October 31, 2006, Kansas Department of Wildlife and Parks (KDWP): Keystone received a consultation letter from the KDWP regarding sensitive species and habitats along the Cushing Extension. The consultation letter included information on federally listed species and their potential for occurrence along the Cushing Extension. Keystone incorporated the sensitive species information to plan species-specific surveys along the Cushing Extension.
- November 7, 2006, USFWS – Missouri Ecological Services Field Office: Keystone sent a study plan to the USFWS Missouri Ecological Services Field Office in Columbia, Missouri, requesting concurrence with the proposed Indiana bat habitat assessment method that would be used to characterize suitable maternity roost habitat for the species in the state of Missouri. Concurrence was received on November 21, 2006, and habitat surveys were initiated following receipt of this approval.

- November 14, 2006, USFWS Marion Field Office: Keystone sent a detailed study plan to the USFWS Marion Field Office in Illinois. Keystone requested concurrence with the proposed Indiana bat habitat survey method specific to the state of Illinois. Keystone received comments back from Joyce Collins (USFWS Marion Field Office) regarding the study plan, and the plan was accepted and signed on November 16, 2006. Habitat surveys were initiated shortly after receiving confirmation of the study plan.
- December 18, 2006, USFWS Nebraska Field Office: Keystone sent email correspondence to the USFWS Nebraska Field Office regarding the upcoming January/February 2007 aerial raptor and bald eagle winter roost and nest surveys. Comments and concurrence were received on the survey locations and methodology on January 24, 2007, and surveys were initiated following receipt of approval.
- December 19, 2006, Multiple Agencies: Keystone distributed copies of the 2006 biological survey reports to the appropriate state wildlife and USFWS representatives for their review. Keystone requested that each species expert review the corresponding report and provide Keystone with comments in order to address any concerns. Keystone followed-up with each agency evaluating biological reports, and no significant comments or concerns were received from any of the report reviewers.
- January 4, 2007, Multiple Agencies: Keystone sent emails to each state wildlife agency representative working on the project, and the USFWS Nebraska Field Office, requesting that Keystone meet with them in early February, in person, to review the overall proposed surveys plans for 2007 and any other outstanding issues.
- January 23, 2007, USFWS: Keystone met with USFWS representatives in Columbia, Missouri, to discuss strategies and opportunities to optimize project scheduling and conservation benefits to Indiana bats.
- February 5, 2007, USFWS – Nebraska Field Office: Keystone met with the USFWS Nebraska Field Office in Grand Island, Nebraska. The goals of the meeting were to: 1) discuss the 2006 survey results for federally listed and candidate species, 2) obtain concurrence on the proposed 2007 survey protocols and survey locations, and 3) discuss other issues or concerns that USFWS had regarding the project.
- February 9, 2007, Multiple Agencies: Keystone distributed copies of the fall/winter 2006 biological survey reports to the appropriate state wildlife and USFWS representatives for their review. Keystone requested that each species expert review the corresponding report and provide Keystone with comments in order to address any concerns. Keystone followed-up with each agency evaluating biological reports, and no significant comments or concerns were received from any of the report reviewers.
- April 12, 2007, Multiple Agencies: Keystone distributed copies of the spring 2007 biological survey reports to the appropriate state wildlife and USFWS representatives for their review. Keystone requested that each species expert review the corresponding report and provide Keystone with comments in order to address any concerns. Keystone followed-up with each agency evaluating biological reports, and no significant comments or concerns were received from any of the report reviewers.
- September 2007, Multiple Agencies: Keystone distributed copies of the summer 2007 biological survey reports to the appropriate state wildlife and USFWS representatives for their review. Keystone requested that each species expert review the corresponding report and provide Keystone with comments in order to address any concerns.

Based on the consultation with state agencies and the USFWS throughout 2006 and 2007, Keystone was able to refine the proposed biological surveys and survey requirements for each species that may potentially be affected by the project.

1.3 Analysis Summary

This species analysis addresses the impacts to 17 federally listed species that were identified by the USFWS and state wildlife agencies as potentially occurring along the project. **Table 1-1** summarizes these species and the impact determinations, based on: 1) correspondence with the USFWS and state wildlife agencies, 2) habitat requirements and the known distribution of these species within the project area, and 3) habitat analysis and field surveys that were conducted for these species in 2006 and 2007.

Table 1-1 Summary of Species Included in Analysis and Findings

Common Name	Scientific Name	Federal Status	Included in Analysis	Findings Summary[1]
Mammals				
Indiana bat	*Myotis sodalis*	Endangered	Yes	NLAA
Gray bat	*Myotis grisescens*	Endangered	No	No Effect
Gray wolf	*Canis lupus*	ND, SD population – delisted Considered extirpated from remaining states crossed by the project	No	No Effect
Birds				
Interior least tern	*Sterna antillarum athalassos*	Endangered	Yes	NLAA
Whooping crane	*Grus americana*	Endangered	Yes	NLAA
Bald Eagle	*Haliaeetus leucocephalus*	Delisted	No	NA
Piping plover	*Charadrius melodus*	Threatened	Yes	NLAA
Fish				
Pallid sturgeon	*Scaphirhynchus albus*	Endangered	Yes	NLAA
Topeka shiner	*Notropis topeka*	Endangered	Yes	NLAA
Arkansas River shiner	*Notropis girardi*	Threatened	Yes	NLAA
Neosho madtom	*Noturus pacidus*	Threatened	Yes	NLAA
Invertebrates				
Higgins eye pearlymussel	*Lampsilis higginsii*	Endangered	Yes	NLAA
Scaleshell mussel	*Leptodea leptodon*	Endangered	Yes	NLAA
Winged mapleleaf	*Quadrula fragosa*	Endangered	No	No Effect
Plants				
Running buffalo clover	*Trifolium stoloniferum*	Endangered	Yes	NLAA
Decurrent false aster	*Boltonia decurrens*	Threatened	Yes	NLAA
Western prairie fringed orchid	*Platanthera praeclara*	Threatened	Yes	NLAA

[1]NLAA – May affect, not likely to adversely affect.

NA – No Applicable.

1.4 Summary of Species Considered but Eliminated from Detailed Analysis for the Biological Assessment

Under Section 7 of the ESA, there is no requirement for federal agencies to consult on species that have been delisted or species that are designated as federal candidates. Effective August 8, 2007, the bald eagle was removed from the list of federal threatened or endangered species in the lower 48 United States [72 Federal Register [FR] 37345 [2007b]). The DOS has no further requirement to consult on the bald eagle under Section 7. In addition, three federal candidate species were identified as potentially occurring within the project area by the USFWS. These species include the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), Arkansas darter (*Etheostoma cragini*), and the Dakota skipper (*Hesperia dacotae*). These species are not discussed in this BA, but are analyzed in the Environmental Impact Statement for the project.

A total of three federally listed species identified for the project were analyzed for this BA, but were eliminated from detailed analysis based on the location of the project relative to the species' known distribution and/or habitat association.

1.4.1 Gray Bat

The gray bat occupies a limited geographic range in limestone karst areas of the southeastern United States (U.S.). Populations are found mainly in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Gray bat colonies are restricted entirely to caves or cave-like habitats for roosting, hibernacula, and parturition (USFWS 1997a, 1982). Although the project crosses the northern portion of the range of gray bat in Missouri and Illinois, the project would not impact any karst limestone formations with cave habitats suitable for gray bat use. Although this species was previously identified as potentially occurring in Madison County, Illinois, subsequent correspondence from the Illinois USFWS has determined that this species would not be impacted from the project. Therefore, the gray bat was eliminated from detailed analysis.

1.4.2 Winged Mapleleaf

The winged mapleleaf was historically known to inhabit 34 rivers in 12 states that included the upper tributaries of the Mississippi River and the Mississippi River itself (USFWS 1997b). Today it is considered extirpated from its entire historic range except for remnant populations in the St. Croix River in Minnesota and Wisconsin, the Ouachita and Saline Rivers in Arkansas, and the Bourbeuse River in Missouri (USFWS 2004, 1997b). The St. Croix River contains the only population known to be reproducing (USFWS 2004). None of these rivers would be crossed by the project, and no populations are known to occur downstream of waterbodies that would be crossed by the project. Therefore, the winged mapleleaf was eliminated from detailed analysis

1.4.3 Gray Wolf

Effective March 12, 2007, the western great lakes population of gray wolves was designated as a distinct population segment and was removed from the list of federal threatened or endangered species (72 FR 6051[2007a]). This population includes wolves that may occur along the project in the eastern half of North Dakota and South Dakota. Based on correspondence from the USFWS (USFWS 2006a,b), this species was only identified as potentially occurring within the project area in North Dakota. Therefore, this species was eliminated from detailed analysis.

1.4.4 Literature Cited

Federal Register (FR). 2007a. Endangered and Threatened Wildlife and Plants; Final Rule Designating the Western Great Lakes Populations of Gray Wolves as a Distinct Population Segment; Removing the Western Great Lakes Distinct Population Segment of the Gray Wolf from the List of Endangered and Threatened Wildlife; Final Rule. Federal Register 17(26):6051-6103.

_____. 2007b. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife; Final Rule; Endangered and

Threatened Wildlife and Plants; Draft Post-Delisting and Monitoring Plan for the Bald Eagle (*Haliaeetus leucocephalus*) and Proposed Information Collection; Notice. Federal Register 17(130): 37345-37372

U.S. Fish and Wildlife Service (USFWS). 2006a. Draft U.S. Fish and Wildlife Service Mountain-Prairie Region. Letter [No date].

_____. 2006b. U.S. Fish and Wildlife Service Mountain-Prairie Region. Letter dated April 28, 2006.

_____. 2004. Endangered species winged mapleleaf fact sheet. http://www.fws.gov/midwest/Endangered/clams/winge_fc.html.

_____. 1997a. Endangered species gray bat fact sheet. http://www.fws.gov/midwest/Endangered/mammals/grbat_fc.html.

_____. 1997b. Winged mapleleaf mussel recovery plan. Region 3, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 59 pp. + appendices.

_____. 1982. Gray bat recovery plan. U.S. Fish and Wildlife Service in cooperation with the gray bat recovery team, Denver, Colorado. 27 pp. + appendices.

2.0 Proposed Action

Keystone proposes to construct and operate an interstate crude oil transmission system from an oil supply hub near Hardisty, Alberta, in Canada to destinations in the U.S. In the U.S., the Keystone Mainline would consist of approximately 1,082 miles of new pipeline constructed from the U.S./Canadian border in Cavalier County, North Dakota, to existing terminals and refineries in Wood River (Madison County) and Patoka (Marion County), Illinois. The Cushing Extension would consist of approximately 296 miles of additional pipeline commencing in Jefferson County near the Nebraska-Kansas border and terminating at existing crude oil terminals in Cushing (Payne County), Oklahoma. The project system initially would be capable of transporting 435,000 barrels per day (bpd) and is expandable up to a capacity of approximately 591,000 bpd. **Table 2-1** summarizes the mileage by state.

Table 2-1 Miles of Pipeline Located in Each State

	North Dakota	South Dakota	Nebraska	Kansas	Missouri	Illinois	Oklahoma	TOTAL
KEYSTONE MAINLINE								
(miles)	217.8	219.9	214.6	98.7	274.0	56.9	0.0	1,081.8
CUSHING EXTENSION								
(miles)	0.0	0.0	2.5	210.4	0.0	0.0	83.1	296.0
PROJECT TOTAL	**217.8**	**219.9**	**217.1**	**309.1**	**274.0**	**56.9**	**83.1**	**1,377.8**

In addition to the pipeline, Keystone would construct aboveground facilities including pump stations, delivery facilities, and mainline valves. Powerlines required for electrical service to pump stations and remotely activated valves would be constructed and operated by local utility providers, not by Keystone. An overview map of the project location is provided in **Appendix A**, **Figure A-1**, while **Figures A-2** to **A-9** are state-specific maps showing the project ROW and aboveground facilities.

Keystone proposes to begin construction of the project in early 2008. Construction would occur on the entire project over an approximately 36-month period, although work on each construction spread will take approximately 6 to 8 months. Keystone is proposing an in-service date for the Keystone Mainline of no later than November 2009. Work on the Cushing Extension would begin in late 2009 or early 2010, with a Cushing Extension in-service date of 2010.

All pipe would be manufactured, constructed, and operated in accordance with applicable local, state, and federal regulations. The pipeline would be constructed primarily in rural areas. The pipeline would be constructed of high-strength steel pipe (American Petroleum Institute [API] 5L). All buried pipe will also receive two methods of protecting buried pipelines and facilities from corrosion, an external pipeline coating (fusion bonded epoxy) would be applied and cathodic protection will provide secondary protection against corrosion. Above ground facilities will be painted to provide protect against corrosion.

Aboveground facilities for the Keystone Mainline would include 24 pump stations (certain stations would contain pigging facilities), two delivery sites, and 55 mainline valves within the ROW. Each pump station would have one additional block valve. These additional valves are not included within the mainline valve totals. The pump stations would enable Keystone to maintain the pressure required to make crude oil deliveries. Meters within the delivery facilities would measure crude oil deliveries to proposed customer locations in Wood River, Illinois and Patoka, Illinois.

Aboveground facilities for the Cushing Extension would include three pump stations (certain stations would contain pigging facilities), two delivery facilities and 15 mainline valves within the ROW. The Keystone delivery facility would be located adjacent to operational tanks in Ponca City, Oklahoma, and Cushing, Oklahoma.

One to three additional pumps would be added at existing pump stations along the Keystone Mainline to achieve a throughput to 591,000 bpd. Such increased throughput would require one additional pump station (Pump Station Number 38, containing two pumps) to be constructed along the Keystone Mainline in Bond County, Illinois.

2.1.1 Land Requirements

Table 2-2 summarizes the land requirements for the project. With the exception of Illinois between Wood River and Patoka, Keystone would construct both the Mainline and the Cushing Extension within a 110-foot-wide corridor, consisting of both a temporary 60-foot-wide construction ROW and a 50-foot permanent ROW. In Illinois between Wood River and Patoka, the project would be constructed within a 95-foot-wide corridor, consisting of both a temporary 45-foot-wide construction ROW and a 50-foot permanent ROW. **Appendix A**, **Figures A-10** through **A-11** illustrate the typical construction ROW and equipment work locations in areas where the proposed pipeline is not located near an existing pipeline. **Appendix A, Figures A-12** through **A-13** illustrate the proposed construction ROW in areas where the pipeline would be located parallel to an existing pipeline. Keystone would reduce the construction ROW width to 85 feet in certain wetlands, shelterbelts, other forested areas, residential areas, and commercial/industrial areas.

Surface disturbance associated with the construction and operation of the project is summarized in **Table 2-2**. For the Keystone Mainline, approximately 17,607 acres of land would be disturbed during construction. This total includes temporary construction workspace and approximately 6,667 acres that would be retained as permanent ROW. All disturbed acreage would be restored and returned to its previous aboveground land-use after construction, except for approximately 135 acres of permanent ROW that would not be restored but would serve to provide adequate space for aboveground facilities, including pump stations, valving, etc. for the life of the pipeline.

Table 2-2 Summary of Land Requirements Associated with the Keystone Pipeline Project

Facility	Land Affected During Construction[1] (acres)	Land Affected During Operation[2] (acres)
KEYSTONE MAINLINE		
NORTH DAKOTA		
Pipeline ROW	2,892	1,320
Lateral ROWs	0	0
Additional Temporary Workspace Areas	121	0
Pipe and Contractor Yards	440	0
Pump Stations/Delivery Facilities[3]	25	25
Permanent Access Roads[4]	0.2	0.2
North Dakota Subtotal[5]	*3,440*	*1,342*
SOUTH DAKOTA		
Pipeline ROW	2,928	1,332
Lateral ROWs	0	0
Additional Temporary Workspace Areas	129	0
Pipe and Contractor Yards	329	0
Pump Stations/Delivery Facilities[3]	19	19
Permanent Access Roads[4]	0.3	0.3
South Dakota Subtotal[5]	*3,377*	*1,349*

Table 2-2 Summary of Land Requirements Associated with the Keystone Pipeline Project

Facility	Land Affected During Construction[1] (acres)	Land Affected During Operation[2] (acres)
NEBRASKA		
Pipeline ROW	2,861	1,301
Lateral ROWs	0	0
Additional Temporary Workspace Areas	123	0
Pipe and Contractor Yards	322	0
Pump Stations/Delivery Facilities[3]	25	25
Permanent Access Roads[4]	0	0
Nebraska Subtotal[5]	*3,335*	*1,323*
KANSAS		
Pipeline ROW	1,314	598
Lateral ROWs	0	0
Additional Temporary Workspace Areas	80	0
Pipe and Contractor Yards	458	0
Pump Stations/Delivery Facilities[3]	11	11
Permanent Access Roads[4]	1	1
Kansas Subtotal[5]	*1,871*	*6,08*
MISSOURI		
Pipeline ROW	3,646	1,660
Lateral ROWs	0	0
Additional Temporary Workspace Areas	280	0
Pipe and Contractor Yards	800	0
Pump Stations/Delivery Facilities[3]	30	30
Permanent Access Roads[4]	2	2
Missouri Subtotal[5]	*4,675*	*1,687*
ILLINOIS		
Pipeline ROW	655	345
Lateral ROWs	0	0
Additional Temporary Workspace Areas	34	0
Pipe and Contractor Yards	175	0
Pump Stations/Delivery Facilities[3]	23	22
Permanent Access Roads[4]	0	0
Illinois Subtotal[5]	*909*	*358*
Keystone Mainline Subtotal[4]	17,607	6,667
CUSHING EXTENSION		
NEBRASKA		
Pipeline ROW	34	15
Lateral ROWs	0	0
Additional Temporary Workspace Areas	4	0

Table 2-2 Summary of Land Requirements Associated with the Keystone Pipeline Project

Facility	Land Affected During Construction[1] (acres)	Land Affected During Operation[2] (acres)
Pipe and Contractor Yards	0	0
Pump Stations/Delivery Facilities[3]	0	0
Permanent Access Roads[4]	0	0
Nebraska Subtotal[5]	37	15
KANSAS		
Pipeline ROW	2,803	1,275
Lateral ROWs	0	0
Additional Temporary Workspace Areas	149	0
Pipe and Contractor Yards	339	0
Pump Stations/Delivery Facilities[3]	10	10
Permanent Access Roads[4]	0	0
Kansas Subtotal[5]	*3,266*	*1,284*
OKLAHOMA		
Pipeline ROW	1,094	497
Lateral ROWs	0	0
Additional Temporary Workspace Areas	52	0
Pipe and Contractor Yards	207	0
Pump Stations/Delivery Facilities[3]	8	8
Permanent Access Roads[4]	0	0
Oklahoma Subtotal[5]	*1,363*	*502*
Cushing Extension Subtotal[4]	4,666	1,801
PROJECT TOTAL[4]	**22,273**	**8,468**

[1]Disturbance is based on a total of 110-foot-wide construction ROW for 30- and 36-inch pipe and a 95-foot-wide construction ROW in portions of Illinois except in certain wetlands, shelterbelts, and other forested areas, residential areas, and commercial/industrial areas where a 85-foot-wide construction ROW would be used, or in areas requiring extra width for workspace necessitated by site conditions. Disturbance also includes pipe storage and contractor yards.

[2]Operation acreage was estimated based on a 50-foot-wide permanently maintained ROW in all areas. All pigging facilities would be located within either pump stations or delivery facility sites. Mainline valves would be constructed within the construction ROW and operated within a 50-foot x 50-foot area or 50-foot x 66-foot area, respectively, centered on the permanently maintained 50-foot-wide ROW. Other mainline valves would be located within the area associated with a pump station. Consequently, the acres of disturbance for these aboveground facilities are captured within the Pipeline ROW and Pump Station/Delivery Facilities categories within the table.

[3]The Wood River delivery facility would be constructed outside of the existing pipeline operational tank facilities. The delivery facility in Patoka would be located within existing facilities. Delivery facilities along the Cushing Extension at Ponca City and Cushing would be located within existing facilities. Additional temporary workspace areas include temporary disturbance for the construction of pump stations and/or delivery facilities.

[4]Acreage calculations were based on an assumption of a 20-foot-wide permanent access road.

[5]Discrepancies in total acreages are due to overlap of pipeline components.

For the Cushing Extension, approximately 4,666 acres of land would be disturbed during construction. This total includes temporary construction workspace and approximately 1,801 acres that would be retained as permanent ROW. All disturbed acreage would be restored except for approximately 18 acres of permanent ROW that would not be restored, but would serve to provide adequate space for aboveground facilities, such as pump stations and valving, for the life of the pipeline.

Almost all of the land affected by the construction and operation of the project would be privately owned; less than one percent would be public lands.

2.1.2 Pipeline ROW

Along the Keystone Mainline, approximately 377 miles (34.8 percent) of the 1,082 miles of the project would be located within about 300 feet of existing pipeline, utility, or road ROWs. Approximately 705 miles (56.6 percent) would be new ROW.

For the Cushing Extension, approximately 48 miles (16.2 percent) of the 296 miles of the project would be within approximately 300 feet of existing pipeline, utility, or road ROWs. Approximately 248 miles (94.7 percent) would be new ROW.

In locations where the project would parallel existing utilities, the project's new permanent ROW would be immediately adjacent to the existing permanent ROW. Pipeline generally would be installed at a 40-foot offset from the nearest existing pipeline centerline (**Appendix A, Figure A-12**) except in areas where the working side of the pipeline construction ROW is adjacent to the existing pipeline. In these areas, the pipeline would be installed at a 60-foot offset from the nearest existing pipeline centerline (**Appendix A, Figure A-13**).

2.1.3 Additional Temporary Workspace Areas

In addition to the construction ROW, Keystone has identified the types of additional temporary workspace areas that would be required (**Table 2-3**) and where these sites would be located. Temporary workspaces would be needed for areas requiring special construction techniques (e.g., river, wetland, and road and railroad crossings; horizontal directional drill (HDD) entry and exit points; steep slopes and hilly terrain; stringing truck turnarounds, foreign utility crossings, rocky soils) and construction staging areas.

Table 2-3 Dimensions and Acreage of Typical Additional Temporary Workspace Areas

Feature	Dimensions (length by width in feet at each side of crossing)	Acreage
Directionally drilled waterbodies	300' x 140' Entry and Exit Sides Plus on Exit Side (length of the drill plus 100') x 25'	2.0 Varies
Waterbodies >50 feet wide	250' x 25' in 4 quadrants (working and spoil sides, both sides of crossing) or 250' x 50' in 2 quadrants (working side, both sides of crossing)	0.6 0.6
Waterbodies <50 feet wide	125' x 25' in 4 quadrants (working and spoil sides, both sides of crossing) or 125' x 50' in 2 quadrants (working side, both sides of crossing)	0.3 0.3
Bored highways and railroads	175' x 25' in 4 quadrants (working and spoil sides, both sides of crossing) or 175' x 50' in 2 quadrants (working side, both sides of crossing)	0.5 0.5
Bored interstate and 4-lane highways	(Width of Crossing + 50') x 25' in 4 quadrants (working and spoil sides, both sides of crossing) or (Width of Crossing + 50') x 50' in 2 quadrants (working side, both sides of crossing)	Varies Varies
Open-cut or bored county or private roads	125' x 25' in 4 quadrants (working and spoil sides, both sides of crossing) or 125' x 50' in 2 quadrants (working side, both sides of crossing)	0.3 0.3
Push-pull wetland crossings	150' x 50' in 2 quadrants and Center Length at Intersection Point	0.2

Table 2-3 Dimensions and Acreage of Typical Additional Temporary Workspace Areas

Feature	Dimensions (length by width in feet at each side of crossing)	Acreage
Push-pull wetland crossings	(Length of Wetland + 100') x 50' on working side	1.0
Construction Mobilization & Demobilization Sites	located adjacent to all season hard pack or paved road at spread breaks	5.0
Stringing truck turnaround areas	200' x 80' (working side)	0.4
Full ROW topsoil stripping/steep or side slopes	Length of Area x 25' (uphill side)	Varies
Merchantable timber stockpiling or marshalling areas	200' x 50'	0.3

The precise location of additional temporary workspaces would be modified as the project continues to be refined. This would involve the adjustment of workspaces as necessary with respect to actual wetland and waterbody locations. Keystone would adjust additional temporary workspace at the prescribed set back distance from waterbody and wetland features unless impractical as determined on a site-specific basis. As a result, wetland impact acreage presented is likely overstated. Prior to surface disturbing activities, temporary workspaces would be evaluated for environmental concerns, including wetlands and waterbodies, and sensitive species.

2.1.4 Pipe Storage and Contractor Yards

Off-ROW extra workspace areas would be required during the construction phase of the project to serve as pipe storage yards and contractor yards. Keystone estimates that 27 pipe storage yards, 19 contractor yards, and 17 combined pipe storage/contractor yards would be required during construction of the Keystone Mainline and 9 pipe storage and 6 contractor yards would be required during construction of the Cushing Extension (**Table 2-4**). Contractor yards would reduce worker transportation requirements during construction and would occupy, on average, approximately 15 to 20 acres. Pipe staging yards would be used to stockpile pipe at approximately 30-mile intervals along the pipeline route and typically are located in proximity to railroad sidings facilities. Pipe yards would occupy, on average, approximately 25 acres. To the extent practical, Keystone proposes to use existing commercial/industrial sites or sites that previously have been used for construction. Existing public or private roads would be used to access each yard. Both pipe storage yards and contractor yards would be used on a temporary basis and would be restored upon completion of construction.

Table 2-4 Locations and Acreage of Potential Pipe Storage Yards and Contractor Yards

Facility Name/Type	County	Acreage
KEYSTONE MAINLINE		
North Dakota		
Berea Pipe Yard	Barnes	30
Valley City-A Contractor Yard	Barnes	12
Valley City-B Contractor Yard	Barnes	6
Milton Pipe Yard	Cavalier	30
Oakes Pipe Yard	Dickey	30
Emerado Contractor Yard	Grand Forks	21
Grand Forks-1 Contractor Yard	Grand Forks	11
Grand Forks-2 Contractor Yard	Grand Forks	7
Larimore Pipe Yard	Grand Forks	30
Aneta Contractor Yard	Nelson	25
Walhalla Pipe Yard	Pembina	30
Devils Lake Contractor Yard	Ramsey	20
Lisbon Contractor Yard	Ransom	17
Verona Pipe Yard	Ransom	30

Table 2-4 Locations and Acreage of Potential Pipe Storage Yards and Contractor Yards

Facility Name/Type	County	Acreage
Luverne Pipe Yard	Steele	46
Dahlen Pipe Yard	Walsh	40
Grafton-A Contractor Yard	Walsh	15
Grafton-B Contractor Yard	Walsh	10
Lankin Pipe Yard	Walsh	30
South Dakota		
Yale Pipe Yard	Beadle	30
Bath Contractor Yard	Brown	30
Claremont Pipe Yard	Brown	30
Ashton Pipe Yard	Clark	30
Iroquois Pipe and Contractor Yard	Kingsbury	50
Emery Pipe Yard	McCook	40
Mitchell Contractor Yard	McCook	3
Yankton Pipe Yard	Yankton	32
Yankton-2 Contractor Yard	Yankton	21
Yanton-1 Contractor Yard	Yankton	33
Nebraska		
Garrison Pipe and Contractor Yard	Butler	65
Laurel Pipe Yard	Cedar	30
Columbus Pipe and Contractor Yard	Colfax	50
Plymouth Pipe and Contractor Yard	Jefferson	39
Humphrey Pipe Yard	Platte	40
Milford Pipe Yard	Seward	30
Norfolk Contractor Yard	Stanton	38
Norfolk Pipe Yard	Stanton	30
Kansas		
Hiawatha-1 Pipe and Contractor Yard	Brown	61
Hiawatha-2 Pipe and Contractor Yard	Brown	44
Woodlawn Pipe Yard	Brown	40
Highland Pipe and Contractor Yard	Doniphan	63
Marysville Pipe and Contractor Yard	Marshall	160
Summerfield Pipe and Contractor Yard	Marshall	50
Hanover East Pipe Yard	Washington	40
Missouri		
Mexico Contractor Yard	Audrain	20
Mexico East-A Pipe and Contractor Yard	Audrain	45
Mexico East-B Pipe and Contractor Yard	Audrain	30
Elmira Pipe and Contractor Yard	Caldwell	50
Tina Pipe Yard	Carroll	49
Keytesville Pipe and Contractor Yard	Chariton	56
Cameron East Pipe and Contractor Yard	Clinton	5
Gower Pipe Yard	Clinton	88
Winston Pipe and Contractor Yard	DeKalb	22
Troy Contractor Yard	Lincoln	33
Buell Pipe Yard	Montgomery	33
Clark-1 Pipe and Contractor Yard	Randolph	109
Clark-2 Pipe and Contractor Yard	Randolph	109
Renick Pipe Yard	Randolph	8
Old Monroe Pipe Yard	St. Charles	63

Table 2-4 Locations and Acreage of Potential Pipe Storage Yards and Contractor Yards

Facility Name/Type	County	Acreage
Illinois		
Alton-2 Contractor Yard	Madison	42
Hartford Pipe Yard	Madison	60
Greenville Contractor Yard	Bond	23
Pocahontas Pipe Yard	Bond	50
CUSHING EXTENSION		
Kansas		
Augusta Contractor Yard	Butler	13
Towanda Pipe Yard	Butler	26
Broughton Pipe Yard	Clay	21
Junction City Pipe Yard	Dickinson	61
Concordia Contractor Yard	Cloud	22
Winfield Pipe Yard	Cowley	31
Grandview Plaza Contractor Yard	Geary	16
Junction City Contractor Yard	Geary	26
Florence Pipe Yard	Marion	42
Lost Springs Pipe Yard	Marion	55
Hanover SW Pipe Yard	Washington	26
Oklahoma		
Ponca City Contractor Yard	Kay	21
Ponca City Pipe Yard	Kay	76
Morrison Pipe Yard	Noble	47
Cushing Pipe Yard	Payne	43
Stillwater-1 Contractor Yard	Payne	20

2.1.5 Access Roads

Keystone would use public and preexisting private roads to provide access to most of the construction ROW. Keystone does not anticipate the need to improve and maintain many temporary roads needed to access the work areas. Paved roads are not likely to require improvement or maintenance prior to or during construction. Gravel roads and dirt roads may require maintenance during the construction period due to high use. Road improvements such as blading and filling would be restricted to the existing road footprint (i.e., the road would not be widened). Private roads and new temporary access roads would be used and maintained only with permission of the landowner or land management agency.

As a part of its permanent aboveground facilities, Keystone also would construct short, permanent access roads from public roads to the proposed pump stations, delivery facilities, and mainline valves. The estimated acres of disturbance associated with proposed permanent access roads are included. Prior to construction, Keystone would finalize the location of permanent access roads along with any additional temporary access roads. At a minimum, construction of new permanent access roads would require completion of cultural resources and biological surveys, along with the appropriate State Historic Preservation Officer and USFWS consultations and approvals. Other state and local permits also may be required prior to construction. In the future, maintenance of newly created access roads would be the responsibility of Keystone.

2.1.6 Aboveground Facilities

The project would require a total of about 132 acres of land along the Keystone Mainline for the location of aboveground facilities, including pump stations, delivery facilities, and mainline valves. The project would require 18 acres for similar facilities on the Cushing Extension.

Keystone would initially construct 24 new pump stations for the Mainline and three for the Cushing Extension. Each station would consist of two or three pumps driven by electric motors, an electrical building, electrical substation, two sump tanks, a small maintenance building, and parking area for station personnel. Stations would operate on locally purchased electric power for pumps, lights, and heating in the buildings and would be fully automated for unmanned operation. Remote start/stop, set point controls, unit monitoring equipment, and station information would be installed at each location. The pipe entering and exiting the pump station sites would be located below grade. The pipe within the pump station (after entering and prior to exiting the pump station facilities) would be aboveground.

Keystone would install two delivery facilities along the Keystone Mainline at Wood River and Patoka and two along the Cushing Extension (Ponca City and Cushing). The delivery facilities would include pressure regulating, heating, sampling, chromatography, tube switching, and crude oil measurement equipment. At Patoka, delivery facilities would be located entirely within existing tank storage facilities. At Wood River, the delivery facilities will be incorporated within one of the aforementioned pump stations. Cushing Extension delivery facilities would be located within the Ponca City and Cushing tank storage facilities.

Keystone would construct 55 mainline valves along the Keystone Mainline and 15 mainline valves along the Cushing Extension. Mainline valves would be installed at each pump station and along the ROW. When not located at a pump station, mainline valves would be sectionalizing block valves constructed within a fenced 25-foot-wide by 25-foot-long site located within the pipeline construction ROW and centered on the 50-foot-wide permanently maintained ROW. Remotely activated valves are located at pump stations, upstream of major river crossings, and sensitive waterbodies. These valves can be activated to shutdown the pipeline in the event of an emergency to minimize environmental impacts in the unlikely event of a spill. Mainline valve intervals would be a maximum of approximately 64 miles, with an average spacing interval of approximately every 15 to 20 miles. The spacing intervals between the mainline valves along the ROW are based upon the location of the pump stations, waterbodies greater than 100 feet in width, high consequence areas such as densely populated areas, and other topographic and environmental considerations.

The project would be designed to permit full in-line inspection of the pipeline with a minimum interruption of service. Pig launchers and/or receivers would likely be constructed and operated completely within the boundaries of the pump stations or delivery facilities.

Construction Procedures

The proposed facilities would be designed, constructed, tested, and operated in accordance with all applicable requirements included in the U.S. Department of Transportation (USDOT) regulations at 49 Code of Federal Regulations (CFR) Part 195, *Transportation of Hazardous Liquids by Pipeline*, and other applicable federal and state regulations. These regulations are intended to ensure adequate protection for the public and to prevent crude oil pipeline accidents and failures. Among other design standards, Part 195 specifies pipeline material and qualification, minimum design requirements, and pipeline integrity requirements.

To manage construction impacts, Keystone would implement Keystone's Construction Mitigation and Reclamation (CMR) Plan (Keystone's Plan; **Appendix C**). This Plan contains construction and mitigation procedures that would be used throughout the project, with subsections to address specific environmental conditions.

Keystone would implement its Spill Prevention, Control, and Countermeasure (SPCC) Plan to avoid or minimize the potential for harmful spills and leaks during construction. The plan describes spill prevention practices, emergency response procedures, emergency and personnel protection equipment, release notification procedures, and cleanup procedures.

Keystone would implement its Emergency Response Plan (ERP) to identify its emergency personnel and the logical sequence of actions, which should be taken in the event of an emergency involving the Keystone system facilities during construction or operation. The ERP would meet federal safety requirements (49 CFR Parts 194 and 195). The ERP establishes written emergency shut down procedures, communication coordination, and clean-up responsibilities in the event of a crude oil pipeline emergency. A draft of Keystone's

ERP was submitted to the Department of State on July 1, 2006. A final draft would be submitted to the USDOT Pipeline Hazardous Materials and Safety Administration (PHMSA) prior to commencement of line filling and operations.

2.1.6.1 General Pipeline Construction Procedures

Before starting construction, Keystone would finalize engineering surveys of the ROW centerline and extra workspaces and substantially complete the acquisition of ROW easements and any necessary acquisitions of property in fee.

Overland pipeline construction generally proceeds as a moving assembly line as shown in **Appendix A**, **Figure A-14** and as summarized below. Keystone currently plans to construct the pipeline in 11 spreads; 8 spreads along the Keystone Mainline and three spreads along the Cushing Extension. Each of the pipeline spreads would consist of approximately 100 to 180 miles of pipeline on the Mainline and 80 to 110 miles on the Cushing Extension. Separate crews would be used for construction of the aboveground facilities.

Standard pipeline construction is composed of specific activities including survey and staking of the ROW, clearing and grading, trenching, pipe stringing, bending, welding, lowering-in, backfilling, hydrostatic testing, and cleanup. In addition to standard pipeline construction methods, Keystone would use special construction techniques where warranted by site-specific conditions. These special techniques would be used when constructing across rugged terrain, waterbodies, wetlands, paved roads, highways, and railroads.

Survey and Staking

The first step of construction involves marking the limits of the approved work area (i.e., the construction ROW boundaries and any additional temporary workspace areas) and flagging the location of approved access roads and foreign utility lines. Wetland boundaries and other environmentally sensitive areas also would be marked or fenced for protection at this time. Before the pipeline trench is excavated, a survey crew would stake the centerline of the proposed trench.

Clearing and Grading

Before clearing and grading activities are conducted, landowner fences would be braced and cut and temporary gates and fences would be installed to contain livestock, if present. A clearing crew would follow the fence crew and would clear the work area of vegetation (including crops) and obstacles (e.g., trees, logs, brush, rocks). Temporary erosion control measures such as silt fences or straw bales would be installed prior to vegetation removal down slopes into wetlands and riparian areas. Grading would be conducted where necessary to provide a reasonably level work surface. Where the ground is relatively flat and does not require grading, disturbance to soils would be substantially reduced and sod and rootmats would be left in the ground. More extensive grading would be required in steep side-slopes or vertical areas and where necessary to prevent excessive bending of the pipeline.

Trenching

The trench would be excavated to a depth that provides sufficient cover over the pipeline after backfilling. Typically, the trench would be about seven to eight feet deep and about four to five feet wide in stable soils. In most areas, the USDOT requires a minimum of 36 inches of cover. In rocky areas the USDOT requires a minimum depth of cover of 18 inches. In most locations, the depth of cover for the project would be a minimum of 48 inches (**Table 2-5**). Trenching may precede bending and welding or may follow based on several factors including soil characteristics, water table, existence of drain tiles, and weather conditions at the time of construction.

When rock or rocky formations are encountered, tractor-mounted mechanical rippers or rock trenchers would be used to fracture the rock prior to excavation. In areas where mechanical equipment can not break up or loosen the bedrock, blasting (use of explosives) would be required. Excavated rock would be used to backfill the trench to the top of the existing bedrock profile. **Table 2-5** summarizes minimum pipeline cover for various land use types.

Table 2-5 Minimum Pipeline Cover

Location	Cover, Normal Excavation (inches)	For Rock Excavation (inches)
All waterbodies	60	36
Dry creeks, ditches, drains, washes, gullies, etc.	60	36
Drainage ditches at public roads and railroads	60	48
All other land	48	36

Topsoil would be separated from subsoil over the trench or over the trench and spoil side. In areas of removal of topsoil only over the trench, separated topsoil would be stored on the near side of the trench and in a pile separate from subsoil (which would be stored on the far side of the trench) to allow for proper restoration of the soil during the backfilling process (see **Appendix A, Figures A-10** through **A-13**). In areas where topsoil over the trench and spoil side is removed, separated topsoils would be stored on the edge of the spoil side of the construction ROW (or, optionally, on the edge of the working side of the construction ROW) and in a pile separate from subsoil (which would be stored on the spoil side of the trench) to allow for proper restoration of the soil during the backfilling process. In areas where the ROW would be graded to provide a level working surface and where there is a need to separate topsoil from subsoil, the ROW would be graded to collect topsoil before any subsoil is disturbed.

Topsoil would be piled such that the mixing of subsoil and topsoil would not occur. Gaps would be left between the spoil piles to prevent storm water runoff from backing up or flooding. Topsoil would be returned to its original horizon after subsoil is backfilled in the trench.

Pipe Stringing, Bending, and Welding

Prior to or following trenching, sections of externally coated pipe up to 80 feet long (also referred to as “joints”) would be transported by truck over public road networks and along authorized private access roads to the ROW and placed or “strung” along the trench in a continuous line.

After the pipe sections are strung along the trench and before joints are welded together, individual sections of the pipe would be bent where necessary to allow for uniform fit of the pipeline with the varying contours of the bottom of the trench. A track-mounted, hydraulic pipe-bending machine would shape the pipe to conform to the contours of the terrain. Where multiple or complex bends are required in a section of pipe, that section of the pipeline would be bent at the factory.

After the pipe sections are bent, the joints would be welded together into long strings and placed on temporary supports. The pipeline joints would be lined up and held in position until securely joined by welding. Keystone would non-destructively inspect 100 percent of the welds using radiographic or ultrasonic methods. Welds that do not meet established specifications would be removed. Once the welds are approved, a protective epoxy coating would be applied to the welded joints. The pipeline would then be electronically inspected or “jeeped” for faults or voids in the epoxy coating and visually inspected for any faults, scratches, or other coating defects. Damage to the coating would be repaired before the pipeline is lowered into the trench.

In rangeland areas used for grazing and livestock, construction activities potentially can hinder the movement of livestock if the livestock cannot be relocated temporarily by the owner. The movement of wildlife in search of food and water also can be hindered by construction activities. To minimize impact on livestock and wildlife movements during construction, Keystone would leave hard plugs (short lengths of unexcavated trench) or install soft plugs (areas where the trench is excavated and replaced with minimal compaction) to allow livestock and wildlife to cross the open trench safely. Soft plugs would be constructed with a ramp on each side to provide an avenue of escape for animals that fall into the trench.

Prior to lowering-in of the pipe into the trench, multiple sections of pipeline may be welded together above the trench. These welded lengths of pipe may be greater than 1 mile in length. Keystone would lower these sections of pipeline into the trench expeditiously to minimize impacts to landowners.

Lowering-in and Backfilling

Before the pipeline is lowered in, the trench would be inspected to be sure it is free of livestock or wildlife, as well as rocks and other debris that could damage the pipe or protective coating. In areas where water has accumulated, dewatering may be necessary to permit inspection of the bottom of the trench. The pipeline then would be lowered into the trench. On sloped terrain, trench breakers (stacked sand bags or foam) would be installed in the trench at specified intervals to prevent subsurface water movement along the pipeline. The trench would then be backfilled using the excavated material. In rocky areas, the pipeline would be protected with an abrasion-resistant coating or rock shield (fabric or screen that is wrapped around the pipe to protect the pipe and its coating from damage by rocks, stones, and roots). Alternatively, the trench bottom would be filled with padding material (e.g., finer grain sand, soil, or gravel) to protect the pipeline. No topsoil would be used as padding material.

Hydrostatic Testing

All permits required by federal, state, and local agencies for procurement of water and for the discharge of water used in the hydrostatic testing operation would be obtained by Keystone. Any water obtained or discharged shall be in compliance with permit notice requirements and with sufficient notice for Keystone's Testing Inspector to make water sample arrangements prior to obtaining or discharging water. In some instances sufficient quantities of water may not be available from the permitted water sources at the time of testing. Withdrawal rates may be limited as stated by the permit. Under no circumstances shall an alternate water source be used without prior authorization from Keystone. Required water analysis would be obtained from each source to be used in sufficient time to have a lab analysis performed prior to any filling operations. The sample bottle shall be sterilized prior to filling with the water sample. The analysis shall determine the pH value and total suspended solids

Staging areas for filling the pipeline with water shall be located a minimum of 50 feet from the waterbody or a wetland boundary if topographic conditions permit. Temporary sediment filter devices would be installed adjacent to all streams where runoff may enter.

Intake hoses would be screened to prevent the entrainment of fish or debris. The hose shall be kept off the bottom of the waterbody. Refueling of construction equipment shall be conducted a minimum distance of 100 feet from the stream or a wetland.

Adequate flow rates would be maintained in the waterbody to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

No chemicals would be used in the test water. No water containing oil or other substances that are in sufficient amounts as to create a visible color film or sheen on the surface of the receiving water would be discharged.

Pipe Geometry Inspection

The pipeline would be inspected prior to final tie-ins utilizing an electronic caliper (geometry) pig to ensure the pipeline does not have any dents or ovality that might be detrimental to the operations of the pipeline.

Final Tie-in

Following successful hydrostatic testing, test manifolds would be removed and the final pipeline tie-in welds would be made and inspected.

Commissioning

After final tie-ins are complete and inspected, the pipeline would be cleaned and dried. If the pipeline is not ready for commissioning after the drying phase, the pipeline would be filled with 10 pounds per square inch,

gauge of dry air until ready for commissioning. Commissioning involves verifying that equipment has been properly installed and is working, the controls and communications systems are functional, and the pipeline is ready for service. In the final step, the pipeline is prepared for service by purging the line of air and filling the line with crude oil.

Cleanup and Restoration

During cleanup, construction debris on the ROW would be disposed of and work areas would be final graded. Preconstruction contours would be restored as closely as possible. Segregated topsoil would be spread over the surface of the ROW and permanent erosion control measures would be installed. After backfilling, final cleanup would begin as soon as weather and site conditions permit. Every reasonable effort would be made to complete final cleanup (including final grading and installation of erosion control devices) within approximately 20 days after backfilling the trench (approximately 10 days in residential areas). Construction debris would be cleaned up and taken to a disposal facility.

After permanent erosion control devices are installed and final grading has occurred, all disturbed work areas except annually cultivated fields would be seeded as soon as possible. Seeding is intended to stabilize the soil, revegetate areas disturbed by construction, and, depending upon land use, restore native flora. Timing of the reseeding efforts would depend upon weather and soil conditions and would be subject to the prescribed dates and seed mixes specified by the landowner, land-managing agency, or Natural Resource Conservation Service (NRCS) recommendations. On agricultural lands, seeding would be conducted only as agreed upon with the landowner.

Keystone would restrict access along the ROW using gates, boulders, or other barriers to minimize unauthorized access by all-terrain vehicles in wooded areas if requested by the landowner. Pipeline markers would be installed at road and railroad crossings and other locations (as required by 49 CFR Part 195) to show the location of the pipeline. Markers would identify the owner of the pipeline and convey emergency information. Special markers providing information and guidance to aerial patrol pilots also would be installed.

2.1.6.2 Special Construction Procedures

In addition to standard pipeline construction methods, Keystone would use special construction techniques where warranted by site-specific conditions. These special techniques would be used when constructing in steep terrain, waterbodies, wetlands, and when blasting through rock. These special techniques are described below.

Steep Terrain

Additional grading may be required in areas where the project would cross steep slopes. Steep slopes often need to be graded down to a gentler slope for safe operation of construction equipment and to accommodate pipe-bending limitations. In such areas, the slopes would be excavated prior to pipeline installation and reconstructed to their original contours during restoration.

In areas where the project crosses laterally along the side of a slope, cut and fill grading may be required to obtain a safe, flat work terrace. Topsoil would be stripped from the entire ROW and stockpiled prior to cut and fill grading on steep terrain. Generally, on steep side-slopes, soil from the high side of the ROW would be excavated and moved to the low side of the ROW to create a safe and level work terrace. After the pipeline is installed, the soil from the low side of the ROW would be returned to the high side and the slope's original contours would be restored. Topsoil from the stockpile would be spread over the surface, erosion control features installed, and seeding implemented.

In steep terrain, temporary sediment barriers such as silt fence and straw bales would be installed during clearing to prevent the movement of disturbed soil into wetland, waterbody, or other environmentally sensitive areas. Temporary slope breakers consisting of mounded and compacted soil would be installed across the ROW during grading and permanent slope breakers would be installed during cleanup. Following construction, seed would be applied to steep slopes and the ROW would be mulched with hay or non-brittle straw or

covered with erosion control fabric. Sediment barriers would be maintained across the ROW until permanent vegetation is established.

Waterbody Crossings

A total of 213 perennial stream and river crossings would occur during the construction of the Keystone Mainline and 58 perennial waterbody crossings would occur on the Cushing Extension. Perennial waterbodies would be crossed using one of four techniques: the open-cut wet method (Keystone's preferred method), open-cut flume method, open-cut dam-and-pump method, or HDD method as described below.

Keystone's preferred crossing method would be to use an open-cut wet crossing. The open-cut wet method involves trenching through the waterbody while water continues to flow through the construction work area (**Appendix A, Figure A-16**). This crossing method results in a shorter construction/disturbance period to the stream. Pipe segments for the crossing would be fabricated adjacent to the waterbody. Generally, backhoes operating from one or both banks would excavate the trench within the streambed. In wider rivers, in-stream operation of equipment may be necessary. Trench plugs consisting of a hard or soft plug would be placed to prevent the flow of water into the upland portions of the trench. Trench spoil excavated from the streambed generally would be placed at least 10 feet away from the water's edge unless stream width is great enough to require placement in the stream bed. Sediment barriers would be installed where necessary to control sediment and to prevent excavated spoil from entering the water. After the trench is dug, the prefabricated pipeline segment would be carried, pushed, or pulled across the waterbody and positioned in the trench. When crossing saturated wetlands and flowing waterbodies using the open-cut method, the pipe coating would be covered with reinforced concrete or concrete weights to provide negative bouyancy. The trench would then be backfilled with native material or with imported material if required by applicable permits. Following backfilling, the banks would be restored and stabilized.

Keystone would utilize dam and pump or dry flume crossings where technically feasible on environmentally sensitive waterbodies as warranted by resource-specific sensitivities. The flume crossing method involves diverting the flow of water across the trenching area through one or more flume pipes placed in the waterbody. The dam-and-pump method is similar to the flume method except that pumps and hoses would be used instead of flumes to move water around the construction work area. In both methods, trenching, pipe installation, and backfilling are done in isolation from the live stream while water flow is maintained for all but a short reach of the waterbody at the actual crossing. Once backfilling is completed, the flume or pump hoses are removed and the streambanks restored and stabilized.

Along the Mainline, Keystone plans to use the HDD method of construction at the Pembina River, South Branch Park River, Missouri River (two crossings), Elkhorn River, Platte River, Chariton River, Cuivre River (two crossings), Mississippi River, Silver Creek, Hurricane Creek, and Kaskaskia River. Along the Cushing Extension, Keystone plans to use the HDD method of construction at the Republican River, Arkansas River, Salt Fork Arkansas River, and Cimarron River. The HDD method involves drilling a pilot hole under the waterbody and banks, then enlarging the hole through successive reamings until the hole is large enough to accommodate a prefabricated segment of pipe. Throughout the process of drilling and enlarging the hole, a slurry consisting mainly of water and bentonite clay would be circulated to power and lubricate the down-hole tools, remove drill cuttings, and hold the hole open. Pipe sections long enough to span the entire crossing would be staged and welded along the construction work area on the opposite side of the waterbody and then pulled through the drilled hole. Ideally, use of the HDD method results in no impact on the banks, bed, or water quality of the waterbody being crossed; however access to the waterbody, and access across the waterbody is often required. **Appendix A, Figure A-17** shows a conceptual HDD waterbody crossing.

Approximately 605 intermittent waterbody crossings would occur on the Keystone Mainline and about 195 intermittent waterbody crossings on the Cushing Extension. If these intermittent waterbodies are dry at the time of crossing, Keystone proposes to use conventional upland cross-country construction techniques. If an intermittent waterbody is flowing when crossed, Keystone would install the pipeline using the open cut wet crossing method discussed above. When crossing waterbodies, Keystone would adhere to the guidelines outlined in its Site-specific Waterbody Crossing Plans, Keystone's Plan (**Appendix C**) and the requirements of its waterbody crossing permits.

Additional temporary workspace areas would be required on both sides of all waterbodies to stage construction, fabricate the pipeline, and store materials. These workspaces would be located at least 10 feet away from the water's edge, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land. Before construction, temporary bridges (e.g., clean rock/gravel fill over culverts, timber mats supported by flumes, railcar flatbeds, flexi-float apparatus) would be installed across all perennial waterbodies to allow construction equipment to cross. Construction equipment would be required to use the bridges, except the clearing crew, which would be allowed one pass through the waterbodies before the bridges are installed.

During clearing, sediment barriers such as silt fence and staked straw bales would be installed and maintained on drainages across the ROW adjacent to waterbodies and within additional temporary workspace areas to minimize the potential for sediment runoff. Silt fence and/or straw bales located across the working side of the ROW would be removed during the day when vehicle traffic is present and would be replaced each night. Alternatively, drivable berms could be installed and maintained across the ROW in lieu of silt fence and/or straw bales.

In general, equipment refueling and lubricating at waterbodies would take place in upland areas that are 100 feet or more from the edges of the water. When circumstances dictate that equipment refueling and lubricating would be necessary in or near waterbodies, Keystone would follow its SPCC Plan to address the handling of fuel and other hazardous materials.

After the pipeline is installed beneath the waterbody, restoration would begin. Waterbody banks would be restored to preconstruction contours or to a stable configuration. Appropriate erosion control measures such as rock riprap or gabion baskets (rock enclosed in wire bins), log walls, vegetated geogrids, willow cuttings, etc.) would be installed as necessary on steep waterbody banks in accordance with permit requirements. More stable banks would be seeded with native grasses and mulched or covered with erosion control fabric. Waterbody banks would be temporarily stabilized within 24 hours of completing in-stream construction. Sediment barriers, such as silt fence and/or straw bales or drivable berms would be maintained across the ROW at all waterbody approaches until permanent vegetation is established. Temporary equipment bridges would be removed following construction.

Wetland Crossings

Data from wetland delineation field surveys, aerial photography, and National Wetland Inventory map data were used to identify wetlands crossed by the proposed project. Pipeline construction across wetlands would be similar to typical conventional upland cross-country construction procedures, with several modifications where necessary to reduce the potential for pipeline construction to affect wetland hydrology and soil structure.

The wetland crossing method used would depend largely on the stability of the soils at the time of construction. If wetland soils are not excessively saturated at the time of construction and can support construction equipment without equipment mats, construction would occur in a manner similar to conventional upland cross-country construction techniques (**Appendix A, Figure A-18**). Topsoil would be salvaged over the trenchline. In saturated soils, topsoil segregation generally would not be possible. Keystone typically would use an 85-foot-wide construction ROW through saturated wetlands unless non-cohesive soils are present that would require a wider construction ROW. Additional temporary workspace areas would be required on both sides of particularly wide saturated wetlands to stage construction, fabricate the pipeline, and store materials. These additional temporary workspace areas would be located in upland areas a minimum of 10 feet from the wetland edge.

Construction equipment working in saturated wetlands would be limited to that area essential for ROW clearing, excavating the trench, fabricating and installing the pipeline, backfilling the trench, and restoring the ROW. In areas where there is no reasonable access to the ROW except through wetlands, non-essential equipment would be allowed to travel through wetlands only if the ground is firm enough or has been stabilized to avoid rutting.

Clearing of vegetation in wetlands would be limited to trees and shrubs, which would be cut flush with the surface of the ground and removed from the wetland. To avoid excessive disruption of wetland soils and the native seed and rootstock within the wetland soils, stump removal, grading, topsoil segregation, and excavation would be limited to the area immediately over the trenchline. During clearing, sediment barriers, such as silt fence and staked straw bales, would be installed and maintained on downslopes adjacent to saturated wetlands and within additional temporary workspace areas as necessary to minimize the potential for sediment runoff.

Where wetland soils are saturated and/or inundated, the pipeline can be installed using the push-pull technique. The push-pull technique would involve stringing and welding the pipeline outside of the wetland and excavating and backfilling the trench using a backhoe supported by equipment mats or timber riprap. The prefabricated pipeline is installed in the wetland by equipping it with buoys and pushing or pulling it across the water-filled trench. After the pipeline is floated into place, the floats are removed and the pipeline sinks into place. Most pipe installed in saturated wetlands would be coated with concrete or equipped with set-on weights to provide negative buoyancy. Because little or no grading would occur in wetlands, restoration of contours would be accomplished during backfilling. Prior to backfilling, trench breakers would be installed where necessary to prevent the subsurface drainage of water from wetlands. Where topsoil has been segregated from subsoil, the subsoil would be backfilled first, followed by the topsoil. Topsoil would be replaced to the original ground level leaving no crown over the trenchline. In some areas where wetlands overlie rocky soils, the pipe would be padded with rock-free soil or sand before backfilling with native bedrock and soil. Equipment mats, timber riprap, gravel fill, geotextile fabric, and/or straw mats would be removed from wetlands following backfilling.

Where wetlands are located at the base of slopes, permanent slope breakers would be constructed across the ROW in upland areas adjacent to the wetland boundary. Temporary sediment barriers would be installed where necessary until revegetation of adjacent upland areas is successful. Once revegetation is successful, sediment barriers would be removed from the ROW and disposed of properly.

In wetlands where no standing water is present, the construction ROW would be seeded in accordance with the recommendations of the local soil conservation authorities or land management agency.

Blasting

Although no blasting activities (use of explosives to fracture rock) are anticipated, blasting may be required in areas where consolidated shallow bedrock or boulders are encountered, which cannot be removed by conventional excavation methods. If blasting is required to clear the ROW and to fracture the ditch, strict safety precautions would be followed. Keystone would exercise extreme care to avoid damage to underground structures, cables, conduits, pipelines, and underground watercourses or springs. To protect property or livestock, Keystone would provide adequate notice to adjacent landowners or tenants in advance of blasting. Blasting activity would be performed during daylight hours and in compliance with federal, state, and local codes and ordinances and manufacturers' prescribed safety procedures and industry practices.

Fences and Grazing

Fences would be crossed or paralleled by the construction ROW. Before cutting any fences for pipeline construction, each fence crossed by the ROW would be braced and secured to prevent the slacking of the fence. To prevent the passage of livestock, the opening in the fenceline would be temporarily closed when construction crews enter and leave the area. If gaps in natural barriers used for livestock control are created by the pipeline construction, the gaps would be fenced according to the landowner's requirements. All existing improvements, such as fences, gates, irrigation ditches, cattle guards, and reservoirs would be maintained during construction and repaired to pre-construction conditions or better.

2.1.6.3 Aboveground Facility Construction Procedures

Construction activities at each of the pump stations would follow a standard sequence of activities: clearing and grading, installing foundations for the electrical building and support buildings, and erecting the structures to support the pumps and associated facilities. A block valve is installed in the mainline with two side block

valves, one to the suction piping of the pumps and one from the discharge piping of the pumps. Construction activities and the storage of building materials would be confined to the pump station construction sites. **Appendix A, Figures A-19** and **A-20** illustrates a typical plot plan for a pump station.

The sites for the pump stations would be cleared of vegetation and graded as necessary to create a level surface for the movement of construction vehicles and to prepare the area for the building foundations. Foundations would be constructed for the pumps and buildings and soil would be stripped from the area of the building foundations. A permanent security fence would be installed around each pump station site.

Each pump station would include one electrical building and one support building. The electrical building would include electrical systems, communications, and control equipment. The second building houses a small office and washroom. The crude oil piping, both aboveground and belowground, would be installed and pressure-tested using methods similar to those used for the main pipeline. After testing is successfully completed, the piping would be tied in to the main pipeline. Piping installed below grade would be coated for corrosion protection prior to backfilling. In addition, all below grade facilities would be protected by a cathodic protection system. Before being put into service, pumps, controls, and safety devices would be checked and tested to ensure proper system operation and activation of safety mechanisms.

Each pump station would require electricity and telephone facilities, which would be obtained from local utilities. Electric power infrastructure for the project would be constructed, permitted, and operated by local cooperative utility providers, not by Keystone. Therefore, inferring reasonably foreseeable impacts from construction and operation of electric power infrastructure to threatened and endangered species is not feasible in this species analysis. Construction of electric power infrastructure would be analyzed under a separate National Environmental Policy Act analysis if permitted by a federal agency or in the course of permit review by state and federal agencies. Where delivery and pigging facilities are collocated with pump stations, the delivery and pigging facilities would be located entirely within the pump station sites. Construction activities would include clearing, grading, trenching, installing piping, erecting buildings, fencing the facilities, cleanup, and restoration. The delivery facilities would operate on locally provided power.

Mainline valve construction would be carried out concurrent with the construction of the pipeline. Where practical, mainline valves typically would be located near public roads to allow year-round access. If necessary, permanent access roads or approaches would be constructed within the permanent ROW to each mainline valve site.

The construction of pig launchers and receivers would be carried out concurrent with the construction of the pump stations and delivery facilities. Activities such as clearing, grading, trenching, and clean-up would occur simultaneously with construction activities associated with the pump stations and delivery facilities.

2.1.6.4 Construction Workforce and Schedule

Keystone proposes to begin construction in early 2008. Construction of the Mainline is expected to last 24 months, ending in September 2009. Keystone proposes to commence service by November 30, 2009. Work on the Cushing Extension would begin in late 2009 or early 2010, with an in-service date for the Cushing Extension of 2010. Keystone anticipates a peak workforce of approximately 2,500 to 3,000 construction personnel. Construction personnel would consist of Keystone employees, contractor employees, construction inspection staff, and environmental inspection staff.

Keystone is planning to build the Keystone Mainline in eight spreads and the Cushing Extension in three spreads (**Table 2-6**).

Table 2-6 Construction Spreads Associated with the Keystone Pipeline Project

Construction Spread	State	Start Milepost (MP)	Location	End MP	Location	Spread Length (miles)
KEYSTONE MAINLINE						
1A	North Dakota	0.0	Canadian Border	129.9	West side of 121st Ave SE, a N/S Road	129.9
2A	North Dakota	129.9	West side of 121st Ave SE, a N/S Road	217.8	North Dakota/South Dakota State Line	133.3
	South Dakota	217.8	North Dakota/South Dakota State Line	263.2	South side of County Road 22 at PS 20	
3B	South Dakota	263.2	South side of County Road 22 at PS 20	403.8	East Side of 435th Ave.	140.6
4B	South Dakota	403.8	East Side of 435th Ave.	437.7	South Dakota/ Nebraska State Line	130.6
	Nebraska	437.7	South Dakota/Nebraska State Line	534.4	South side of County Road J Valve 18	
5B	Nebraska	534.4	South side of County Road J Valve 18	651.9	Nebraska/Kansas State Line	140.7
	Kansas	651.9	Nebraska/Kansas State Line	675.1	East Side of County Road 99	
6B	Kansas	675.1	East Side of County Road 99	750.8	Kansas/Missouri State Line	104.5
	Missouri	750.8	Kansas/Missouri State Line	779.6	South side of NW 292nd Street	
7B	Missouri	779.6	South side of NW 292nd Street	905.9	East Side of County Road Ee	126.3
8B	Missouri	905.9	East Side of County Road Ee	1024.9	Missouri/Illinois State Line	175.8
	Illinois	1024.9	Missouri/Illinois State Line	1081.7	End of Line in Patoka Illinois	
Total Mainline	**1081.7**					
CUSHING EXTENSION						
9C	Nebraska	0.0	Pump Station 28 in Jefferson, NE	2.4	Nebraska/Kansas State Line	107.8
	Kansas	2.4	Nebraska/Kansas State Line	107.6	South side of 290th St. in Marion, KS	
10C	Kansas	107.6	South side of 290th St. in Marion, KS	211.9	South side of 322nd in Cowley, KS	104.9
11C	Kansas	211.9	South side of 322nd in Cowley, KS	212.8	Kansas/Oklahoma State Line	83.3
Total Cushing	**296.0**					

Keystone anticipates 500 to 600 construction and inspection personnel associated with each spread. Each spread would require approximately 6 to 8 months to complete. All construction work is expected to be completed by the end of December 2009. Currently, Keystone proposes to start construction of the aboveground facilities in the summer of 2008. Construction of each pump station would require approximately 20 to 30 additional workers. Construction of all pump stations would be completed in 18 months.

Keystone, through its construction contractors and subcontractors, would attempt to hire temporary construction staff from the local population. At peak workforce, Keystone anticipates that an average of 10 to 15 percent of the total construction workforce may be hired locally, with the remaining portion of the workforce (85 to 90 percent or more) consisting of non-local personnel.

Only work vehicles would be allowed on the construction ROW or additional temporary workspace areas during construction.

2.1.6.5 Abandonment

The project is expected to operate for 50 or more years. Keystone has not identified plans for abandonment of these facilities at this time. If abandonment of any facilities is proposed in the future, the abandonment would be subject to approvals by state and/or federal agencies having jurisdiction. Abandonment would be implemented in accordance with then-applicable permits, approvals, codes, and regulations.

2.1.7 Operation and Maintenance

Keystone would operate and maintain the project facilities in accordance with the USDOT regulations in 49 CFR Parts 194 and 195 and other applicable federal and state regulations. Operation and maintenance of the pipeline system in most cases would be accomplished by Keystone personnel. Keystone estimates that operation of the pipeline would require approximately 20 employees in the U.S.

2.1.7.1 Normal Operations and Routine Maintenance

The pipeline would be inspected periodically in accordance with 49 CFR Part 195. These surveillance activities would provide information on possible encroachments and nearby construction activities, erosion, exposed pipe, and other potential concerns that may affect the safety and operation of the pipeline. Evidence of population changes would be monitored and High Consequence Areas identified as necessary. Mainline valves also would be inspected annually and the results documented.

In order to maintain operational accessibility of the ROW in order to accommodate pipeline integrity surveys and comply with federal regulations, shrubs and trees would be maintained in an herbaceous state over portions of the pipeline ROW. Cultivated croplands would be allowed to grow in the permanent ROW. Keystone would use mechanical mowing or cutting along the ROW for normal vegetation maintenance and will avoid the use pesticides during construction or ROW maintenance activities except for application at aboveground operational facilities or on the ROW during construction or maintenance using spot treatment as part of a noxious weed management plan.

During operations, Keystone would monitor the pipeline and conduct pipeline integrity surveys to identify any potential integrity concerns. Plans related to waterbodies, wetlands, and upland areas are discussed in Keystone's Plan (**Appendix C**). Operation and maintenance procedures, including record keeping, would be performed in accordance with the USDOT requirements. Keystone would survey the ROW to identify areas where permanent erosion control devices require repair or additional erosion control devices are necessary to prevent future degradation.

Keystone would further monitor the ROW to identify any areas where soil productivity has been degraded as a result of pipeline construction and reclamation measures would be implemented to rectify any such concerns. Applicable reclamation measures are outlined in the Plan (**Appendix C**).

Supervisory Control and Data Acquisition (SCADA) facilities would be located at all pump stations and delivery facilities. The pipeline SCADA system would be capable of the following functions:

- Mainline valve position remote indication;
- Mainline valve remote closing and opening control from a control center;
- Remote indication of line pressure and temperature; and
- Remote indication of delivery flow and total flow.

The project would have a control center manned by an experienced and highly trained crew 24 hours per day for 365 days per year. A backup control center also would be constructed.

Communications systems would provide up-to-date information from the pump stations to the control center plus the capability to contact field personnel. A backup communications system would be included within the system design and installation. The control center has state-of-the-art pipeline monitoring systems including a leak detection system that would indicate out-of-normal conditions (see Section 2.1.9.2, Abnormal Operations) and initiate visual and audible alarms if they detect an operating condition that warrant operator investigation. Serious abnormal situations that are not investigated would initiate automatic pipeline shutdown systems.

2.1.7.2 Abnormal Operations

Abnormal operating procedures would be implemented whenever appropriate in accordance with 49 CFR Section 195.402(d). In the event of any unusual situation, the operations manager on duty would alter the pipeline's operation. In the event pressure indications show a change, higher or lower, the pipeline controller would immediately make an evaluation. If a leak is suspected, Keystone would initiate its ERP (preliminary draft submitted to the DOS on July 1, 2006). A final draft would be submitted to the USDOT PHMSA prior to commencement of line filling and operations.

If a leak is suspected and the pipe is shutdown, the operation of the segment would not be resumed until the cause of the alarm (e.g., false alarm by instrumentation) or the leak is identified and repaired. If a reportable leak were to occur, USDOT approval would be required to resume operation of the affected segment.

Keystone would perform aerial surveillance of the pipeline ROW at least 26 times a year not to exceed 3 weeks between intervals in accordance with 49 CFR Part 195. In addition to visual surveillance and operator diligence, Keystone would employ two technology-based leak detection systems to facilitate the early detection of pipeline leaks. These systems include:

- Leak detection software associated with the SCADA monitoring system; and
- Volumetric balancing.

As described above, Keystone's SCADA system would constantly monitor pipeline operation to quickly detect abnormal operation, including the detection of leaks. The SCADA system and leak detection software would fully comply with industry standards (API 1149). Using real-time dynamic flow modeling software, line-pack compensated volumetric balancing, and a hydraulic gradient model, the SCADA system would check pipeline conditions (e.g., flow rates, pressure, temperature, and fluid density) every 3 to 5 seconds while the pipeline is actively transporting crude oil. Pressure transducers and other monitoring equipment would be located at pump stations and data from these locations would be transmitted via satellite to the centralized SCADA location. The SCADA system would acquire and accumulate these data, which would then be fed into a leak detection model for analysis and trending. Real-time measurements would be analyzed against predetermined thresholds; if a predetermined threshold is exceeded, the information would be sent to the SCADA system, and the operator would be informed to take corrective actions. Compared to older leak detection programs, line-pack compensated volume-balancing represents an improved method for volume accounting that calculates changes in fluid volume within the pipeline.

When the project is not actively transporting oil, the pipeline would enter a "static" mode. Since crude oil would not be moving, the pressures between pressure transducers should remain relatively constant after accounting for temperature changes and other minor pressure changes.

Emergency Response Procedures

Potential system emergencies include leaks or fires located near or directly involving a pipeline or pipeline facility and pipeline or pipeline facility damage from natural and human causes. If an emergency were to occur, pipeline flow would be stopped and would not resume until the cause of the problem (e.g., instrumentation failure or leak) is detected and repaired.

Keystone would be required to prepare site-specific ERPs for the system, which would be submitted to and reviewed by the Office of Pipeline Safety (OPS) prior to operation. A preliminary draft ERP has been submitted to the DOS (July 1, 2006). The ERP would: 1) establish guidelines and procedures to be followed in emergencies and to minimize hazards resulting from pipeline emergencies, 2) establish procedures for training Keystone's employees on emergency procedures, and 3) establish guidelines for continuing educational programs designed to inform the public of the procedures to follow in recognizing and reporting an emergency condition in compliance with the recommended practice of API 1162.

If a spill were to occur, Keystone would be required to immediately notify the National Response Center (NRC) in the event of a release of crude oil that: 1) violates water quality standards, 2) creates a sheen on water, or 3) causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines (40 CFR Part 112). In addition to the NRC, Keystone would make timely notifications to other agencies, including the appropriate Local Emergency Planning Committees, sheriff's departments, the applicable state's Department of Environmental Qualifications, U.S. Environmental Protection Agency (USEPA), and affected landowners.

Under the National Contingency Plan, USEPA is the lead federal response agency for oil spills occurring on land and in inland waters. USEPA would evaluate the size and nature of a spill, its potential hazards, the resources needed to contain and clean it up, and the ability of the responsible party or local authorities to handle the incident. The USEPA would monitor all activities to ensure that the spill is being contained and cleaned up appropriately. All spills meeting legally defined criteria (see criteria above per 40 CFR Part 112) must be monitored by the USEPA, even though most spills may be small and cleaned up by the responsible party. In the unlikely event of a large spill, Keystone and its contractors would be expected to take the lead in recovery and cleanup. The role of local emergency responders is typically to notify community members, direct people away from the hazard area, and address potential impacts to the community such as temporary road closings.

A fire associated with a spill is relatively rare. According to historical data (OPS 2005), only about four percent of reportable liquid spills are ignited. In the event of a fire, local emergency responders would execute the roles listed above and firefighters would take actions to prevent the crude oil fire from spreading to adjacent foliage or structures. Fire departments might choose to extinguish a small- or moderate-sized crude oil fire, but in many cases the best course of action may be to let the fire burn itself out. Local emergency responders typically are trained and able to execute the roles described above without any additional training or specialized equipment. Keystone also would work with emergency response agencies to provide pipeline awareness education and other support.

Remediation

Corrective remedial actions would be dictated by federal regulations and enforced by the USEPA and OPS. Required remedial actions may range from the excavation and removal of contaminated soil allowing the contaminated soil to recover through natural environmental fate processes (e.g., evaporation, biodegradation). Decisions concerning remedial methods and extent of the cleanup would consider state-mandated remedial cleanup levels, potential effects to sensitive receptors, volume and extent of the contamination, compliance with water quality standards, and the magnitude of adverse impacts that would be caused by remedial activities.

In the event of a spill, several federal regulatory programs define the notification requirements and required response actions, including the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300), the Clean Water Act, and the Oil Pollution Act. At the most fundamental level, these interlocking programs mandate notification and initiation of response actions in a timeframe and on a scale commensurate with the threats posed. They also establish a required endpoint for response actions: the mitigation of any unacceptable threat to human health and safety or the environment. The cumulative result of these regulatory constraints is that the adverse impacts of a release event would be temporary and baseline conditions ultimately would be restored.

3.0 Species Evaluation

3.1 Federal Endangered

3.1.1 Indiana Bat

3.1.1.1 Natural History and Habitat Association

The Indiana bat (*Myotis sodalis*) was federally listed as endangered on March 11, 1967 (32 FR 4001) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 United States Code 668aa(c)). Across the species range, the population declined dramatically from 800,000 bats in 1965 to an estimated 382,350 bats in 2002 (Clawson 2002). Population declines are primarily attributed to: 1) destruction/ degradation on hibernacula; 2) loss/degradation of summer habitat, migration habitat, and swarming habitat; 3) disturbance of hibernating bats, and to a lesser extent summering bats; and 4) natural events such as the flooding of hibernacula (USFWS 2007). Although, the latest survey efforts did not show the same declining trends, present population estimates are still much lower than historical estimates. As of 2005, the total Indiana bat population was estimated at 457,000 bats. Of these, 81.9 percent are found in 23 Priority 1 hibernacula (i.e., hibernacula containing 10,000 bats or more) in seven states including, Illinois (n=1), Indiana (n=7), Kentucky (n=5), Missouri (n=6), New York (n=2), Tennessee (n=1), and West Virginia (n=1). The remaining 18.1 percent are in Priority 2, 3, and 4 hibernacula (personal communication with Bloomington, Indiana, USFWS Field Office).

The Indiana bat occurs in most of the eastern half of the U.S. The Indiana bat is a migratory bat that hibernates in caves or mines from mid-October through mid-April. During summer months (approximately mid-May through mid-August), Indiana bats forage at night in upland and riparian forests, along wooded edges between forests and croplands, and over fields. Indiana bats roost during daytime in upland or bottomland habitats under exfoliating bark, in crevices/hollows of live or dead trees, or occasionally in tree cavities. Female Indiana bats (usually less than 100) gather in maternity roosts in trees, where they give birth and raise a single young each year (Barbour and Davis 1969; Whitaker and Hamilton 1998). Female Indiana bats are known to migrate long distances to set up maternity colonies. Maternity colonies usually consist primarily of females and young (Humphrey et al. 1977) with non-reproductive females and males roosting separately (Hall 1962). Male Indiana bats typically roost beneath bark or in cavities of trees, and tend to roost singly or in small groups (Thomson 1982).

The Indiana bat requires specific habitat conditions during hibernation and for summer roosting and foraging. Indiana bats hibernate in caves or mines that provide a narrow range of climatic conditions. The best hibernacula in the south and central portions of the winter range tend to have large openings with a large volume, and vertical shafts. Occupied hibernacula have stable ambient temperatures typically below 50 degrees Fahrenheit (°F), and generally between 37 to 43°F (Tuttle and Kennedy 2002). Warmer temperatures may increase metabolic rates and expedite fat depletion during hibernation (Richter et al. 1993). Relative humidity for occupied hibernacula is typically between 70 and 100 percent (Hall 1962; LaVal et al. 1976; Humphrey 1978; Tuttle and Kennedy 1999). Preferred hibernacula also have noticeable airflow (Henshaw 1965) and often have multiple openings at different elevations exhibiting the chimney effect (Tuttle and Kennedy 2002). However, in the northern portion of the Indiana bat's range, most suitable hibernacula do not exhibit the chimney effect.

Summer maternity habitat consists of mature trees in riparian or upland forests. In Michigan, over 97 percent of roost trees used by adult females and young were located in wetlands (Kurta et al. 2002). Upland forests also provide important maternity, roosting, and foraging habitat (Gardner et al. 1991; BHE Environmental, Inc. [BHE] 2001). Callahan et al. (1997) reported maternity roosts are often found under exfoliating bark or in crevices of trees 8.7 inches in diameter at breast height (dbh) or larger, with exposure to direct sunlight. Gardner et al. (1991) found roost tree averages of 14.4 inches dbh while Callahan et al. (1997) found roost tree averages to be 23.0 + 1.7 inches dbh. At least 33 species of trees have been documented as maternity

roosts (USFWS 2007). Snags (standing dead trees) are most commonly used, but some maternity colonies have been found in live trees.

The use of snags by Indiana bats may be influenced by bark characteristics. Because virtually all maternity roosts are found under exfoliating bark, the characteristics of a species as a snag may be more important than the specific tree species on which the bark is present (Rommé et al. 1995). The ability of a tree species to produce plates of exfoliating bark probably influences Indiana bat use (Callahan et al. 1997; Rommé et al. 1995). Nevertheless, Indiana bat maternity roosts have been found in trees which typically do not exhibit these characteristics, such as a pine snags, and eastern hemlock (Britzke et al. 2003).

Snags providing suitable habitat for roosting Indiana bats are an ephemeral resource. Maternity colonies often use numerous (10 to 20) roost trees, including 1 to 3 primary roosts which are used by many adult females and young, and alternate roost trees which support fewer individuals and are used intermittently (Callahan et al. 1997). Females may use the same maternity roosts in successive summers if the trees remain standing and retain exfoliating bark (Kurta et al. 2002; Gumbert et al. 2002; Gardner et al. 1991; Callahan et al. 1997). If the primary roost tree is destroyed, surviving members of the maternity colony may move to one of the other roosts. A maternity colony may use several roosts up to 2.3 miles apart (Kurta et al. 2002). Adult male Indiana bats typically roost separately from the females and often use several different roost trees in an area from night to night (Rommé et al. 1995; Gardner et al. 1991).

While female Indiana bats typically migrate from hibernacula to summer habitat, male Indiana bats may roost in hibernacula and in trees near hibernacula throughout the summer. In addition, male and female Indiana bats are active near caves during spring staging and autumn swarming.

Spring staging occurs from approximately mid-April through early May. Females typically leave caves before males (Humphrey 1978; LaVal and LaVal 1980). Following mid-May emergence from hibernation, a single radio-marked male was followed for two weeks and traveled 10 miles in western Virginia (Hobson and Holland 1995). During staging, Indiana bats emerge from hibernation to roost in trees, and forage near hibernacula. In Missouri, staging male and female Indiana bats traveled between 1.2 and 6.4 miles from their hibernaculum nightly (Rommé et al. 2002). Females may leave immediately for their summer habitat or linger for a number of days.

Autumn swarming occurs from approximately mid-August through September. During swarming, numerous bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in caves during the day (Cope and Humphrey 1977). In Missouri, swarming Indiana bats traveled up to 4 miles from roost sites (Rommé et al. 2002). In Kentucky, male Indiana bats radio-tracked during October were found to travel up to 1.7 miles from their roost sites, and roosted in trees between 0.5 and 1.5 miles from the hibernaculum (Kiser and Elliot 1996). Indiana bats periodically use tree roosts during fall swarming (Menzel et al. 2001). In eastern Kentucky and West Virginia, roosts were located predominately in medium-size hardwood snags and trees with a mean dbh of 10.6 inches and 13 inches, respectively (Kiser and Elliot 1996). These snags and trees were located in small forest openings or canopy gaps.

Additional data describing the life history of the Indiana bat is well summarized in the document *Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision, April 2007* (USFWS). That document is hereby incorporated by reference.

3.1.1.2 Potential Presence in Project Area

Indiana bats are assumed to be present between April 1 and September 30 during spring, summer, and autumn seasons in all Missouri and Illinois counties crossed by the Keystone Mainline. The bats are presumed absent from the project area during October 1 through March 31. Habitat assessments have revealed that high quality summer habitat exists within some of the woodlots that the Keystone Mainline will cross in Missouri. A detailed description of the habitat assessment can be found in **Appendix B-1**. Known summer occurrences in the 10 counties of Missouri crossed by the project are limited to captures in Clinton, Chariton, and Randolph counties. The 1983 record from Chariton County was of a maternity roost tree. Indiana bats have more

recently been identified at the Swan Lake National Wildlife Refuge in Chariton County, approximately 6 miles north of the Keystone Mainline. The 1985 record from Clinton County was an "other occurrence" (non-reproductive) record. Since that time, Indiana bats have not been captured in Clinton County, though netting activities in Clinton County have occurred. A pregnant Indiana bat was captured in Randolph County in May 2007 during mist-net surveys for the Rockies Express-West (REX-West) Pipeline Project, which parallels the Keystone Mainline in portions of Missouri. The bat was radio-tagged to determine if its summer roost was within the project area. The results of the radio telemetry data indicated the bat was not using roost sites within 5 miles of the capture point (i.e., the project ROW). A number of other sites adjacent to the project ROW were surveyed to detect the presence of Indiana bats as part of the environmental investigations for the REX-West Pipeline Project in Missouri. These surveys were conducted in the REX-West ROW adjacent to 33 of the 51 (65 percent) wooded sites crossed by the project construction ROW in Missouri where habitat values were equal to or greater than 0.6 on a 0.0 to 1.0 scale (see Section 3.1.2.3, below). No Indiana bats were captured except for the pregnant female in Randolph County described above.

The nearest known confirmed winter occurrences in Missouri (two hibernacula) are more than 5 miles (8 kilometers [km]) south of the Keystone Mainline in Boone County. USFWS records also indicate presence of a hibernaculum in St. Louis County, approximately 15 miles (24 km) south of the Keystone Mainline (Andrew King [USFWS], personal communication).

Known summer occurrences in the four Illinois counties include captures of non-reproductive Indiana bats in Madison and Bond counties. In 1986, two adult lactating female and three juvenile Indiana bats were collected in Bond County, Illinois. Additionally, two adult lactating females were collected in the same area in 1987. These data support the likely presence of a maternity colony in Bond County. One or two maternity colonies of Indiana bats also are thought to occur in the Carlyle Lake WMA (Joyce Collins [USFWS], personal communication). Habitat assessments have revealed that high quality summer habitat exists within some of the woodlots that the Keystone Mainline will cross in Illinois. A detailed description of the Illinois summer bat habitat assessment can be found in **Appendix B-2**.

The nearest known winter occurrence in Illinois is at the Brainerd Mine, a Priority 3 hibernaculum (450 Indiana bats recorded in 2002) located more than 10 miles northeast of the Keystone Mainline ROW in Jersey County (Andrew King [USFWS], personal communication).

Indiana bats are not known to occur in North Dakota, South Dakota, Nebraska, Oklahoma or Kansas. This assessment of effects therefore focuses upon Missouri and Illinois.

3.1.1.3 Habitat for Non-hibernating Indiana Bats in the Project Area

Extensive field investigations and remote sensing efforts were completed to characterize the quality of Indiana bat habitat within and near the project ROW in Missouri and Illinois by BHE. Meetings and discussions with USFWS species specialists in Missouri and Illinois were held to tailor investigations to address state-specific concerns. Of primary importance in the development of the field investigations is the USFWS perspective that non-hibernating habitat is generally widespread and not limiting in Missouri, while the contrary is believed to be the case in Illinois. However, the presence of potential roost trees was an important factor in the habitat evaluation in both states. Although details of the habitat characterization approved by each USFWS office varied, areas of quality Indiana bat non-hibernating habitat was identified in each state. In Missouri, 238 locations were identified where the project crossed wooded areas. All but 22 of the sites (where access permission was denied) were evaluated in the field, and most (75 percent, n=157) were of low habitat quality, with 43 percent (n=90) having Habitat Suitability Index values (HSI) of 0.0, and 32 percent (n=67) having HSI values from 0.1 to 0.5. An HSI value of 0.6 or greater was calculated for 51 (25 percent) of the woodlots. Construction of the project would involve clearing approximately 148.8 acres of wooded habitat at these sites in Missouri.

Missouri sites with potential for moderate/high habitat quality	
Sites evaluated	208
Low quality habitat	75%
Moderate or high quality habitat (acres)	25% (148.8)

In Illinois, 124 locations were identified where the pipeline crossed wooded areas. All but 23 of the sites (where access permission was denied) were evaluated in the field. Most (60 percent, n=61) were of no quality or low quality, 34 percent (n=34) provided moderate quality habitat, and 6 percent (n=6) were of high quality. Construction of the project would involve clearing approximately 61.5 acres of wooded habitat at these sites in Illinois.

Illinois sites with deciduous tree cover crossed by the pipeline corridor	
Sites evaluated	101
No habitat present or low quality habitat	60%
Moderate quality habitat	34%
High quality habitat	6%
High/Moderate quality acres	61.5

In total, there are 92 sites in the two states with moderate or high quality wooded habitat that would be crossed by the project ROW. The area of wooded habitat to be cleared at these 101 sites totals 210.3 acres.

3.1.1.4 Impact Evaluation

Construction

As indicated above, Indiana bats are assumed to be present during spring, summer, and autumn (April 1 to September 30) in Missouri and Illinois counties crossed by the project. The removal of wooded habitat used by non-hibernating bats is of concern, especially in Illinois where that habitat is thought to be limiting. Additionally, removal of trees during the time of year when the bats are not hibernating has potential to generate fatalities if the bats are roosting in the trees when they are cut. There are no known hibernacula within 5 miles of the project. Consequently, no project-related impacts to Indiana bat hibernacula would occur.

The potential for direct mortality caused by the cutting of occupied roost trees would be avoided since potential roost trees greater than or equal to 22 cm dbh (i.e., suitable as maternity roosts) in wooded parcels with moderate or higher quality Indiana bat habitat within the construction ROW would be cut down only from October 1 to March 31, when the bats are not present. The schedule for the seasonal cutting window, and the locations in which it would be applied have been agreed to by both the Illinois and Missouri USFWS. A minor potential for effects exists if Indiana bats utilize low quality habitat, including roost trees less than 22 cm dbh, and if those roost trees are felled during the spring, summer, or fall. BHE believes that the chances of this occurrence would be low, especially for reproductively active females and their (potentially) pre-volant young.

Theoretically, removal of suitable roost trees and foraging habitat anywhere within the range of the Indiana bat has the potential to indirectly affect the species. Tree-clearing has the potential to reduce foraging success because Indiana bats forage in upland and riparian woodlands, under closed canopy (Clark et al. 1987; Humphrey et al. 1977). The bats also exhibit foraging site fidelity, using the same foraging areas year after year. If suitable foraging habitat is lost, bats may be forced to relocate to new areas. Tree clearing also has the potential to reduce survivability. Female Indiana bats often use the same maternity roosts year after year (Gumbert et al. 2002) and if a maternity roost is removed, bats may be challenged to locate another suitable maternity roost.

Based upon the assessment of habitat quality at sites crossed by the pipeline alignment, 570 trees with at least minimally suitable conditions for roosting bats that would be cut down were identified. A total of 381 of these trees are in woodlots with moderate or high quality habitat. In addition, 289 of these trees were identified in groupings of sites where habitat conditions are more likely to support a maternity colony than at other groupings of sites.

Based on input from the Illinois USFWS, nine ways in which the project has potential to affect non-hibernating Indiana bats at locations where the construction ROW crosses wooded habitat were evaluated.

1. Will a primary roost tree be destroyed or made unsuitable for use?

2. Will the forested landscape be altered?

3. Will an adequate number of currently suitable roost trees be maintained during and after construction of the pipeline?

4. Will the appropriate species of trees be maintained in adequate densities to provide for the future recruitment of roost trees?

5. Will a continuous supply of future suitable roost trees be available following the project?

6. Will access to drinking water be maintained?

7. Will appropriate-sized trees be maintained?

8. Will the roosting area provide suitable microclimate diversity?

9. Will connectivity between roosting and foraging areas be maintained?

The results of this analysis (**Appendix B-3** and **B-4**) indicate that the conditions addressed in Question 3 through Question 9, when considered in the context of Indiana bat biology/life history, including a landscape scale assessment of habitat within 3.5 km of trees that would be felled, indicate that the project is unlikely to change habitat to any meaningful extent. In assessing the effects of the project on amount of forest cover near areas to be cleared (Question 2), It was determined that although forest clearing would total approximately 680 acres within the construction ROW in Missouri and Illinois (in total), in all cases, the forest to be removed constitutes an exceedingly small percentage of the forest within 3.5 km of each site. The post-project reduction in forest cover varied with the amount of forest near the project ROW, and the amount of forest within the construction ROW, and ranged from 0 to 2.32 percent. This level of change is believed to be inconsequential relative to the biology of the Indiana bat. With Question 2 through Question 9 addressed as described above, the likelihood that proposed forest clearing would remove primary maternity roost trees (Question 1) was addressed.

To facilitate this analysis wooded tracts crossed by the project were grouped based upon geographic proximity and/or similarities in habitat attributes (e.g., amount of forest cover within 3.5 km of the sites). Results available from recent mist net surveys completed at sites adjacent to the project sites (i.e., sites along the REX-West Pipeline ROW in central and western Missouri – see **Appendix B-3**) were utilized in the analysis. As presence/absence data (mist net survey results) and habitat utilization data (telemetry investigations) are unavailable for many project sites in Missouri and Illinois, it was not possible to definitively determine if maternity roost trees would be removed. Instead, the likelihood that a maternity roost would be present based upon data gathered in the assessment of habitat suitability in woodlots crossed by the project ROW in the two states was qualitatively described (**Appendices B-3** and **B-4**).

This approach is believed to be extremely conservative (i.e., overstates the potential impact), because it assumes maternity roosts *would* be present in areas of quality habitat. Based upon the documented occurrence of maternity roosts throughout the species range, it is reasonable to conclude roosts occur in only a minute fraction of sites that appear to provide suitable habitat. Furthermore, the forest to be removed as part of this project constitutes an exceedingly small percentage of the forest habitat near each site. This analysis conservatively assumes the primary roost trees in the project area are coincident with the project ROW. For purposes of the analysis, and where groupings of wooded sites span considerable distances, it is assumed that primary roosts would be no closer together than two times the average travel distance from roosts (3.5 km or 2.2.miles) (Murray and Kurta 2004; Sparks et al. 2005; Butchkoski and Hassinger 2002), that is, 7.0 km or 4.3 miles.

This assessment identified 32 groupings of wooded areas crossed by the project ROW; 20 groups in Missouri and 12 groups in Illinois. Of the 20 groups of wooded sites in Missouri, two have habitat that has a greater likelihood of supporting a primary maternity roost. Six of 12 such groups of sites were identified in Illinois. Based upon the very conservative assumption that each of these 8 groups of sites supports one or more maternity roost(s), the project may remove up to approximately 19 primary maternity roosts. In all likelihood the actual number of primary roosts removed would be significantly lower than this estimate, with an estimate of zero occupied primary roost trees removed being a distinct possibility/probability.

It is difficult to precisely characterize the effect of removing a theoretical maximum of 19 primary roosts trees along the 387.4-mile-long ROW through 14 counties. It is believed that because the proposed removal of trees is a very small percentage, typically less than 4 tenths of 1 percent of the wooded habitat present near each site within each group (**Table 3-1**), and because potential roost trees would be removed at a time of year when Indiana bats are not present, and because:

- The change in the number of currently suitable roost trees available during and after construction within 3.5 km of each wooded site would remain essentially unchanged;
- The species of trees present, and the density of those trees within 3.5 km of each wooded site would remain essentially unchanged;
- the supply of trees which have potential to become roost trees within 3.5 km of each wooded site in the future would remain essentially unchanged;
- The availability of drinking water within 3.5 km of each wooded site would be unchanged;
- The mean size of trees within 3.5 km of each wooded site would remain essentially unchanged;
- The available microclimates within 3.5 km of each wooded site would persist essentially unchanged; and
- Connectivity between roosting and foraging areas within 3.5 km of each wooded site would remain essentially unchanged.

The project may affect, but is not likely to adversely affect Indiana bats.

Table 3-1 Forested Habitat to be Removed at Wooded Site Groupings Relative to Forest Within 3.5 km of each Wooded Site

Wooded Site Group	County/State	Approximate Percent of Wooded Area w/in 3.5 km of each Site to be Removed	Wooded Site Group	County/State	Approximate Percent of Wooded Area w/in 3.5 km of each Site to be Removed
A	Buchanan, MO	≤0.25%	Q	Chariton & Randolph, MO	≤0.39%
B	Buchanan, MO	≤0.11%	R	Audrain, MO	≤0.12%
C	Clinton, MO	≤0.11%	S	Montgomery & Lincoln, MO	≤0.57%
D	Clinton, MO	≤0.20%	T	St. Charles, MO	≤0.28%
E	Clinton, MO	≤0.36%	AA	Madison, IL	≤0.28%
F	Caldwell, MO	≤0.10%	BB	Madison, IL	≤0.28%
G	Caldwell, MO	≤0.08%	CC	Madison, IL	≤0.37%
H	Caldwell, MO	≤0.03%	DD	Madison, IL	≤0.05%
I	Caldwell, MO	≤0.07%	EE	Madison, IL	≤0.37%
J	Caldwell, MO	≤0.07%	FF	Madison, IL	≤0.49%
K	Carroll, MO	≤0.08%	GG	Madison & Bond, IL	≤0.09%
L	Carroll, MO	≤0.05%	HH	Bond, IL	≤0.21%
M	Carroll, MO	≤0.09%	II	Bond, IL	≤0.37%

Table 3-1 Forested Habitat to be Removed at Wooded Site Groupings Relative to Forest Within 3.5 km of each Wooded Site

Wooded Site Group	County/State	Approximate Percent of Wooded Area w/in 3.5 km of each Site to be Removed	Wooded Site Group	County/State	Approximate Percent of Wooded Area w/in 3.5 km of each Site to be Removed
N	Carroll & Chariton, MO	≤0.08%	JJ	Bond, IL	≤2.32%
O	Chariton, MO	≤0.35%	KK	Fayette & Marion, IL	≤0.32%
P	Chariton, MO	≤0.42%	LL	Marion, IL	≤0.19%

As discussed above in Chapter 2, electrical powerline providers, not Keystone, would be responsible for obtaining the necessary approvals or authorizations from federal, state, and local governments. The construction of approximately 0.3 mile of new electrical powerline segments across wooded vegetation would result in the incremental reduction of potential foraging and roosting habitat. Protection measures that could be implemented by electrical service providers to prevent impacts to roosting Indiana bats would include the removal of trees in the ROW between October 1 and March 31, when this species is not known to occur within the project area.

Operations

Routine operation of the project is not expected to affect Indiana bats or their habitat. Following construction, maintenance activities (e.g., vegetation management) along the project would preclude the re-establishment of trees within the permanent (50-foot) ROW. Pesticides would not be used during construction or operation of the pipeline. The remainder of the construction ROW (60 feet) would be allowed to revegetate with trees.

Adverse effects to Indiana bats resulting from a crude oil spill from the pipeline are highly improbable due to: 1) the low probability of a spill, 2) the low probability of the spill coinciding with the presence of Indiana bat, and 3) the low probability of a bat contacting the spilled product (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil).

3.1.1.5 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.1.6 Mitigation

The potential for direct mortality caused by the cutting of occupied roost trees would be avoided because potential roost trees greater than or equal to 22 cm dbh (i.e., suitable as maternity roosts) in moderate or high quality sites in Illinois, and sites with an HSI score of 0.6 or more in Missouri, and in sites where habitat quality has not been assessed, site clearing will only be conducted from October 1 to March 31 when the species is not present.

3.1.1.7 Determination

Effect on Critical Habitat. The project would have "no effect" on critical habitat for the Indiana bat. No direct or indirect effects to Critical Habitat for the Indiana bat are anticipated from the project. The USFWS has designated the following areas as Critical Habitat in Missouri – Cave 021 (Crawford County), Caves 009 and 017 (Franklin County), Pilot Knob Mine (Iron County), Bat Cave (Shannon County), Cave 029 (Washington County) and Blackball mine (La Salle County) in Illinois. None of these areas occur within 5 miles of the project.

Effect on the Species. The project "may affect, but is not likely to adversely affect" Indiana bats. This determination is based on the amount of remaining habitat available to Indiana bats that may utilize roost trees in or near the project ROW and fact that no Indiana bat hibernacula would be impacted by the project.

Adverse effects to Indiana bats resulting from a crude oil spill from the pipeline are highly improbable due to: 1) the low probability of a spill, 2) the low probability of the spill coinciding with the presence of Indiana bat, and 3) the low probability of a bat contacting the spilled product.

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3.1.2 Interior Least Tern

3.1.2.1 Natural History and Habitat Association

The interior least tern (*Sterna antillarum athalassos*) was listed as endangered on May 28, 1985 (50 FR 21784). Historically, the breeding range of this subspecies extended from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana. It included the Rio Grande, Red, Missouri, Arkansas, Mississippi, and Ohio River systems. It winters along the Gulf Coast, the coast of Caribbean Islands, the eastern coast of Central America and northern South America. The interior least tern continues to breed in most of the historic river systems, although its distribution generally is restricted to less altered river segments (USFWS 1990). No critical habitat has been designated for this subspecies, but essential breeding habitat has been identified within its historic range (USFWS 1990).

Interior least terns spend 4 to 5 months at their breeding sites. They arrive at breeding areas from late April to early June. The riverine nesting areas of interior least terns are sparsely vegetated sand and gravel bars within a wide, unobstructed river channel or salt flats along lake shorelines (Nelson 1998; USFWS 1990). Nesting locations are usually well above the water's edge, since nesting is typically initiated during high river flows, when only small amounts of sandy shoreline are exposed. Therefore, the size of nesting areas depends on water levels and the extent of associated sandbars. The least tern also will nest on artificial habitats including sand and gravel pits and dredge islands (Campbell 1995; USFWS 1990).

Least terns are considered colonial nesters that generally consist of up to 20 nests. However, colonies with up to 75 nests have been recorded on the Mississippi River (http://ecos.fws.gov/docs/life_histories/BO7N.html). Remnant nesting populations of interior least terns in the project area would most likely exist as either single nests, or a few scattered nests along river drainages. Least terns nest on the ground in a simple unlined scrape, typically on sites that are sandy and relatively free of vegetation. Usually two to three eggs are laid by late May (Biota Information System of New Mexico 2002). Both the male and female share incubation duty, which generally lasts from 20 to 25 days. Fledging occurs within 3 weeks after hatching. Departure from colonies varies but is usually complete by early September (USFWS 1990).

The interior least tern is piscivorous, feeding in shallow waters of rivers, streams, and lakes. In addition to small fish, terns also may feed on crustaceans, insects, mollusks, and annelids. On the Great Plains, fish are the primary diet of this species (Nelson 1998; USFWS 1990). Although terns nesting at sand and gravel pits or other artificial habitats may travel up to 2 miles to forage (USFWS 1990), terns usually feed close to their nesting sites. Feeding behavior involves hovering and diving over standing or flowing water.

3.1.2.2 Potential Presence in Project Area

North Dakota. No river crossings in North Dakota have historically supported, or currently support, breeding populations of interior least tern.

Nebraska and South Dakota. The distribution of interior least tern along the Platte River formerly included western Nebraska, but today breeding least terns are only found in the central and eastern portions of the state (USFWS 1990). The project would cross the Platte River at the border between Colfax and Butler counties, and sandbars and sand/gravel pits associated with this segment of the river are known to still support breeding populations of least tern. The Elkhorn River, a tributary to the Platte River, would be crossed in Stanton County, and sandbars and sand/gravel pits along this segment of the Elkhorn also continue to support breeding least terns (USFWS 1990). Finally, the segment of the Missouri River along the Nebraska-South Dakota state line from Sioux City, Iowa, upstream to near Pickstown, South Dakota, still supports breeding terns along the Missouri River (USFWS 1990). The project crosses this segment of the river at the Cedar County, Nebraska–Yankton County, South Dakota line.

Illinois, Missouri, and Kansas. Historically the interior least tern bred on the Mississippi River from south of Cairo, Illinois (south of the project) to Iowa. The least tern is currently known to nest at various locations on the Mississippi River in Alexander and Jackson counties, Illinois, and Mississippi, Scott, Cape Giradeau and Perry counties, Missouri. Additionally, nesting attempts have occurred on Ellis Island in St. Charles County, Missouri, north of the project area (Joyce Collins, USFWS 2007). Least terns are not known to occur at the Mississippi River where the project would cross the river.

Although the interior least tern was formerly a common breeder along most of the Missouri River, it now is entirely absent along the river from St. Louis to Sioux City, Iowa (USFWS 1990). The project crossing location of the Missouri River at the Kansas-Missouri state line is included in this segment. This is the only river crossing for the project in Kansas that formerly supported breeding least terns.

Oklahoma. Known breeding areas in the Arkansas River system in Oklahoma include sandbars on the Arkansas and Cimarron rivers. The project would cross the Arkansas River in Cowley County, and this segment of river does not support breeding activity by interior least tern (USFWS 1990). The Cimarron River would be crossed in Payne County where breeding least terns are known to occur (USFWS 1990).

Summary. Potential interior least tern breeding habitat that is traversed by the project include the Cimarron River in Oklahoma, the Platte and Elkhorn rivers in Nebraska, and the Missouri River at the Nebraska-South Dakota state line. **Table 3-2** identifies the results of habitat and occurrence surveys that were conducted at these habitat locations in 2007.

Table 3-2 Habitat and Occurrence Surveys for the Interior Least Tern Along the Keystone Mainline and Cushing Extension in 2007

State	County	Survey Location	Survey Corridor	Survey Date	Survey Results	Comments
South Dakota/Nebraska	Yankton/Cedar	Missouri River	0.25-mile each side of centerline	May 7, 2007	No least terns observed.	Good suitable nesting and foraging habitat at crossing location.
Nebraska	Stanton	Elkhorn River	0.25-mile each side of centerline	May 7, 2007	No least terns observed.	Marginal nesting and foraging habitat at crossing location.
Nebraska	Colfax/Butler	Platte River	0.25-mile each side of centerline	May 6, 2007	No least terns observed.	Good suitable nesting and foraging habitat at crossing location.
Oklahoma	Payne	Cimarron River	0.25-mile each side of centerline	May 8, 2007	No least terns observed.	Poor suitable habitat, potentially due to high water levels.

3.1.2.3 Impact Evaluation

Construction

As indicated, the interior least tern is known to nest within or near the project at the Missouri River at the Nebraska-South Dakota state line, the Platte and Elkhorn rivers in Nebraska, and Cimarron River in Oklahoma. No direct impacts to least tern breeding habitat would be anticipated at these locations, since pipeline placement across the rivers would be completed by the HDD method.

Indirect impacts could result from increased noise and human presence at work site locations if breeding terns are located within 0.25 mile of the project. Prior to construction-related activities, including HDD and hydrostatic testing, that would occur within 0.25 mile from potential breeding habitat, Keystone would conduct presence/absence surveys up to 2 weeks prior to construction-related activities to identify occupied breeding territories and/or active nest sites, in coordination with the USFWS. If occupied breeding territories and/or active nest sites are identified, the USFWS would be notified and appropriate protection measures, such as seasonal construction constraints and the establishment of a 0.25-mile buffer area, would be implemented on a site-specific basis in coordination with the USFWS.

Water depletion impacts on the interior least tern from hydrostatic testing could include a temporary incremental reduction of potential habitat in the lower Platte River Basin due to changes in downstream water flow. The USFWS defines “depletion” as consumptive loss plus evaporative loss of surface or groundwater within the affected basin.

However, because Keystone plans on returning hydrostatic test water back to its source within a 30-day period, the USFWS would consider the temporary water reduction as insignificant. As a result, indirect impacts from hydrostatic testing on the interior least tern would be negligible. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Similar constraints and/or mitigation measures may apply to any pipeline maintenance activities if nesting terns are present within 0.25 mile of the project. Operations personnel would coordinate with the USFWS to establish authorized mitigation if maintenance activities are required during the nesting season within 0.25 mile of suitable nesting habitat.

The major rivers that contain interior least tern habitat (Cimarron, Platte, Elkhorn, and Missouri at the Nebraska/South Dakota state line) would be crossed using the HDD method. In the unlikely event of a leak, the crude oil would need to penetrate this significant amount of overburden before reaching the river, thereby reducing the risk of crude oil reaching the river and the potential for least tern exposure. Additionally, these major rivers also are subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195). Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact interior least tern.

Direct contact with a crude oil spill could result in adverse effects to interior least terns due to oiling of plumage, ingestion of crude oil from contaminated plumage and prey, and transfer of crude oil to eggs and young. While these exposure routes have the potential to cause adverse effects to individuals, the probability of adverse effects to interior least terns are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of least tern individuals (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

As discussed above in Chapter 2, electrical powerline providers, not Keystone, would be responsible for obtaining the necessary approvals or authorizations from federal, state, and local governments. The construction of a new electrical powerline segment across the Elkhorn River would incrementally increase the collision potential for foraging interior least terns in the project area. Based on the 2007 habitat and occurrence surveys for this species at the Elkhorn River crossing, breeding habitat quality within 0.25-mile from the project was considered to be of marginal quality. Protection measures that could be implemented by electrical service

providers to minimize or prevent collision risk to foraging interior least terns at the Elkhorn River crossing would include the use of standard measures as outlined in *Mitigating Bird Collision with Power Lines* (Avian Power Line Interaction Committee [APLIC] 1994).

3.1.2.4 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.2.5 Mitigation

The following mitigation measures would apply if construction-related activities, including HDD and hydrostatic testing, were to occur during the interior least tern breeding season:

- Pre-construction surveys would occur within 0.25 mile from suitable breeding habitat at the Cimarron River in Oklahoma, the Platte and Elkhorn rivers in Nebraska, or the Missouri River at the Nebraska-South Dakota state line, no more than two weeks prior to construction.

- Construction would not be permitted within a 0.25-mile buffer from an occupied nest site during the breeding season (April 15 though August 15).

3.1.2.6 Determination

Effect on Critical Habitat. No critical habitat has been identified for this species. Therefore, the project would have "no effect" on critical habitat for the interior least tern.

Effect on the Species. The project "may affect, but is not likely to adversely affect" interior least terns. This determination is based on Keystone's plan to HDD the Missouri (Missouri River at the Nebraska-South Dakota state line), Platte, Elkhorn, and Cimarron rivers; Keystone's CMR and Hydrostatic Test plans; and applicable protection measures that have been developed for this species. As a result no direct or indirect impacts would result from project construction.

The project would have no effect on the interior least tern from water depletion issues resulting from hydrostatic testing. This finding is based on Keystone's commitment to return the hydrostatic test water to its source within a 30-day period.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of adverse effects to interior least terns are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of least tern individuals.

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3.1.3 Whooping Crane

3.1.3.1 Natural History and Habitat Association

The whooping crane (*Grus americana*) was listed as endangered on March 11, 1967 (32 FR 4001). Whooping cranes occur only in North America and the total wild population was estimated at 315 birds in 2003 (Canadian Wildlife Service [CWS] and USFWS 2005). This estimate includes the 194 birds in the only self-sustaining Aransas-Wood Buffalo National Park Population (AWBP) that winters in coastal marshes in Texas and migrates to Canada to nest in Wood Buffalo National Park and adjacent areas as well as the 121 captive-raised birds that have been released in Florida and the eastern U.S. in an effort to establish a non-migratory population in Florida and a migratory population between Florida and Wisconsin (CWS and USFWS 2005). The last remaining bird in the Rocky Mountain reintroduced population died in the spring of 2002 (CWS and USFWS 2005). The overall decline of the whooping crane has been attributed to habitat loss, direct disturbance and hunting by humans, predation, disease, and collisions with manmade features (CWS and USFWS 2005).

During spring and fall migration, the AWBP population moves through the central Great Plains including portions of North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma. Birds from the AWBP population depart from their wintering grounds in Texas from late March through May 1. Fall migration typically begins in mid-September with most birds arriving on wintering grounds between late October and mid-November (CWS and USFWS 2005).

Whooping cranes use a variety of habitats during migration (Howe 1987; Lingle 1987; Lingle et al. 1991; Johns et al. 1997). The whooping crane is most closely associated with river bottoms, marshes, potholes, prairie grasslands, and croplands (CWS and USFWS 2005). In states without riverine habitats, seasonally and semi-permanently flooded palustrine wetlands are used for roosting and various cropland and emergent wetlands for feeding (Austin and Richert 2001; Johns et al. 1997). They generally feed on small grains (including a number of cultivated crops), aquatic plants, insects, crustaceans, and small vertebrates (Oklahoma State University 1993). Cranes roost on submerged sandbars in wide unobstructed channels that are isolated from human disturbance (Armbruster 1990).

Critical habitat for migrating birds has been designated in three states (Nebraska, Kansas, Oklahoma) crossed by the project (CWS and USFWS 2005). However, no critical habitat would be crossed by the project. In Nebraska an area of critical habitat has been designated along the “Platte River Bottoms,” which includes a 3-mile swath along the river, with the south boundary paralleling Interstate 80 (I-80), beginning at the junction of U.S. Highway 283 and I-80 near Lexington and extending eastward along I-80 to the interchange for Shelton and Dehman, Nebraska, near the Buffalo-Hall County line. The two critical habitat areas in Kansas are: 1) Quivira National Wildlife Refuge in Stafford, Reno, and Rice counties and 2) Cheyenne Bottoms State Waterfowl Management Area in Barton County. The Salt Plains National Wildlife Refuge in Alfalfa County is the critical habitat area identified in Oklahoma.

3.1.3.2 Potential Presence in Project Area

The project in Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota is east of the primary migration pathway of whooping crane through the central Great Plains (CWS and USFWS 2005). However, individual birds can be found outside the primary movement corridor and could possibly occur along the project during spring and fall migration. Possible areas of occurrence would include the major rivers crossed by the project and associated river bottom wetlands. Designated Critical Habitat Areas and other identified important stopover or roosting sites occur several miles west of the project (CWS and USFWS 2005). Therefore, the probability of whooping cranes being found on or near the project during spring and fall migration is low.

3.1.3.3 Impact Evaluation

Construction

No direct impacts to the whooping crane are anticipated from the construction and operation of the project. Although potentially suitable roosting and /or foraging habitat may occur along the project, historic records for this species in the project area are sporadic, and established communal roost sites have not been documented in or adjacent to the project. Consequently, based on the current migration pathway of this species through central Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota, potential occurrence within or near the project would be limited to individual migrants.

Indirect impacts could result from migrating individuals being flushed from the project during construction-related activities. Since whooping cranes are highly mobile, it is anticipated that individuals would move to other suitable resting and foraging habitats within the project region. Based on the rarity of the species, and location of the project outside of the primary migration route for this species, potential impacts from encountering and flushing a migrating whooping crane from the project would be negligible. Habitat loss from project construction would be negligible since the major river crossings would be crossed using the HDD method and any disturbance adjacent to suitable riverine habitat would be allowed to completely revegetate following project construction.

Water depletion impacts on the whooping crane from hydrostatic testing could include a temporary incremental reduction of potential habitat in the lower Platte River Basin due to changes in downstream water flow. The USFWS defines “depletion” as consumptive loss plus evaporative loss of surface or groundwater within the affected basin.

However, because Keystone plans on returning water back to its source within a 30-day period, the USFWS would consider the temporary water reduction as insignificant. As a result, indirect impacts from hydrostatic testing on the whooping crane would be negligible. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Because the project is downstream of designated whooping crane critical habitat, it is unlikely that impacts from operations would affect this species.

The major rivers with the highest potential for occurrence for whooping cranes (Cimarron, Platte, Elkhorn, and Missouri at the Nebraska/South Dakota state line) would be crossed by HDD. In the unlikely event of a leak, the crude oil would need to penetrate this significant amount of overburden before reaching the river, thereby reducing the risk of crude oil reaching the river and thereby reducing the potential for whooping crane exposure. Additionally, these major rivers also are subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195). Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact whooping crane.

Direct contact with a crude oil spill could result in adverse effects to whooping crane due to oiling of plumage, ingestion of crude oil from contaminated plumage and prey, and transfer of crude oil to eggs and young. While these exposure routes have the potential to cause adverse effects to individuals, the probability of adverse

effects to whooping cranes are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of whooping crane individuals (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

As discussed above in Chapter 2, electrical powerline providers, not Keystone, would be responsible for obtaining the necessary approvals or authorizations from federal, state, and local governments. The construction of approximately 173 miles of new electrical powerline segments would incrementally increase the collision potential for migrating whooping cranes in the project area. However, because the primary migration corridor for this species occurs west of the project area, the likelihood for migrating individuals to collide with a powerline located in the project area would be relatively low. Protection measures that could be implemented by electrical service providers to minimize or prevent collision risk to migrating whooping cranes in the project area would include the use of standard measures as outlined in *Mitigating Bird Collision with Power Lines* (APLIC 1994).

3.1.3.4 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.3.5 Mitigation

No mitigation measures are proposed for the whooping crane.

3.1.3.6 Determination

Effect on Critical Habitat. The project would have "no effect" on critical habitat for the whooping crane. Areas of designated critical habitat for whooping crane are well outside of the project area.

Effect on the Species. The project "may affect, but is not likely to adversely affect" whooping cranes. This determination is based on the rarity of the species, and the location of the project area, located outside of the primary migration route for this species. This determination also is based on Keystone's CMR and Hydrostatic Test plans that have been developed for the project. As a result, no direct impacts would result from project construction. Based on the, indirect impacts from encountering and flushing a migrating whooping crane from the project would be negligible.

The project would have no effect on the whooping crane from water depletion issues resulting from hydrostatic testing. This finding is based on Keystone's commitment to return the hydrostatic test water to its source within a 30-day period.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of adverse effects to whooping cranes are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of whooping crane individuals.

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3.1.4 Pallid Sturgeon

3.1.4.1 Natural History and Habitat Association

The pallid sturgeon (*Scaphirhynchus albus*) was listed as endangered on September 6, 1990 (55 FR 36641). This species is native to the Missouri and Mississippi rivers and is adapted to habitat conditions in these large rivers prior to river modifications. Preferred habitat is described as large, free-flowing rivers with warm water, turbid habitat with a diverse mix of physical habitats that were in a constant state of change (USFWS 1993). Pallid sturgeon is adapted for living close to the bottom of large, shallow, silty rivers with sand and gravel bars. Adults and larger juveniles feed primarily on fish while smaller juveniles feed primarily on the larvae of aquatic insects (Wilson 2004).

Macrohabitat environments required by pallid sturgeon are formed by floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters within the large river ecosystem. Prior to dam development along the Missouri and Mississippi rivers, these features were in a constant state of change. With the introduction of dams and bank stabilization, areas of former river habitat have been covered by lakes, water velocity has increased in remaining river sections making deep stretches of clear water, and water temperatures have significantly decreased. All of these factors are believed to have contributed to the decline in pallid sturgeon populations (USFWS 1993).

The pallid sturgeon has never been common since it was first described in 1905, and catch records and recovery and research efforts since that time have indicated a steady decline in this species (Wilson 2004). The historic range of this fish formerly included the Mississippi River (below its confluence with the Missouri River), the Missouri River, and the very lower reaches of the Platte, Kansas, and Yellowstone Rivers near their confluence with the Missouri or Mississippi (USFWS 1993). Although widely distributed, pallid sturgeon remains one of the rarest fish in the Missouri and Mississippi river basins.

No critical habitat has been designated for the pallid sturgeon (http://ecos.fws.gov/speciesProfile/SpeciesReport.do?spcode=E06X), but sections of rivers relatively unchanged by dam construction and operation that maintain large, turbid, free-flowing river characteristics are important in maintaining residual populations of this species.

3.1.4.2 Potential Presence in Project Area

River sections near the project where pallid sturgeon are most frequently collected include the Missouri River at the mouth of the Platte River near Plattsmouth, Nebraska, east of the project, and the Mississippi River near Chester, Illinois, south of the project (USFWS 1993; Wilson 2004). Recent collections data indicate that the Chain-of-Rocks area in the Mississippi River, below the mouth of the Missouri River, may be an important area for pallid sturgeon (Collins 2007). The river crossings where the pallid sturgeon may occur, but is not likely to be common, include the Mississippi River at the Illinois-Missouri state line, the Platte River in Nebraska, and the Missouri River near Yankton at the Nebraska-South Dakota state line.

3.1.4.3 Impact Evaluation

Construction

No direct impacts to the pallid sturgeon would result from the project. Although pallid sturgeon may be present at the crossings of the Mississippi River at the Illinois-Missouri state line, the Platte River in Nebraska, and the Missouri River near Yankton at the Nebraska-South Dakota state line, these river crossings would be crossed using the HDD method, and there would be no direct effect on potential river bottom habitat for pallid sturgeon.

At streams and rivers crossed by the HDD method, a small electric pump and hose (1 to 2 inches in diameter) would be placed in the waterbody to provide water to the HDD operation. The intake end of this pump would be screened using an appropriate mesh size to prevent entrainment or entrapment of larval fish or other aquatic organisms. The withdrawal rates for the pumps would occur at a rate of less than 15cm/s, thus reducing the potential for entrainment or entrapment of aquatic species. The intake screens would be periodically checked for entrainment of fish. Should a sturgeon become entrained, Keystone would immediately stop operations contact the USFWS to determine if additional protection measures would be required. The water withdrawals would take place in conjunction with the HDD operations. Many of the HDDs would take place early in the construction period, potentially during the pallid sturgeon spawning period. However, the combination of effective screening and low water withdrawal rates would prevent impacts to the species.

Additionally, the Mississippi River at the Illinois-Missouri state line, the Platte River in Nebraska, and the Missouri River near Yankton at the Nebraska-South Dakota state line have been identified as water sources to be used for hydrostatically testing the pipeline. During this testing process, a pump would be placed in or adjacent to the river for the duration of the water intake and filling period. The intake end of the pump would be screened to prevent entrainment of larval fish or debris. Care would be taken during the discharge to prevent erosion or scouring of the waterbody bed and banks.

Water depletion impacts on the pallid sturgeon from hydrostatic testing could include a temporary incremental reduction of potential habitat in the lower Platte River Basin due to changes in downstream water flow. The USFWS defines “depletion” as consumptive loss plus evaporative loss of surface or groundwater within the affected basin.

However, because Keystone plans on returning water back to its source within a 30-day period, the USFWS would consider the temporary water reduction as insignificant. As a result, indirect impacts from hydrostatic testing on the pallid sturgeon would be negligible. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Routine pipeline operations would not affect the pallid sturgeon.

Suitable habitat within the Missouri River (both crossings) and the Mississippi River would be crossed by HDD. In the unlikely event of a leak, the crude oil would need to penetrate this significant amount of overburden before reaching the river, thereby reducing the risk of crude oil reaching the river and thereby reducing the potential for pallid sturgeon exposure. Additionally, these major rivers also are subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195).

In the unlikely event of a spill that would enter a river, exposure to crude could result in adverse toxicological effects to pallid sturgeon. However, the probability of adverse effects to pallid sturgeon are unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where pallid sturgeon are present. Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact pallid sturgeon (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.1.4.4 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.4.5 Mitigation

No mitigation measures are proposed for the pallid sturgeon.

3.1.4.6 Determination

Effect on Critical Habitat. No areas of critical habitat have been identified for pallid sturgeon. Therefore, the project would have "no effect" on critical habitat for pallid sturgeon.

Effect on the Species. The project "may affect, but is not likely to adversely affect" the pallid sturgeon. This determination is based on Keystone's plan to HDD the Missouri and Mississippi rivers, and Keystone's CMR plan that have been developed for the project. As a result, no direct or indirect impacts would result from project construction.

The project would have no effect on the pallid sturgeon from water depletion issues resulting from hydrostatic testing. This finding is based on Keystone's commitment to return the hydrostatic test water to its source within a 30-day period.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of such an event would be unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where pallid sturgeon are present.

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3.1.5 Topeka Shiner

3.1.5.1 Natural History and Habitat Association

The Topeka shiner (*Notropis topeka*) was listed as federally endangered on December 15, 1998 (63 FR 69008). Protection was deemed necessary as the result of precipitous population declines and range contractions that have been attributed to: 1) increased sedimentation as the result of row crop agriculture;

2) increased pesticide use; 3) construction of watershed lakes and associated introduction of large piscivores; and 4) over-grazing of riparian vegetation, among others.

Topeka shiners are typically found in small prairie streams with good water quality, having water temperatures moderated by groundwater inputs, and low fish diversity (Minckley and Cross 1959; Barber 1986; Pflieger 1997). Streams are generally categorized as perennial but might become intermittent during the summer or in extreme weather patterns. Regardless of flow, most observations in Kansas, Missouri, and Nebraska indicated the importance of and preference of Topeka shiners for pool macrohabitat types (Everman and Cox 1896; Minckley and Cross 1959; Pflieger 1997) having water levels stabilized by ground water inputs. In South Dakota, Wall et al. (2001) and Cunningham (2002) reported the occurrence of Topeka shiners from a variety of macrohabitat types including; degraded streams, off-channel backwaters, borrow pits, and sloughs in contrast to those considered typical in Nebraska, Kansas, and Missouri. However, groundwater availability was a primary predictor of presence within the native range in South Dakota (Blausey 2001; Wall et al. 2001).

The Topeka shiner is a shoaling species found throughout the water column and often in association with other species including central stonerollers (*Campostoma anomalum*), bluntnose minnows (*P. notatus*), and fathead minnows (Kerns 1983; Stark et al. 1999). Topeka shiners feed on small macroinvertebrates, fish larvae, microcrustaceans, and some plant material. These might be taken in an opportunistic fashion from the surface and midwater or in association with the activity of the benthic species mentioned above.

Topeka shiners spawn from late-May to mid-August in pool habitats over green sunfish (*Lepomis cyanellus*) and orangespotted sunfish (*L. humulis*) nests (Cross 1962; Pflieger 1997; Kerns and Bonneau 2002) and perhaps near fathead minnow (*Pimephales promelas*) nests (Stark et al. 2002). Groups of mature Topeka shiners aggregate during the spawning season and breeding males defend small territories associated with centrarchid nests or other areas of having coarse clean substrates (Pflieger 1997; Katula 1998; Hatch 2001; Kerns and Bonneau 2002; Stark et al. 2002). Based on ovarian development Topeka shiners appear to be multiple-clutch spawners (Hatch 2001).

Historically, the Topeka shiner was widespread throughout the prairie region of the central U.S. and had a range that included eastern South Dakota, southwestern Minnesota, Iowa, Nebraska, Kansas, and Missouri (Bailey and Allum 1962; Gilbert 1884). The species has exhibited major declines throughout this historic range. Specifically, there has been an 80 percent reduction in the number of historic locations where populations still persist; the majority of these losses occurring in the last 50 years (USFWS 2001). Currently, Topeka shiners occur in fragmented populations within a small portion of the historic range but recent surveys indicate that the species still occurs in isolated locations in the Smoky Hill, Big Blue, and Lower Kansas watersheds in the Kansas River Basin in Kansas; the Neosho watershed in the Arkansas River Basin in central Kansas; the Missouri, Grand, Lamine, Chariton, and Des Moines watersheds in the Missouri River Basin in Missouri; the Elkhorn and Loup watersheds in Nebraska; the Des Moines, Raccoon, Boone, Big Sioux, and Rock watersheds in Iowa; the Big Sioux, Vermilion, and James watersheds in eastern South Dakota and; the Big Sioux and Rock watersheds in southwestern Minnesota.

The USFWS has designated critical habitat for Topeka shiner in five different watersheds (60 FR 9607, 70 FR 15239). These include the North Raccoon River, Boone River, and Rock River watersheds in Iowa; the Big Sioux/Rock Rivers Watershed in Minnesota; and the Elkhorn River Watershed in Madison County, Nebraska. The USFWS excluded all previously proposed critical habitat in the states of Kansas, Missouri, and South Dakota (70 FR 15239).

3.1.5.2 Potential Presence in Project Area

South Dakota

According to recent surveys, Topeka shiner populations persist in the James and Vermillion watersheds in South Dakota (Cunningham 1999). Initial habitat surveys indicated good to marginal habitat persists at only seven stream-crossings within the historic range in South Dakota (ENSR 2006). Topeka shiner occurrence surveys were completed in June 2007 at all sites identified as suitable Topeka shiner habitat. Six Topeka

shiners were identified at the Redstone Creek stream crossing location in Miner County, South Dakota. Surveys confirmed that no other stream crossing locations supported Topeka shiner populations (**Table 3-3**).

Table 3-3 Habitat and Occurrence Surveys for the Topeka Shiner Along the Keystone Mainline and Cushing Extension in 2006 and 2007

State	County	Survey Location [1]	Survey Date(s)	Survey Results	Comments
KEYSTONE MAINLINE					
South Dakota	Clark	Foster Creek	09/2006 06/2007	No Topeka shiners found.	Suitable habitat.
South Dakota	Clark	Foster Creek	09/2006 06/2007	No Topeka shiners found.	Marginal habitat.
South Dakota	Clark	Tributary of Shue Creek	09/2006	Habitat surveys only.	Stream-crossing dry; no suitable habitat and no fish surveys conducted.
South Dakota	Beadle	Tributary of Shue Creek	09/2006	Habitat surveys only.	Stream-crossing dry; no suitable habitat and no fish surveys conducted.
South Dakota	Beadle	Shue Creek	09/2006	Habitat surveys only.	Stream-crossing dry; no suitable habitat and no fish surveys conducted.
South Dakota	Beadle	Middle Pearl Creek	09/2006	Habitat surveys only.	Stream-crossing dry; no suitable habitat and no fish surveys conducted.
South Dakota	Kingsbury	South Fork Pearl Creek	09/2006 06/2007	No Topeka shiners found.	Marginal habitat consisting of excavated pools in adjacent floodplain.
South Dakota	Kingsbury	Redstone Creek	09/2006	Habitat surveys only.	Stream-crossing dry; no suitable habitat and no fish surveys conducted.
South Dakota	Kingsbury	West Redstone Creek	09/2006	Habitat surveys only.	Stream-crossing dry; no suitable habitat and no fish surveys conducted.
South Dakota	Miner	Redstone Creek	09/2006 06/2007	6 Topeka shiners were found at crossing location.	Topeka shiners in breeding colors were found at crossing of Redstone Creek. Very high diversity of other fish species.
South Dakota	Miner	Rock Creek	09/2006 06/2007	No Topeka shiners found.	Good habitat.
South Dakota	Hansen	Wolf Creek	09/2006	No fish sampling conducted.	Marginal habitat.
South Dakota	McCook	Wolf Creek	09/2006 06/2007	No Topeka shiners found.	Good habitat.
South Dakota	Hutchinson	Wolf Creek	09/2006	Habitat surveys only.	Marginal habitat.
South Dakota	Hutchinson	Tributary of Wolf Creek	09/2006	Habitat surveys only.	Very poor habitat.
South Dakota	Hutchinson	Tributary of Wolf Creek	09/2006	Habitat surveys only.	Poor habitat.
South Dakota	Yankton	Tributary of James River	09/2006	Habitat surveys only.	Very poor habitat.

Table 3-3 Habitat and Occurrence Surveys for the Topeka Shiner Along the Keystone Mainline and Cushing Extension in 2006 and 2007

State	County	Survey Location [1]	Survey Date(s)	Survey Results	Comments
South Dakota	Yankton	James River	09/2006	Habitat surveys only.	Poor habitat.
South Dakota	Yankton	Tributary of James River	09/2006	Habitat surveys only.	Poor habitat.
South Dakota	Yankton	Beaver Creek	09/2006	Habitat surveys only.	Very poor habitat.
South Dakota	Yankton	Missouri River	09/2006	Habitat surveys only.	Very poor habitat.
Kansas	Marshall	North Elm Creek	03/2007	Habitat surveys only.	State-designated Topeka shiner critical habitat.
Kansas	Marshall	Tributary to North Elm Creek	12/2006	No Topeka shiners found.	
Kansas	Marshall	North Elm Creek	03/2007	142 Topeka shiners were found.	State-designated Topeka shiner critical habitat.
Kansas	Marshall	Tributary to North Elm Creek			No access to survey site. Surveys to be conducted when access is acquired.
Missouri	Clinton	Castile Creek	09/2006 10/2006	No Topeka shiners found.	Marginal habitat. Surface water present to conduct fish sampling.
Missouri	Clinton	Little Platte River	09/2006 10/2006	No Topeka shiners found.	Suitable habitat. Surface water present to conduct fish sampling.
Missouri	Clinton	Tributary to Little Platte River	12/2006	No Topeka shiners found.	Suitable habitat. Surface water present to conduct fish sampling.
Missouri	Clinton	Shoal Creek	09/2006 10/2006	No Topeka shiners found.	Suitable habitat. Surface water present to conduct fish sampling.
Missouri	Clinton	Little Shoal Creek	09/2006	Habitat surveys only.	Very poor habitat. No water at site to conduct fish sampling.
Missouri	Caldwell	Log Creek	09/2006	Habitat surveys only.	Very poor habitat. No water at site to conduct fish sampling.
Missouri	Caldwell	Tributary to Log Creek	09/2006 10/2006	No Topeka shiners found.	Very poor habitat. Surface water present to conduct fish sampling.
Missouri	Caldwell	Tributary to Log Creek	09/2006 10/2006	No Topeka shiners found.	Very poor habitat. Surface water present to conduct fish sampling.
Missouri	Caldwell	Brush Creek	09/2006 10/2006	No Topeka shiners found.	Poor habitat. Surface water present to conduct fish sampling.
Missouri	Caldwell	Tributary to Brush Creek	09/2006	Habitat surveys only.	Very poor habitat. No water at site to conduct fish sampling.
Missouri	Caldwell	Tributary to Crabapple Creek	09/2006	Habitat surveys only.	Very poor habitat. No water at site to conduct fish sampling.
Missouri	Caldwell	Crabapple Creek	09/2006 10/2006	No Topeka shiners found.	Poor habitat. Surface water present to conduct fish sampling.

Table 3-3 Habitat and Occurrence Surveys for the Topeka Shiner Along the Keystone Mainline and Cushing Extension in 2006 and 2007

State	County	Survey Location [1]	Survey Date(s)	Survey Results	Comments
Missouri	Chariton	East Fork Chariton River	09/2006 10/2006	No Topeka shiners found.	Very poor habitat. Surface water present to conduct fish sampling.
Missouri	Chariton	Tributary to East Fork Chariton River	09/2006	Habitat surveys only.	Very poor habitat. No water at site to conduct fish sampling.
CUSHING EXTENSION					
Kansas	Dickinson	Carry Creek.	06/2007	No Topeka shiners found.	State designated critical habitat. Poor habitat at crossing.
Kansas	Dickinson	Carry Creek	06/2007	No Topeka shiners found.	State designated critical habitat. Poor habitat at crossing.
Kansas	Dickingon	Trib. to W. Branch Lyon's Creek	06/2007	No Topeka shiners found.	State designated critical habitat. Poor habitat at crossing.
Kansas	Dickinson	W. Branch Lyon's Creek	06/2007	No Topeka shiners found.	State designated critical habitat. Poor habitat at crossing.
Kansas	Dickinson	Trib to Lyon's Creek	06/2007	No Topeka shiners found.	Poor habitat.
Kansas	Dickinson	Trib to Lyon's Creek	06/2007	No Topeka shiners found.	Poor habitat.
Kansas	Dickinson	Lyon's Creek	06/2007	No Topeka shiners found.	Poor habitat.
Kansas	Dickinson	Trib to Lyon's Creek	06/2007	No Topeka shiners found.	Poor habitat.
Kansas	Marion	Trib to Mud Creek	06/2007	Habitat surveys only.	State designated critical habitat. No surface water present to conduct fish sampling.
Kansas	Marion	Trib to Mud Creek	06/2007	No Topeka shiners found.	State designated critical habitat. Poor habitat at crossing.
Kansas	Marion	Trib to Mud Creek	06/2007	No Topeka shiners found.	State designated critical habitat. Poor habitat at crossing.
Kansas	Marion	Trib to Mud Creek	06/2007	No Topeka shiners found.	State designated critical habitat. Poor habitat at crossing.

[1]Habitat and occurrence surveys were conducted 100 meters upstream and 100 meters downstream of centerline.

Kansas

In Kansas two stream-crossings along the project would be located within state designated critical habitat on North Elm Creek in Marshall County. Nearly 150 Topeka shiners were observed at the upstream-most location during the habitat and fish assessments conducted for another project (ENSR 2007). Eight stream-crossings along the Cushing Extension in Kansas would be located within state designated critical habitat on Carry Creek, West Branch Lyon's Creek, Mud Creek, and tributaries to these streams. No Topeka shiners were identified during occurrence surveys conducted in June 2007 along the Cushing Extension (**Table 3-3**).

Missouri

In Missouri, most stream-crossings had poor habitat within streams having historic occurrences. No individuals were observed during assessments of these stream locations (**Table 3-3**).

Topeka shiners might move short distances upstream or downstream to spawn (Barber 1986), and vagrants from adjacent populations have been observed (Kerns 1983). However, genetic analysis suggests that migration over short distances is rare and over long distances unlikely (Michels 2000). The relatively sedentary behavior indicates that recent surveys are likely to accurately reflect the presence or absence of Topeka shiners at a given location.

3.1.5.3 Impact Evaluation

Construction

Only populations that occur within the ROW or immediately adjacent to the ROW are likely to be affected given the apparent low vagility of the species. Direct impacts to these populations could result from in-stream construction activities. Indirect affects could result from increased sediment loading within suitable habitat. However, there would be no in-stream construction during the spawning season; May 15th through July 31 at locations with known Topeka shiner populations, or within state-designated critical habitat. Exclusive of the spawning season at crossings of known occurrence, pre-construction relocations to upstream suitable habitat would occur to avoid "takings" of individuals. On small streams (discharges less than 20 cubic feet per second), if the crossings are made rapidly (24 to 48 hours), and stream banks and channels are stabilized with clean coarse substrates to minimize siltation as part of the construction activities, the effect on Topeka shiner populations would be minimal. On moderate to large streams, some means of maintaining flow regime would be maintained to preserve the integrity of downstream habitats. These safeguards would be implemented in Marshall, Dickinson, and Marion counties, Kansas, at the locations within state designated critical habitats, and at all other locations where fish surveys have indicated presence.

Additionally, four creeks have been identified as water sources to be used for hydrostatically testing the pipeline including three creeks in South Dakota (Foster Creek, Redstone Creek, and Wolf Creek), and one creek in Kansas (Carry Creek). During this testing process, a pump would be placed in or adjacent to the river for the duration of the water intake and filling period. The intake end of the pump would be screened to prevent entrainment of free-swimming larva or debris. Once the pipeline is filled with water and pressure tested, the water would be returned to the same drainage where it was originally withdrawn. Keystone plans on returning water back to its source within a 30-day period. Care would be taken during the discharge to prevent erosion or scouring of the waterbody bed and banks. No direct impacts are anticipated from this process to the Topeka shiner.

During hydrostatic test water withdrawals, Keystone will not withdraw more than 10 percent of the ambient stream flow, and adequate flow rates would be maintained in the waterbody to protect aquatic life and provide for downstream uses, in compliance with regulatory and permit requirements. In the event that primary test water sources do not contain adequate flow rates to support the hydrostatic test water withdrawal without affecting downstream uses and resources, the alternate water sources identified in Attachment A may be used. In some cases, the alternate water source may replace more than one primary water source. In waterbodies where sensitive species are located, Keystone would generally avoid withdrawal of hydrostatic test water until after August 1, unless specific approval is obtained in advance from the appropriate regulatory or resource agency(ies). Small withdrawals associated with horizontal directional drills may take place before August 1. In these cases, the withdrawal rates would be minor and the pump intakes would be screened with fine mesh to avoid entrainment or impingement of fish or debris. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Routine pipeline operations would not affect Topeka shiner.

Most suitable Topeka shiner habitat is contained within USDOT-designated High Consequence Areas and are subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195). Consequently, the risk of a spill in these areas would be extremely unlikely, and minimizes potential impacts to this species.

In the unlikely event of a spill that would enter a river, exposure to crude could result in adverse toxicological effects to Topeka shiner. However, the probability of adverse effects to Topeka shiner are unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a waterbody in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a stream reach where Topeka shiner are present. Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact Topeka shiner (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.1.5.4 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.5.5 Mitigation

Mitigation measures to be employed at crossings inhabited by Topeka shiner or within state designated Topeka shiner critical habitat would be as follows:

- Construction activities would be prohibited during the spawning period (May 15 through July 31) at specific stream crossings identified in consultation with the USFWS, unless HDD methods are used.
- Outside of the spawning season, all pools would be seined within the ROW at least 2 weeks prior to construction, and fish would be relocated upstream to a pool or location of similar depth. Repeated relocation efforts may be necessary if high-water events were to delay construction activities more than two weeks following the initial relocation efforts. Temporary cofferdams would block off the work area in which salvage operations occur in order to prevent fish from repopulating the work area.
- Relocation activities would occur during ambient weather conditions suitable to ensure survivorship during relocation. Relocation activities would be performed in the early daytime hours to avoid ambient air temperatures that exceed 80^{o}F.
- Individuals would be held in proper transfer containers that ensure suitable water quality conditions. This includes utilizing aeration equipment and ensuring water temperatures do not exceed ambient water temperatures. Ambient water temperatures would be collected at a depth of no more than 60 percent of maximum pool depth from the pools in which salvage efforts are attempted.
- Relocation efforts would be implemented rapidly to avoid excessive holding time prior to relocation.
- Erosion control measures would be implemented as described in Keystone's CMR Plan (**Appendix C**). Erosion and sediment controls would be monitored daily during construction to ensure effectiveness, particularly after storm events.
- Banks and beds of streams would be restored using erosion control and revegetation measures as described in Keystone's CMR Plan (**Appendix C**).

During operation of the pipeline and during routine inspection and maintenance, crews should be aware of the location of populations of Topeka shiners within the ROW and locations should be clearly marked on maps and described in maintenance orders. Adherence to these construction and operation guidelines and mitigation measures would result in negligible foreseeable impacts to Topeka shiner populations as the result of construction and operations activities.

3.1.5.6 Determination

Effect on Critical Habitat. No areas of federal designated critical habitat for Topeka shiner would be crossed by the project or are downstream of the project. Therefore, the project would have "no effect" on critical habitat for the Topeka shiner.

Effect on the Species. The project "may affect, but is not likely to adversely affect" the Topeka shiner. This determination is based on Keystone's CMR and Hydrostatic Test plans, and the applicable protection measures that have been developed for this species.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of such an event would be unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a stream reach where Topeka shiner are present.

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3.1.6 Higgins Eye Pearlymussel

3.1.6.1 Natural History and Habitat Association

The Higgins eye pearlymussel (*Lampsilis higginsii*) was listed as federally endangered on June 14, 1976 (41 FR 24062). It is a large river mussel species that occupies stable substrates varying from sand to boulders, but not substrates consisting of packed clay, flocculent silt, organic material, bedrock, concrete, or unstable sand (USFWS 2004). Higgin's eye pearlymussels are usually found in mussel beds containing at least 15 other species at densities greater than 0.01 individual per square miles (mi^2). In the Mississippi River, the density of all mussels in the bed typically exceeds 10/mi^2 (USFWS 2004).

The historic range of Higgins eye pearlymussel included: the main stem of the Mississippi River from just north of St. Louis, Missouri to just south of St. Paul, Minnesota; Illinois, Sangamon, Rock rivers in Illinois; Iowa, Cedar, and Wapsipinicon rivers in Iowa; Wisconsin and St. Croix rivers in Wisconsin; and Minnesota River in Minnesota (USFWS 2004). Its current range is about 50 percent reduced from its historic distribution. The revised recovery plan for Higgins eye pearlymussel identifies 10 "Essential Habitat Areas" that the USFWS and its partners considered of utmost importance to the conservation of this species. Three are in the St. Croix

River near its confluence with the Mississippi River at Prescott, Wisconsin. One is in the Wisconsin River near Orion, Wisconsin. The remaining six are in the Mississippi River between river miles 489 (Sylvan Slough, near Moline, Illinois) and 656 (Whiskey Rock, near Lansing, Iowa). These areas currently sustain, or once supported, high populations of Higgins eye pearlymussel.

Higgins eye pearlymussel occurs elsewhere in the Mississippi River but much of its former range has become severely infested by the non-native zebra mussel (*Dreissena polymorpha*), which has reduced habitat suitability for Higgins eye pearlymussel and other native mussel species. Zebra mussels have been identified as the most serious threat to native populations of Higgins eye pearlymussel, although construction activities, environmental contaminants, and poor water quality may also pose significant threats to mussel populations (USFWS 2004). Since zebra mussels invaded the Mississippi River in the early 1990s, only one Essential Habitat Area on the St. Croix remains free of zebra mussels and three other Essential Habitat Areas have become severely infested (USFWS 2004). There are currently no effective means of controlling or eliminating populations of zebra mussel that threaten Higgins eye pearlymussel.

Reproduction occurs when male mussels release sperm into the water, and the sperm are taken into the incurrent siphon of female mussels. Fertilized eggs (zygotes) are brooded in the gills of the females until they are released as larvae (glochidia). The glochidia attach to the gills of a fish host where they remain for about 3 weeks as they transform into juveniles. At this stage of their life cycle, the juveniles drop off their fish host and settle on suitable habitat substrate where they attach by means of a byssal thread, which prevents them from being swept away by water currents (USFWS 2004). Higgins eye pearlymussels are filter feeders. They remove small suspended food particles from the water by using their gills as feeding organs.

3.1.6.2 Potential Presence in Project Area

The historic range of the Higgins eye pearlymussel included the Mississippi River just north of St. Louis (near the project crossing of the Mississippi), upstream to the Upper Mississippi. The current distribution of the mussel extends to Pool 22 along the Upper Mississippi River. Although known populations in “Essential Habitat Areas” are all located considerable distances upstream of the project crossing of the Mississippi, it is unknown if populations of Higgins eye pearlymussel remain in the Mississippi River near the project crossing.

The Missouri River near Yankton at the Nebraska-South Dakota state line would be an additional location where the Higgins eye pearlymussel may occur, but is not likely to be common. The likelihood that populations of Higgins eye pearlymussel remain at the project crossing of the Mississippi and Missouri rivers and downstream segments potentially affected is low. The James River project crossing would be the only large river crossing with potential mussel habitat that would not be crossed using the HDD method. Surveys completed at the James River crossing in 2006 found no evidence of Higgins eye pearlymussel (ENSR 2006).

Construction

Direct impacts to the Higgins eye pearlymussel would not result from the project. Although the mussel may be present at the crossings of the Mississippi River at the Illinois-Missouri state line, and the Missouri River at the Nebraska-South Dakota state line, these rivers would be crossed using the HDD method. Consequently, there would be no direct effect on potential river bottom habitat for Higgins eye pearlymussel. The James River crossing was the only other large river crossing identified that may have potential mussel habitat. This river would not be crossed using the HDD method. Surveys completed at the James River crossing in 2006 found no evidence of Higgins eye pearlymussel (ENSR 2006).

At streams and rivers crossed by the HDD method, a small electric pump and hose (1 to 2 inches in diameter) would be placed in the waterbody to provide water to the HDD operation. The intake end of this pump would be screened using an appropriate mesh size to prevent entrainment or entrapment of free-swimming aquatic larva or other aquatic organisms. The withdrawal rates for the pumps would be low, thus reducing the potential for entrainment or entrapment of aquatic species. The water withdrawals would take place in conjunction with the HDD operations. The combination of effective screening and low water withdrawal rates would prevent direct impacts to the species.

Additionally, the Mississippi River at the Missouri-Illinois state line, and the Missouri River at the South Dakota-Nebraska state line have been identified as water sources to be used for hydrostatically testing the pipeline. During this testing process, a pump would be placed in or adjacent to the river for the duration of the water intake and filling period. The intake end of the pump would be screened to prevent entrainment of free-swimming larva or debris. Based, on correspondence with the Missouri USFWS Ecological Field Office (USFWS 2007), no further mitigation for mussels would be required. Once the pipeline is filled with water and pressure tested, the water would be returned to the same drainage where it was originally withdrawn. Care would be taken during the discharge to prevent erosion or scouring of the waterbody bed and banks. No direct impacts are anticipated from this process to the Higgins eye pearlymussel. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Routine pipeline operations would not affect Higgins eye pearlymussel.

Suitable habitat within the Missouri River (Nebraska-South Dakota crossing) and the Mississippi River would be crossed by HDD. In the unlikely event of a leak, the crude oil would need to penetrate this significant amount of overburden before reaching the river, thereby reducing the risk of crude oil reaching the river and thereby reducing the potential for Higgins eye pearlymussel exposure. Additionally, the Missouri River crossing location is subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195).

In the unlikely event of a spill that would enter a river, exposure to crude could result in adverse toxicological effects to Higgins eye pearlymussel. However, the probability of adverse effects to Higgins eye pearlymussel are unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where Higgins eye pearlymussel individuals were present. Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact Higgins eye pearlymussel (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.1.6.3 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.6.4 Mitigation

No mitigation measures are proposed for the Higgins eye pearlymussel.

3.1.6.5 Determination

Effect on Critical Habitat. No critical habitat has been designated for Higgins eye pearlymussel. Therefore, the project would have “no effect” on critical habitat for the Higgins eye pearlymussel.

Effect on the Species. The project “may affect, but is not likely to adversely affect” the Higgins eye pearlymussel. This determination is based on Keystone’s plan to HDD the Missouri and Mississippi rivers, and Keystone’s CMR and Hydrostatic Test plans that have been developed for the project. The James River would be the only large river crossing with potential mussel habitat that would not be crossed using the HDD method. Surveys completed at the James River crossing in 2006 found no evidence of Higgins eye pearlymussel (ENSR 2006). As a result, no direct or indirect impacts to this species would result from project construction.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of such an event would be unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where Higgins eye pearlymussel are present.

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3.1.7 Scaleshell Mussel

3.1.7.1 Natural History and Habitat Association

The scaleshell mussel (*Leptodea leptodon*) was federally listed as endangered in 2001. Scaleshell mussels live in large and medium-sized rivers with low to medium gradients, stable channels, and good water quality (USFWS 2004). It prefers stable riffles and runs with gravel or mud substrate and moderate current velocity. It is usually found where a diversity of other mussel species are concentrated (USFWS 2004). This mussel buries itself in sand, gravel, or mud bottoms with only the edge of their partially opened shells exposed. They feed by siphoning water over their gills and removing small, suspended food particles (plant debris, plankton, and other microorganisms) from the water.

The scaleshell mussel historically occurred in 55 rivers in the Mississippi River drainage over much of the eastern U.S. in a total of 13 states but, apparently, was never common (Szymanski 1998). The scaleshell mussel has been extirpated from all states in the northern and eastern portions of its range and is now known from only 14 rivers in Arkansas, Missouri, and Oklahoma (USFWS 2001). Rivers with known populations include the Meramec, Bourbeuse, Big, Gasconade, and Osage rivers in Missouri; Frog Bayou and the St. Francis, Spring, South Fork Spring, South Fourhe LaFave, and White rivers in Arkansas; and Little, Mountain Fork, and Kiamichi rivers in Oklahoma. Populations in 13 of these rivers are believed to be declining (USFWS 2004).

Relatively little is known about the life history of the scaleshell mussel. Its general biology is believed to be similar to other fresh water mussels in the family Unionidae. Like Higgins eye pearlymussel, reproduction occurs when male mussels release sperm into the water, and the sperm are taken into the incurrent siphon of female mussels. Fertilized eggs (zygotes) are brooded in the gills of the females until they mature as larvae (glochidia). The transfer pathway of *Scaleshell glochidia* to a host fish is unknown, but one hypothesis is that the transfer occurs through fish predation of female scaleshells. The glochidia attach to the gills of a fish host where they remain for about 2 to 3 weeks as they transform into juveniles. Laboratory studies indicate scaleshell mussels appear to utilize the freshwater drum (*Aplodinotus grunniens*) exclusively as a host for its larvae, although this has not been confirmed by field studies (USFWS 2004). The fact that freshwater drum are molluscivores lends some support to the ingestion hypothesis for *scaleshell glochidia* transfer to its fish host. Once the glochidia mature to juveniles, they drop off their fish host and settle into suitable habitat substrate (USFWS 2004).

Habitat destruction and degradation as a result of physical, chemical, and biological alterations, has and continues to threaten scaleshell populations. The major causes of such alteration are water pollution, sedimentation, channelization, sand and gravel mining, dredging, and impoundments (Szymanski 1998). The introduction of non-native freshwater bivalves into the U.S. has contributed to the decline of the native mussel fauna and also is likely to impact existing scaleshell populations in the future (USFWS 2004). Zebra mussels starve and suffocate native mussels by attaching to their shells to the surrounding habitat in large numbers. Zebra mussels have spread throughout much of the Mississippi River Basin, but at this time, no established

populations are known to occur in streams occupied by scaleshell (USFWS 2004). However, they are likely to eventually invade these streams based on the proliferation and spread of this species that has already occurred.

3.1.7.2 Potential Presence in Project Area

Within the project area, there are no known extant populations of scaleshell mussel. The only historic population location within the project area is the Missouri River near Yankton, South Dakota (Hoke 1983; Perkins and Backlund 2003). The James River project crossing would be the only large river crossing with potential scaleshell habitat that would not be crossed using the HDD method. Surveys completed at the James River crossing in 2006 found no evidence of scaleshell mussel (ENSR 2006).

Construction

Direct impacts to the scaleshell mussel would not result from the project. Although there is a remote possibility the scaleshell may be present at the crossing of the Missouri River near Yankton, South Dakota, this river crossing would be crossed using the HDD method, and there would be no direct effect on potential river bottom habitat for scaleshell mussel. The James River crossing would be the only large river crossing with potential scaleshell habitat that would not be crossed using the HDD method. Surveys completed at the James River crossing in 2006 found no evidence of scaleshell mussel (ENSR 2006).

At streams and rivers crossed by the HDD method, a small electric pump and hose (1 to 2 inches in diameter) would be placed in the waterbody to provide water to the HDD operation. The intake end of this pump would be screened using an appropriate mesh size to prevent entrainment or entrapment of free-swimming aquatic larva or other aquatic organisms. The withdrawal rates for the pumps would be low, thus reducing the potential for entrainment or entrapment of aquatic species. The water withdrawals would take place in conjunction with the HDD operations. HDD methods are a critical part of the project and may require multiple attempts to complete the crossings. The combination of effective screening and low water withdrawal rates would prevent direct impacts to the species.

Additionally, the Missouri River at the South Dakota-Nebraska state line has been identified as water sources to be used for hydrostatically testing the pipeline. During this testing process, a pump would be placed in or adjacent to the river for the duration of the water intake and filling period. The intake end of the pump would be screened to prevent entrainment of free-swimming larva or debris. Based, on correspondence with the Missouri USFWS Ecological Field Office (USFWS 2007), no further mitigation for mussels would be required. Once the pipeline is filled with water and pressure tested, the water would be returned to the same drainage where it was originally withdrawn. Care would be taken during the discharge to prevent erosion or scouring of the waterbody bed and banks. No direct impacts are anticipated from this process to the scaleshell mussel. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Routine pipeline operations would not affect scaleshell mussel.

Suitable habitat within the Missouri River (Nebraska-South Dakota crossing) would be crossed using the HDD method. In the unlikely event of a leak, the crude oil would need to penetrate this significant amount of overburden before reaching the river, thereby reducing the risk of crude oil reaching the river and thereby reducing the potential for scaleshell mussel exposure. Additionally, the Missouri River crossing location is subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195).

In the unlikely event of a spill that would enter a river, exposure to crude could result in adverse toxicological effects to scaleshell mussel. However, the probability of adverse effects to scaleshell mussel are unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where scaleshell mussel individuals were present. Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of

sufficient size to potentially impact scaleshell mussel (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.1.7.3 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.7.4 Mitigation

No mitigation measures are proposed for the scaleshell mussel.

3.1.7.5 Determination

Effect on Critical Habitat. No critical habitat has been designated for scaleshell mussel. Therefore, the project would have "no effect" on critical habitat for the scaleshell mussel.

Effect on the Species. The project "may affect, but is not likely to adversely affect" the scaleshell mussel. This determination is based on Keystone's plan to HDD the Missouri and Mississippi rivers, and Keystone's CMR and Hydrostatic Test plans that have been developed for the project. The James River would be the only large river crossing with potential mussel habitat that would not be crossed using the HDD method. Surveys completed at the James River crossing in 2006 found no evidence of scaleshell mussel (ENSR 2006). As a result, no direct or indirect impacts to this species would result from project construction.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of such an event would be unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where scaleshell mussel are present.

3.1.7.6 Literature Cited

ENSR. 2006. A field survey for the winged mapleleaf (*Quadrula fagosa*) and scaleshale mussel (*Leptodea leptodon*) for the Keystone Pipeline Project at the James River crossing in South Dakota. Unpublished report prepared by ENSR Corporation for the Keystone Pipeline Project. Document No. 10623-004. 7 pp. + appendices.

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3.1.8 Running Buffalo Clover

3.1.8.1 Natural History and Habitat Association

Running buffalo clover (*Trifolium stoloniferum*) was listed as federally endangered on June 5, 1987 (52 FR 21478). Historically widespread from eastern Kansas to West Virginia, the population started to decline in the late 1800's (52 FR 21478). The population decline is believed to be linked to the arrival of European settlers and the subsequent decline of bison (*Bison bison*) (Ford et al. 2003; Missouri Department of Conservation 2000; 52 FR 21478). Running buffalo clover was considered extinct from 1940 until the discovery of a population of four individuals in West Virginia in 1983. In 1987, it was federally listed as endangered (52 FR 21478). Since that discovery, 120 populations have been identified in five states, West Virginia, Ohio, Kentucky, Indiana, and Missouri (USFWS 2005). The largest populations are in West Virginia, while the greatest number of populations is located in Kentucky (USFWS 2007a,b).

Running buffalo clover is a short lived, stoloniferous herb (52 FR 21478; Ohio DNR 1985). Its name derives from the stolons, also called runners, which root at the nodes (USFWS 2005). Individuals are defined as a "rosette that is rooted into the ground" called a rooted crown (USFWS 2005). The species lacks a rhizobial associate, but it is unclear whether it has lost a past association or did not develop a need for an association due to a low nitrogen requirement (NatureServe 2006; USFWS 2005). While research has suggested a low nitrogen requirement (USFWS 2005), running buffalo clover is limited by its inability to fix nitrogen to areas underlain with limestone or other calcareous bedrock or soils (Missouri Department of Conservation 2007; USFWS 2005; Schuler et al. 2004). In addition, it is found in soils with a pH ranging from neutral to moderately alkaline (Missouri Department of Conservation 2007; Schuler et al. 2004). The elevation range for running buffalo clover extends from 120 to 1,000 feet (Missouri Department of Conservation 2007).

Running buffalo clover favors areas of partial to filtered sunlight as it does not tolerate full sun or full shade (USFWS 2007a,b). Mesic forests and woodlands; areas of rich soils in the stable ecotones between open forest and prairie; moist, partially shaded woodlands and along stream or river terraces are all preferred habitat (52 FR 21478). Based on historical accounts, the distribution of running buffalo clover seems to have followed the bison (*Bison bison*) (Ford et al. 2003). Bison and other ungulates would have created a continual, moderately disturbed habitat. Running buffalo clover is commonly found in areas with a continual, moderately intense disturbance such as grazing, mowing or trampling by ungulates (Missouri Department of Conservation 2007; 52 FR 21478). These include areas such as old trails, logging roads, jeep trails, mowed paths, old home sites and mowed wildlife openings (Missouri Department of Conservation 2007; NatureServe 2006; Ford et al. 2003). It is theorized that bison and other ungulates increased germination rates by dispersing seeds, scarifying seeds passed through their digestive tract, and enriching soils (NatureServe 2006; Ford et al. 2003).

The primary threat to running buffalo clover is habitat alteration (USFWS 2007b). Habitat destruction, the closing of forest canopies, invasive species, small natural populations, and reduction in pollinators are all threats to the survival of running buffalo (USFWS 2007b). While there is distinct genetic differences between the natural populations, individual natural populations have low genetic diversity (Crawford et al. 1998; Hickey et al. 1991). While it is unclear whether this is either a causal factor in the species' decline or the result of having smaller, more isolated populations (Hickey et al. 1991), it is a concern in the long-term survival of the species (Crawford et al. 1998). Small populations are at risk of extirpation from physical disturbances (NatureServe 2006). Other factors that make running buffalo clover vulnerable include its dependence on seed scarification, seed dispersal and moderate disturbance by ungulates, especially bison (USFWS 2007b). In 1995, the Missouri Department of Conservation and Missouri Botanical Gardens established 24 reintroduced populations throughout Missouri. The running buffalo clover reintroductions have been relatively unsuccessful, but four populations have persisted (USFWS 2007b).

The introduction of invasive species such as European white clover (*Trifolium repens*), bluegrass (*Poa pratensis*), Nepalese browntop (*Microstegium vimineum*), and Garlic mustard (*Alliaria petiolata*) into running buffalo clover habitat has contributed to its decline (NatureServe 2006; U.S. Department of Agriculture, Natural Resources Conservation Service 2007). These invasive species are commonly found in disturbed areas and compete with running buffalo clover for resources (NatureServe 2006).

3.1.8.2 Potential Presence in Project Area

Historically, running buffalo clover was widespread in eastern Kansas, Missouri, and Illinois. Running buffalo clover populations in Kansas and Illinois are presumed extirpated (NatureServe 2006). In Missouri, running buffalo clover populations are found in Madison, Maries, Lincoln, and Montgomery counties. The project crosses only through Montgomery and Lincoln counties. The largest known Missouri population was found in the Loutre River Valley in 2003 at Graham Cave State Park in Montgomery County, approximately 15 miles south of the project. The project does not cross the Loutre River or tributaries to the river. The second known population of running buffalo clover is present on the floodplain of the Cuivre River in Cuivre River State Park, northeast of Troy in Lincoln County (USFWS 2006). The project would cross the Cuivre River floodplain just south of the Cuivre River State Park. Surveys would be conducted where the project crosses the floodplains of the West Fork Cuivre River and Cuivre River in Missouri prior to construction during the flowering period.

3.1.8.3 Impact Evaluation

Construction

If running buffalo clover is located within the ROW, construction of the pipeline would disturb existing plant communities as vegetation is cleared and the ground is graded. Construction of permanent ancillary facilities also could displace plant communities for the lifetime of the project. Revegetation of the ROW could introduce or expand invasive species into the project area that could compete with running buffalo clover, potentially contributing to its decline. In forested areas, construction of the pipeline would involve clearing trees and shrubs in the ROW. The creation of open areas with full sunlight could adversely affect running buffalo clover as it does not tolerate full sun.

As discussed above in Chapter 2, electrical powerline providers, not Keystone, would be responsible for obtaining the necessary approvals or authorizations from federal, state, and local governments. The construction of new electrical powerline segments could impact the running buffalo clover if powerline ROWs were to disturb potential habitat for this species. Protection measures that could be implemented by electrical service providers to prevent impacts to this species would be the same as described below in Mitigation.

Operations

In order to maintain accessibility of the ROW, woody vegetation directly above the pipeline periodically would be cleared and large trees would be removed from the permanent ROW. Smaller trees and shrubs would be allowed to revegetate the permanent ROW, except for an approximately 30-foot-wide corridor that would be maintained. This ROW maintenance activity could potentially benefit running buffalo clover by providing partial shade habitat needed for the species. Other maintenance activities of the ROW would include infrequent mowing, which also could benefit running buffalo clover as it would provide a source of continual moderate disturbance. Mowing would be scheduled outside the April through August sexual reproduction window (Missouri Department of Conservation 2007). If herbicides must be used for noxious weed control, application would be conducted by spot spraying. Populations of running buffalo clover would be identified and no herbicides would be used at those locations.

Direct contact with a crude oil spill could result in adverse toxicological effects to running buffalo clover. While these exposure routes have the potential to cause adverse effects, the probability of adverse effects to running buffalo clover are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of running buffalo clover (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.1.8.4 Cumulative Impacts

No future state, or local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.1.8.5 Mitigation

Surveys for running buffalo clover would be conducted prior to construction within the floodplains of the West Fork Cuirvre River and Cuivre River in Missouri. If surveys identify running buffalo clover, Keystone would consult with the USFWS to determine appropriate mitigation measures. Mitigation measures for identified populations could include:

- Reducing the width of the construction ROW in areas where populations have been identified, to the extent possible.
- Salvaging and segregating topsoil appropriately where populations have been identified to preserve native seed sources in the soil for use in re-vegetation efforts in the ROW.
- Restoring habitat by using an approved seed mix provided by the NRCS or appropriate state agency.
- Collecting seed to repopulate the ROW or an appropriate offsite location, or for creation of a nursery population until viable natural populations have established themselves.
- Avoiding the population by rerouting around plants or boring under plants.
- Implementing procedures in the ROW maintenance plan that would not allow mowing or disruption of the plants during the period of sexual reproduction (April through August).

Other recommended mitigation measures for populations of running buffalo clover would be developed on a site-specific basis, in consultation with the USFWS, if warranted.

3.1.8.6 Determination

Effect on Critical Habitat. No critical habitat has been identified for this species. Therefore, the project would have "no effect" on critical habitat for the running buffalo clover.

Effect on the Species. The project "may affect, but is not likely to adversely affect" running buffalo clover. This determination is based on Keystone's CMR Plan and applicable protection measures that have been developed for this species. As a result no direct impacts would result from project construction. Indirect impacts could result from the incremental reduction of potential habitat for this species.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of adverse effects to running buffalo clover are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of running buffalo clover.

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3.2 Federal Threatened

3.2.1 Piping Plover

3.2.1.1 Natural History and Habitat Association

The piping plover (*Chardrius melodus*) was listed as endangered December 11, 1985 (50 FR 50726). Piping plover on the Great Lakes were listed as endangered, while the remaining Atlantic and Northern Great Plains populations were listed as threatened. Migrating and wintering populations of piping plover also were classified as threatened. Populations of piping plover near the project area fall under the threatened classification.

Historically, piping plover bred across three geographic regions: 1) U.S. and Canadian Northern Great Plains from Alberta to Manitoba south to Nebraska, 2) Great Lakes beaches, and 3) Atlantic coastal beaches from Newfoundland to North Carolina. Wintering areas are not well known, although wintering birds have been most often seen along the Gulf of Mexico, southern U.S. Atlantic coastal beaches from North Carolina to Florida, eastern Mexico, and scattered Caribbean Islands (Haig 1986; USFWS 1988). The piping plover's current breeding range is similar except that breeding populations in the Great Lakes have almost disappeared (Haig and Plissner 1993).

Piping plover begin arriving on breeding grounds in mid-April, and most birds have arrived in the Northern Great Plains and initiate breeding behavior by mid-May (USFWS 1994). Populations that nest on the Missouri, Platte, Niobrara, and other rivers use beaches and dry barren sandbars in wide, open channel beds. Nesting habitat of inland populations consists of sparsely vegetated shorelines around small alkali lakes, large

reservoir beaches, river islands and adjacent sandpits, and shorelines associated with industrial ponds (Haig and Plissner 1993). Vegetation cover is usually 25 percent or less (USFWS 1994). The piping plover will feed by probing the sand and mud for insects, small crustaceans, and other invertebrates in or near shallow water. This species feeds more leisurely than other sandpipers, alternating running and pausing to search for prey (Bent 1929).

Nests consist of shallow scrapes in the sand with the nest cup often lined with small pebbles or shell fragments. The nest is typically far from cover. Nesting piping plover have been found in least tern nesting colonies at a number of sites on Great Plains river sandbars and sand pits (USFWS 1994). Egg laying commences by the second or third week in May. The female generally chooses from several nest sites the male has constructed. Complete clutches contain three to four cryptically colored eggs (USFWS 1994). Incubation is shared by the male and female and averages 26 days. Incubation begins only after the last egg is laid and eggs typically hatch on the same day. Brooding duties also are shared by the male and female. Broods remain in nesting territories until they mature unless they are disturbed. Fledging takes approximately 21 to 35 days (USFWS 1994). If a nest fails or is destroyed, adults may re-nest up to four times (USFWS 1987). Breeding adults begin leaving nesting grounds as early as mid-July with the majority gone by the end of August (Wiens 1986, as cited in USFWS 1994).

3.2.1.2 Potential Presence in Project Area

Presence of breeding piping plover within the project area is restricted to South Dakota and Nebraska. Potential breeding habitat along the project for the piping plover is restricted to sandy beaches and sandbars along the Missouri River at the Nebraska-South Dakota border; shorelines of lakes in eastern South Dakota; the Elkhorn River, Nebraska; and the Platte River, Nebraska.

On the Missouri River at the Nebraska-South Dakota state line, most breeding activity occurs on sandbars from Yankton, South Dakota, to Ponca, Nebraska, and from the Fort Randall Dam to Springfield (USFWS 1994). This section of the river has been designated as critical habitat for piping plover (USFWS 2002). Piping plover also have been found to occasionally breed on saline wetlands in northeast South Dakota (USFWS 1994). Birds breeding in Nebraska are found on sandbars and at commercial sand pits along three rivers crossed by the project: Missouri River (discussed previously), Elkhorn River, and Platte River. Crossings of these rivers were surveyed by ENSR in May 2007 to confirm absence or presence of suitable breeding habitat and breeding piping plover. One pair of foraging plovers was identified at the Missouri River crossing near Yankton, South Dakota. No nesting piping plover were identified within 0.25 mile of the ROW crossing of the rivers identified below (**Table 3-4**). Surveys would be repeated at these locations prior to construction to ensure that no new nests have been built within 0.25 mile of the ROW.

3.2.1.3 Impact Evaluation

Construction

Threats to piping plover nesting habitat include reservoirs, channelization of rivers, and modifications of river flows that have eliminated hundreds of kilometers of nesting habitat along Northern Great Plains' rivers (USFWS 1994). Eggs and young are vulnerable to predation and human disturbance, including recreational activities and off-road vehicle use.

As indicated, the piping plover is known to nest within or near the project at the Missouri River (Nebraska-South Dakota state line) and the Platte and Elkhorn rivers in Nebraska. No direct impacts to the piping plover or its breeding habitat would be anticipated at these locations, since pipeline placement across the rivers would be completed using the HDD method. As a result, no impacts to breeding habitat or designated critical habitat would occur from the project.

Table 3-4 Habitat and Occurrence Surveys for the Piping Plover Along the Keystone Mainline in 2007

State	County	Survey Location	Survey Corridor	Survey Date	Survey Results	Comments
South Dakota/ Nebraska	Yankton/Cedar	Missouri River	0.25-mile each side of centerline	05/2007	Pair of foraging piping plover observed. No nesting piping plover observed.	Good suitable nesting and foraging habitat at crossing location.
Nebraska	Stanton	Elkhorn River	0.25-mile each side of centerline	05/2007	No piping plover observed.	Marginal nesting and foraging habitat at crossing location.
Nebraska	Colfax/Butler	Platte River	0.25-mile each side of centerline	05/2007	No piping plover observed.	Good suitable nesting and foraging habitat at crossing location.

Indirect impacts could result from increased noise and human presence at work site locations if breeding plover are located within 0.25 mile of the project. Prior to construction-related activities, including HDD and hydrostatic testing, that would occur within 0.25 mile from potential breeding habitat, Keystone would conduct presence/absence surveys up to 2 weeks prior to construction-related activities to identify occupied breeding territories and/or active nest sites, in coordination with the USFWS. If occupied breeding territories and/or active nest sites are identified, the USFWS would be notified and appropriate protection measures, such as seasonal construction constraints and the establishment of a 0.25-mile buffer area, would be implemented on a site-specific basis in coordination with the USFWS.

Water depletion impacts on the piping plover from hydrostatic testing could include a temporary incremental reduction of potential habitat in the lower Platte River Basin due to changes in downstream water flow. The USFWS defines “depletion” as consumptive loss plus evaporative loss of surface or groundwater within the affected basin.

However, because Keystone plans on returning water back to its source within a 30-day period, the USFWS would consider the temporary water reduction as insignificant. As a result, indirect impacts from hydrostatic testing on the piping plover would be negligible. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Similar constraints and/or mitigation measures may apply to any pipeline maintenance activities if nesting plover are present within 0.25 mile of the project. Operations personnel would coordinate with the USFWS if maintenance is required during the nesting season within 0.25 mile of suitable nesting habitat.

The major rivers that contain piping plover habitat (Missouri River at the South Dakota – Nebraska state line, Elkhorn River, and Platte River) would be crossed using the HDD method. In the unlikely event of a leak, the crude oil would need to penetrate this significant amount of overburden before reaching the river, thereby reducing the risk of crude oil reaching the river and thereby reducing the potential for piping plover exposure.

Additionally, these major rivers also are subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195). Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact piping plover.

Direct contact with a crude oil spill could result in adverse effects to piping plover due to oiling of plumage, ingestion of crude oil from contaminated plumage and prey, and transfer of crude oil to eggs and young. While these exposure routes have the potential to cause adverse effects to individuals, the probability of adverse effects to piping plover are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of piping plover individuals (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

As discussed above in Chapter 2, electrical powerline providers, not Keystone, would be responsible for obtaining the necessary approvals or authorizations from federal, state, and local governments. The construction of a new electrical powerline segment across the Elkhorn River would incrementally increase the collision potential for foraging piping plover in the project area. Based on the 2007 habitat and occurrence surveys for this species at the Elkhorn River crossing, breeding habitat quality within 0.25-mile from the project was considered to be of marginal quality. Protection measures that could be implemented by electrical service providers to minimize or prevent collision risk to foraging piping plover at the Elkhorn River crossing would include the use of standard measures as outlined in *Mitigating Bird Collision with Power Lines* (APLIC 1994).

3.2.1.4 Cumulative Impacts

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.2.1.5 Mitigation

The following mitigation measures would apply if construction-related activities, including HDD and hydrostatic testing, were to occur during the piping plover breeding season:

- Pre-construction surveys would occur within 0.25 mile from suitable breeding habitat at the Platte and Elkhorn rivers in Nebraska, or the Missouri River at the Nebraska-South Dakota state line, no more than 2 weeks prior to construction.

- Construction would not be permitted within a 0.25-mile buffer from an occupied nest site during the breeding season (April 15 though August 15).

3.2.1.6 Determination

Effect on Critical Habitat. The project would have “no effect” on designated critical habitat for the piping plover. The project would cross designated piping plover critical habitat along the Missouri River at the Nebraska-South Dakota state line: however, the project crossing of the river would be HDD. Therefore, no impacts to piping plover critical habitat would occur.

Effect on the Species. The project “may affect, but is not likely to adversely affect” the piping plover. This determination is based on Keystone’s construction plan to HDD the Missouri (Missouri River at the Nebraska-South Dakota state line), Platte, and Elkhorn rivers; Keystone’s CMR and Hydrostatic Test plans; and applicable protection measures that have been developed for this species.

The project would have no effect on the piping plover from water depletion issues resulting from hydrostatic testing. This finding is based on Keystone’s commitment to return the hydrostatic test water to its source within a 30-day period.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of adverse effects to piping plover are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of piping plover individuals.

3.2.1.7 Literature Cited

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3.2.2 Arkansas River Shiner

3.2.2.1 Natural History and Habitat Association

The Arkansas River shiner (*Notropis girardi*) was listed as threatened on November 23, 1998 (63 FR 64771). This listing was based on habitat destruction and modification from stream dewatering or depletions due to diversion of surface water and groundwater pumping, construction impoundments, and water quality degradation (USFWS 1998). Competition with the Red River shiner (*Notropis bairdi*) in the Cimarron River also has contributed to reduced distribution and abundance of Arkansas River shiner. Critical habitat has been designated for the Arkansas River shiner in the Cimarron River in Kansas and Oklahoma and the Canadian River in Oklahoma (USFWS 2005). The critical habitat includes a lateral distance of 300 feet on each side of the river width at bankfull discharge. The reach of critical habitat on the Cimarron River begins at U.S. Highway 54 in Seward County, Kansas, and continues downstream to U.S. Highway 77 Bridge near I-35 in Logan County, Oklahoma (USFWS 2005). The ROW crossing location is over 25 miles downstream of the east end of the reach of the Cimarron River designated as critical habitat.

The Arkansas River shiner inhabits the main channels of wide, shallow, sandy bottomed rivers and larger streams in the Arkansas River basin (Gilbert 1980). Adults usually are not found in quiet pools or backwaters (Cross 1967, as cited in USFWS 1998). Studies by Polivka and Matthews (1997) in the South Canadian River indicated that this species used a broad range of microhabitat features. Microhabitat types such as bank, island, sandridges, backwaters, midchannel, and pools were analyzed separately for abundance at all sampling locations. Bank habitat, islands, and ridges supported greater numbers of Arkansas River shiners than the other types. Sand was the predominate type of substrate in these microhabitats. Seasonally, adults selected bank and backwater areas in the winter and remained in islands and sandridges during the fall,

spring, and summer. In contrast, juveniles exhibited their highest numbers in backwaters, however, they also were abundant in bank and sandridge habitats.

The spawning period for the Arkansas River shiner occurs from June 1 through August 30 (Mammoliti 2001). Spawning consists of pelagic, non-adhesive eggs that are broadcast and drift with the current during high flow periods. Hatching occurs within 1 or 2 days, with larvae capable of swimming within 3 or 4 days (USFWS 1998). Larvae seek out backwater pools and quiet water at the mouth of tributaries where food is more abundant (Moore 1944).

3.2.2.2 Potential Presence in the Project Area

Historically, the Arkansas River shiner was considered to be widely distributed and common in the Cimarron River in Oklahoma, and Kansas and the Arkansas River in Kansas (USFWS 1998). The abundance of this species declined markedly after 1964. It is believed to no longer exist in the Arkansas River in Kansas (USFWS 1998). A small, remnant population may still persist in the Cimarron River, based on the collection of nine individuals in 1990 (USFWS 1998). At present, habitat appears to be suitable throughout most of the system, but no detailed studies have been conducted. The project crosses the Cimarron River approximately 5 miles northwest of Cushing, Oklahoma. No Arkansas River shiners were found during surveys conducted at the Cimarron and Arkansas rivers in 2007. Survey results are summarized below in **Table 3-5**.

Table 3-5 Habitat and Occurrence Surveys for the Arkansas River Shiner Along the Keystone Cushing Extension in 2007

State	County	Survey Location[1]	Survey Date	Survey Results	Comments
Kansas	Colfax	Arkansas River	09/2007	No Arkansas River shiners found.	Good suitable habitat at crossing location.
Oklahoma	Payne	Cimarron River	06/2007	No Arkansas River shiners found.	Good suitable habitat at crossing location.

[1]Habitat and fish surveys were conducted 100 meters upstream and 100 meters downstream of centerline.

3.2.2.3 Impact Evaluation

Construction

Based on 2007 survey results, no populations of Arkansas River shiner exist at the crossing of the Cimarron River in Oklahoma. The project crossing of both the Arkansas River in Kansas, and the Cimarron River in Oklahoma would be crossed using the HDD method. Consequently, no direct impacts to this species or its habitat would occur from project construction.

At streams and rivers crossed by the HDD method, a small electric pump and hose (1 to 2 inches in diameter) would be placed in the waterbody to provide water to the HDD operation. The intake end of this pump would be screened using an appropriate mesh size to prevent entrainment or entrapment of larval fish or other aquatic organisms. The withdrawal rates for the pumps would be low, thus reducing the potential for entrainment or entrapment of aquatic species. The water withdrawals would take place in conjunction with the HDD operations. HDD methods are a critical part of the project and may require multiple attempts to complete the crossings. Many of the HDD's would take place early in the construction period, potentially during the Arkansas River shiner spawning period. However, the combination of effective screening and low water withdrawal rates would prevent direct impacts to the species.

Additionally, the Arkansas River in Kansas and the Cimarron River in Oklahoma have been identified as water sources to be used for hydrostatically testing the pipeline. During this testing process, a pump would be placed in or adjacent to the river for the duration of the water intake and filling period. The intake end of the pump

would be screened to prevent entrainment of larval fish or debris. Once the pipeline is filled with water and pressure tested, the water would be returned to the same drainage where it was originally withdrawn. Care would be taken during the discharge to prevent erosion or scouring of the waterbody bed and banks. Hydrostatic testing operations would generally take place outside the spawning season for the Arkansas River shiner, and no direct impacts are anticipated.

During hydrostatic test water withdrawals, Keystone will not withdraw more than 10 percent of the ambient stream flow, and adequate flow rates would be maintained in the waterbody to protect aquatic life and provide for downstream uses, in compliance with regulatory and permit requirements. In the event that primary test water sources do not contain adequate flow rates to support the hydrostatic test water withdrawal without affecting downstream uses and resources, the alternate water sources identified in Attachment A may be used. In some cases, the alternate water source may replace more than one primary water source. In waterbodies where sensitive species are located, Keystone would generally avoid withdrawal of hydrostatic test water until after August 1, unless specific approval is obtained in advance from the appropriate regulatory or resource agency(ies). Small withdrawals associated with horizontal directional drills may take place before August 1. In these cases, the withdrawal rates would be minor and the pump intakes would be screened with fine mesh to avoid entrainment or impingement of fish or debris. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Routine pipeline operations would not affect Arkansas River shiner.

The potential for remnant populations of Arkansas River shiner at or downstream of the Arkansas and Cimarron river crossing locations are very low. Nevertheless, these locations are within USDOT-designated High Consequence Areas and are subject to an intensive integrity management program stipulated by the USDOT (Integrity Management Rule, 49 CFR Part 195). Consequently, the risk of a spill in these areas would be extremely unlikely, and minimizes potential impacts to this species.

In the unlikely event of a spill that would enter a river, exposure to crude could result in adverse toxicological effects to Arkansas River shiner. However, the probability of adverse effects to Arkansas River shiner are unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a waterbody in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where Arkansas River shiner individuals were present. Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact Arkansas River shiner (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.2.2.4 Cumulative Impacts

No future federal, state, or local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.2.2.5 Mitigation

The Arkansas River crossing is state designated critical habitat for this species. There are no federally designated critical habitat areas crossed by the project. The following mitigation requirements would apply to minimize impacts to the Arkansas River shiner:

- Construction activities would be prohibited during the spawning period (June 1 through August 30) at the Arkansas and Cimarron river crossings unless HDD methods are used.
- Outside of the spawning season and if HDD methods were not used, if construction would disturb streams with pool depths of 3 feet or greater, those pools would be seined at least 1 week prior to construction, and fish would be relocated upstream to a pool or location of similar depth.

- Erosion control measures would be implemented as described in the CMR Plan. Erosion and sediment controls would be monitored daily during construction to ensure effectiveness, particularly after storm events, and only the most effective techniques would be utilized.

3.2.2.6 Determination

Effect on Critical Habitat. The project would have "no effect" on critical habitat for the Arkansas River shiner. No areas of federal designated critical habitat for Arkansas River shiner would be crossed by the project.

Effect on the Species. The project "may affect, but is not likely to adversely affect the Arkansas River shiner. This determination is based on Keystone's plan to HDD the Cimarron and Arkansas rivers, Keystone's CMR and Hydrostatic Test plans, and applicable protection measures that have been developed for this species. As a result no direct or indirect impacts would result from project construction.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of such an event would be unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a major river in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where Arkansas River shiners are present.

3.2.2.7 Literature Cited

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3.2.3 Neosho Madtom

3.2.3.1 Natural History and Habitat Association

The Neosho madtom (*Noturus placidus*) was listed as federally threatened on May 22, 1990 (55 FR 21148). This fish is a small member of the catfish family that resides within the Neosho, Cottonwood, and Spring rivers within the Arkansas River Basin. It formerly was found in the Illinois River as well. Threats to this species are primarily the result of impoundment construction, which inundates suitable habitat areas and renders river reaches downstream of the dam unsuitable as a result of cold water discharges (Wenke and Eberle 1991).

Removal of gravel bars also has resulted in the loss of Neosho madtom populations (Wenke and Eberle 1991).

Neosho madtom prefer stream riffles with gravel bottoms although smaller populations occasionally are found in other habitat types. They have been collected from areas with fine gravel or sand bottoms overlain with leaf litter and detritus as well as stream reaches with large stone or cobble bottoms (Wenke and Eberle 1991). They feed on a variety of aquatic insects, principally the larvae of caddisflies, mayflies, and dipterans. Egg development begins in March, but it is speculated that spawning typically takes place in June and July (Moss 1981), which usually coincides with peak streamflow.

3.2.3.2 Potential Presence in Project Area

The project crosses the Cottonwood River near the east end of Marion Reservoir. Neosho madtom has been found within the Cottonwood River but only as far upstream at its confluence near Middle Creek near Elmdale, Kansas in Chase County (55 FR 21148). This area is more than 20 miles downstream of the crossing of the Cottonwood River. No Neosho madtom fish were observed during surveys conducted at the Cottonwood River in summer 2007 (**Table 3-6**). No other rivers or streams crossed by the project are inhabited by Neosho madtom.

Table 3-6 Habitat and Occurrence Surveys for the Neosho Madtom Along the Keystone Cushing Extension in 2007

State	County	Survey Location[1]	Survey Date	Survey Results	Comments
Kansas	Marion	Cottonwood River	06/2007	No Neosho madtoms found.	Poor quality habitat for the Neosho madtom at crossing location.

[1]Habitat and fish surveys were conducted 100 meters upstream and 100 meters downstream of centerline.

Construction

Neosho madtom is known to occur in the Cottonwood River but considerably downstream of the project crossing of the river. According to Kansas Department of Wildlife and Parks (KDWP), if surveys determined habitat to be unsuitable at the Cottonwood River crossing, no seasonal restrictions or mitigation would apply. Based on the results of the habitat and occurrence surveys at the Cottonwood River in 2007, no impacts to this species would be anticipated from project construction.

Operations

Routine pipeline operations would not affect Neosho madtom.

In the unlikely event of a spill that would enter a river, exposure to crude could result in adverse toxicological effects to Neosho madtom. However, the probability of adverse effects to Neosho madtom are unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a waterbody in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where Neosho madtom individuals were present. Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact Neosho madtom (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.2.3.3 Cumulative Effects

No future state, local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.2.3.4 Mitigation

No mitigation measures are recommended for the Neosho madtom.

3.2.3.5 Determination

Effect on Critical Habitat. No areas of federal designated critical habitat have been identified for Neosho madtom. Therefore, the project would have "no effect" on critical habitat for the species.

Effect on the Species. The project "may affect, but is not likely to adversely affect" on the Neosho madtom. This determination is based on the location of known populations of this species relative to the crossing at the Cottonwood River and Keystone's CMR Plan that have been developed for the project. As a result no direct or indirect impacts would result from project construction.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of adverse effects to Neosho madtom are unlikely due to: 1) the low probability of a spill, 2) the low probability of the spill reaching a waterbody in sufficient amounts to cause toxic effects, and 3) low probability of a spill in a river reach where Neosho madtom individuals were present. Further, if a spill event were to occur, federal and state laws would require cleanup of a spill of sufficient size to potentially impact Neosho madtom.

3.2.3.6 Literature Cited

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3.2.4 Decurrent False Aster

3.2.4.1 Natural History and Habitat Association

Decurrent false aster (*Boltonia decurrens*) was listed as threatened on November 14, 1988 (53 FR 45858). It is a member of the Asteraceae (Sunflower) family. As a big river floodplain species, it is endemic to a 400 km stretch of floodplains of the Mississippi and Illinois Rivers (Smith and Keene 1998). Its historic range stretched 250 miles from LaSalle, Illinois, on the Illinois River to St. Louis, Missouri, on the Mississippi River (53 FR 45858). One historical record identified a population outside of this range, in Cape Giradeau County, Missouri, 120 miles south of St. Louis (Baskin and Baskin 2002; 53 FR 45858). This population has not been found again. With the conversion of floodplains to agriculture land and the drainage of wetlands, suitable habitat for the species decreased (Stoecker et al. 1995; 53 FR 45858). Eighteen extant populations occur in Illinois and two extant populations occur in Missouri (USFWS 1990). It was federally listed as threatened in 1988 (53 FR 45858).

Decurrent false aster prefers moist soils and open areas (MDC 2000; USFWS 1990). The species is dependent on regular disturbances such as periodic flooding to maintain these open areas and wet soils, as well as decrease competition from other species (MDC 2000; USFWS 1990). Open areas provide high light which seems to increase germination, plant growth and seed production (Smith and Moss 1998) in the species. Decurrent false aster has high flood-tolerance especially in comparison with competitors, which may provide it a competitive light advantage during early growth (Smith and Moss 1998; Stoecker et al. 1995). Historically, cyclical flooding, with floodwaters receding in the spring, occurred regularly in the historic range of the decurrent false aster (Smith and Moss 1998; Stoecker et al. 1995). Due to extensive levee systems and the conversion of floodplain to agriculture land, most of the floodplain areas no longer flood or are underwater for long periods of time (Smith and Moss 1988). Without disturbances such as flooding, decurrent false aster is

quickly overtaken by faster growing species that can over-shade it. Another possible cause in the decline of the decurrent false aster is increased siltation in the floodplains from the extensive levee systems and agriculture practices (USFWS 1990). Excessive silt can decrease seed germination (USFWS 1990).

With the decline in its natural habitats such as wet prairies, marshes, lakeshores and streambanks, the species is now most commonly found in human disturbed lowland areas, roadsides, bottomland field margins, moist–soil regions behind levees, alluvial soil habitats, and disturbed bottom-land lake shores (MDC 2004; Smith and Moss 1998).

3.2.4.2 Potential Presence in Project Area

As mentioned above, decurrent false aster historically was found in a 250-mile stretch of the Illinois and Mississippi rivers. It is still found in isolated populations in the floodplains, including the Mississippi River floodplain in Madison County, Illinois, and the Mississippi/Missouri River floodplain in St. Charles County. The most likely occurrence in the project area would be in the eastern half of St. Charles County, Missouri, in the Confluence State Park, where known populations of the aster occur (USFWS 2006). The species will most likely be found in seasonally flooded emergent wetlands, and disturbed alluvial soils in the floodplain. Surveys were conducted on September 19, 2007, for the decurrent false aster in the floodplain of the Mississippi River in Confluence State Park, St. Charles County, Missouri. Decurrent false aster was identified within the state park; however, no decurent false aster was identified within the ROW during the survey. Surveys for decurrent false aster would be conducted in the Mississippi River floodplain in St. Charles County, Missouri, and Madison County, Illinois, prior to construction.

3.2.4.3 Impact Evaluation

Construction

No decurrent false asters were found during surveys conducted within the ROW in 2007. If the decurrent false aster is found during preconstruction surveys, construction of the pipeline would disturb these plant communities as vegetation is cleared and graded. These activities could lead to the loss of decurrent false aster populations if they are present in the ROW. Construction of permanent ancillary facilities also could displace plant communities for the lifetime of the project; however, no permanent facilities would be built within wetlands. Revegetation of the pipeline could introduce or expand invasive species into the project area, which could compete with decurrent false aster and potentially contribute to its decline.

As discussed above in Chapter 2, electrical powerline providers, not Keystone, would be responsible for obtaining the necessary approvals or authorizations from federal, state, and local governments. The construction of new electrical powerline segments could impact the decurrent false aster if powerline ROWs were to disturb potential habitat for this species. Protection measures that could be implemented by electrical service providers to prevent impacts to this species would be the same as described below in Mitigation.

Operations

In order to maintain accessibility of the ROW, woody vegetation directly above the pipeline periodically would be cleared and large trees would be removed from the permanent ROW. Smaller trees and shrubs would be allowed to revegetate the permanent ROW, except for an approximately 30-foot-wide corridor that would be maintained. This ROW maintenance activity could potentially benefit decurrent false aster by preventing forest succession and maintaining open habitat needed for the species. Other maintenance activities of the ROW would include infrequent mowing, which also could benefit decurrent false aster as it would provide a source of disturbance. If herbicides must be used for noxious weed control, application would be conducted by spot spraying. Populations of decurrent false aster would be identified and no herbicides would be used at those locations.

Direct contact with a crude oil spill could result in adverse toxicological effects to decurrent false aster. While these exposure routes have the potential to cause adverse effects, the probability of adverse effects to decurrent false aster are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill

coinciding with the presence of decurrent false aster (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.2.4.4 Cumulative Impacts

No future state, or local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.2.4.5 Mitigation

Surveys for decurrent false aster were conducted in the Mississippi River floodplain in Confluence State Park, St Charles County, Missouri, in 2007. Surveys also would be conducted prior to construction within suitable habitat during the flowering period. If surveys identify decurrent false aster, Keystone would consult with the USFWS to determine appropriate mitigation measures. Mitigation measure for identified populations could include:

- Reducing the width of the construction ROW in areas where populations have been identified, to the extent possible.
- Salvaging and segregating topsoil appropriately where populations have been identified to preserve native seed sources in the soil for use in re-vegetation efforts in the ROW.
- Restoring habitat by using an approved seed mix provided by the NRCS or appropriate state agency.
- Collecting seed to repopulate the ROW or an appropriate offsite location, or for creation of a nursery population until viable natural populations have established themselves.
- Avoiding the population by rerouting around plants or boring under plants.
- Monitoring populations for 2 years after construction to identify and remove exotic weed, grass or legume species that could hinder the re-establishment of decurrent false aster.

Other recommended mitigation measures for populations of decurrent false aster would be developed on a site-specific basis in consultation with the USFWS, if warranted.

3.2.4.6 Determination

Effect on Critical Habitat. No critical habitat has been identified for this species. Therefore, the project would have “no effect” on critical habitat for the decurrent false aster.

Effect on Species. The project “may affect, but is not likely to adversely affect” the decurrent false aster. This determination is based on Keystone’s CMR plan and applicable protection measures that have been developed for this species. As a result no direct impacts would result from project construction. Indirect impacts could result from the incremental reduction of potential habitat for this species.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of adverse effects to decurrent false aster are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of decurrent false aster.

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3.2.5 Western Prairie Fringed Orchid

3.2.5.1 Natural History and Habitat Association

The western prairie fringed orchid (*Platanthera praeclara*) was listed as federally threatened on September 28, 1989 (54 FR 39857). This plant species is an erect, stout herbaceous perennial that occurred throughout the tallgrass prairies of south Canada and the central U.S. up to the Mississippi River (USFWS 1996; Sieg and King 1995). A 60 percent decline from documented historic levels is attributed to the conversion of much of the tallgrass prairie to agricultural land (USFWS 1996). Federally listed as threatened in 1989, western prairie fringed orchid is presently known to occur in six states (Iowa, Kansas, Minnesota, Missouri, Nebraska, and North Dakota) and Manitoba, Canada (USFWS 1996).The species appears to be extirpated from South Dakota and Oklahoma (U.S. Geological Survey [USGS] 2006; USFWS 1996). The majority of the populations are found in North Dakota and Minnesota, with only about 3 percent of the population being found in the southern part of the range (USFWS 1996).

Pollination seems to be dependent on a specific group of moths: hawkmoths (*Sphingidae*) (Phillips 2003; Sieg and King 1995; Sheviak and Bowles 1986). This relationship has been difficult to prove in research studies and the actual pollination of a western prairie fringed orchid by a hawkmoth has not been documented (Phillips 2003). The long nectar spur of western prairie fringed orchid, the longest of any orchid in North America, requires its pollinators to have long enough tongues and widely spaced eyes to allow them to harvest the pollen (Phillips 2003). Based on historic documents, hawkmoths that may be possible pollinators include *Eumorpha acemon*, *Hyles lineata*, *Sphinx drupiferatum*, *S. kalmiae*, *Catacola* sp., *ceratomia undulosa*, and *Hyles galli* (USFWS 1996). While western prairie fringed orchid are pollinator-specific, the hawksmoths have other nectar sources (Phillips 2003; USFWS 1996). It is theorized that a lack of pollinators or pollination activity could be contributing to observed low pollination rates of western prairie fringed orchid affecting the long-term survival of western prairie fringed orchid populations (Phillips 2003).

Even though periodic fires and bison grazing were common in the historic ranges of western prairie fringed orchid (Sieg and Bjugstad 1994), it is unclear the effect of these disturbances on the species (USGS 2006). Populations of western prairie fringed orchid vary dramatically between wet and dry years, with increases in

wet years, and decreases in dry years (Sieg and Wolken 1999). Western prairie fringed orchid prefers moist soils as soil moisture seems to be the most significant factor in the survival of individual orchids and the number of orchids flowering in a given year (USFWS 2007; Phillips 2003; Sieg 1997; Sieg and King 1995). The species is most commonly found in moist, undisturbed mesic to wet calcareous prairies, sedge meadows and mesic swales (Phillips 2003; Sieg 1997; USFWS 1996).

The spread of invasive species into the swales have had a negative effect on western prairie fringed orchid populations (Sieg 1997; USFWS 2007). These include leafy spurge (*Euphorbia esula*), Kentucky bluegrass (*Poa pratensis*), and Canada thistle (*Cirsium arvense*), which are outcompeting western prairie fringed orchid (Sieg 1997; USFWS 2007). Other threats to the long-term survival of western prairie fringed orchid include the use of herbicides, heavy grazing, early haying, habitat fragmentation, channelization, siltation, and road and bridge construction (Minnesota DNR 2007; USFWS 2006).

3.2.5.2 Potential Presence in Project Area

Western Prairie Fringed Orchid is found in North Dakota, South Dakota, Missouri, Nebraska, Kansas, and Oklahoma (NatureServe 2006). Known populations that maybe present in the project area occur in Seward and Stanton counties, Nebraska; and Ransom County in the Sheyenne National Grasslands, North Dakota (USFWS 2006). The population in Sheyenne National Grasslands is the largest in the U.S. Populations in South Dakota are possibly extirpated (NatureServe 2006), but since erratic flowering patterns and long dormancies make it difficult to detect populations (Phillips 2003), the species could still be present (USFWS 2006). Surveys were conducted along the project in North Dakota, South Dakota, and Nebraska in 2006 and 2007 to determine areas of suitable habitat for the species. A rare plant survey was conducted for the species at locations within the ROW identified as suitable habitat between June 29 and July 3, 2007. Increased precipitation and flooding in the project area during the spring and summer of 2007 diminished the likelihood of western prairie fringe orchid being dormant during the survey. No western prairie fringed orchids were located during the survey (**Table 3-7**).

Table 3-7 Habitat and Occurrence Surveys for the Western Prairie Fringed Orchid Along the Keystone Mainline in 2007

State	County	Start MP	End MP	Survey Date	Survey Results
South Dakota	Day	258.26	258.43	06/2007	No WPFO observed.
South Dakota	Clark	278.03	278.86	06/2007	No WPFO observed.
South Dakota	Clark	279.39	280.03	06/2007	No WPFO observed.
South Dakota	McCook	385.34	385.85	06/2007	No WPFO observed.
South Dakota	Hutchinson	392.12	392.97	06/2007	No WPFO observed.
South Dakota	Yankton	422.3	422.75	07/2007	No WPFO observed.
South Dakota	Yankton	423.78	424.01	07/2007	No WPFO observed.
Nebraska	Cedar	439.86	440.17	07/2007	No WPFO observed.
Nebraska	Stanton	505.79	506.88	07/2007	No WPFO observed.
Nebraska	Colfax	542.88	543.3	07/2007	No WPFO observed.
Nebraska	Jefferson	637.13	638.90	07/2007	No WPFO observed.
Nebraska	Jefferson	639.11	640.41	07/2007	No WPFO observed.

WPFO = western prairie fringed orchid.

3.2.5.3 Impact Evaluation

Construction

No individuals or populations of western prairie fringed orchid were found during surveys in 2007. If the western prairie fringed orchid is found during preconstruction surveys, construction of the pipeline would disturb these plant communities as vegetation is cleared and graded. Construction of permanent ancillary facilities also could displace plant communities for the lifetime of the project. Revegetation of the pipeline could introduce or expand invasive species, especially leafy spurge, Kentucky bluegrass and Canada thistle into the project area, potentially contributing to the decline of western prairie fringed orchid.

As discussed above in Chapter 2, electrical powerline providers, not Keystone, would be responsible for obtaining the necessary approvals or authorizations from federal, state, and local governments. The construction of new electrical powerline segments could impact the western prairie fringed orchid if powerline ROWs were to disturb potential habitat for this species. Protection measures that could be implemented by electrical service providers to prevent impacts to this species would be the same as described below in Mitigation.

Water depletion impacts on the western prairie fringed orchid from hydrostatic testing could include a temporary incremental reduction of potential habitat in the lower Platte River Basin due to changes in downstream water flow. The USFWS defines “depletion” as consumptive loss plus evaporative loss of surface or groundwater within the affected basin.

However, because Keystone plans on returning water back to its source within a 30-day period, the USFWS would consider the temporary water reduction as insignificant. As a result, indirect impacts from hydrostatic testing on the western prairie fringed orchid would be negligible. The Hydrostatic Test Plan for the project is provided in **Appendix D**.

Operations

Operation of the project would not result in permanent impacts to the western prairie fringed orchid. Clearing of trees/shrubs in the ROW would be required for operational monitoring, but since this species inhabits open, native prairie, no tree or shrub clearing would occur within suitable habitat. If herbicides must be used for noxious weed control, application would be conducted by spot spraying. Populations of western prairie fringed orchid would be identified and no herbicides would be used at those locations.

Direct contact with a crude oil spill could result in adverse toxicological effects to western prairie fringed orchid. While these exposure routes have the potential to cause adverse effects, the probability of adverse effects to western prairie fringed orchid are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of western prairie fringed orchid (see **Appendix E**, Environmental Fate and Risk Associated with Crude Oil, for further information regarding impacts to wildlife from a potential spill event).

3.2.5.4 Cumulative Impacts

No future state, or local, or private actions that are reasonably certain to occur in the project area have been identified for the project.

3.2.5.5 Mitigation

Based on the results of the 2007 habitat and occurrence surveys for this species, construction activities would be permitted within potentially suitable habitat prior to the flowering period. If construction activities were to occur during the flowering period, preconstruction surveys would be conducted within suitable habitat. If surveys identify the western prairie fringed orchid, Keystone would consult with the USFWS to determine appropriate mitigation measures. Mitigation measure for identified populations could include:

- Reducing the width of the construction ROW in areas where populations have been identified, to the extent possible.
- Salvaging and segregating topsoil appropriately where populations have been identified to preserve native seed sources in the soil for use in re-vegetation efforts in the ROW.
- Restoring habitat by using an approved seed mix provided by the NRCS or appropriate state agency.
- Collecting seed to repopulate the ROW or an appropriate offsite location, or for creation of a nursery population until viable natural populations have established themselves.
- Avoiding the population by rerouting around plants or boring under plants.
- Monitoring populations for 2 years after construction to identify and remove exotic weed, grass or legume species that could hinder the re-establishment of western prairie fringed orchid.

Other recommended mitigation measures for populations of western prairie fringed orchid would be developed on a site-specific basis in consultation with the USFWS, if warranted.

3.2.5.6 Determination

Effect on Critical Habitat. No critical habitat has been identified for this species. Therefore, the project would have "no effect" on critical habitat for the western prairie fringed orchid.

Effect on Species. The project "may affect, but is not likely to adversely affect" the western prairie fringed orchid. This determination is based on Keystone's CMR plan and applicable protection measures that have been developed for this species. As a result no direct impacts would result from project construction. Indirect impacts could result from the incremental reduction of potential habitat for this species.

The project would have no effect on the western prairie fringed orchid from water depletion issues resulting from hydrostatic testing. This finding is based on Keystone's commitment to return the hydrostatic test water to its source within a 30-day period.

Although it is possible that a spill event could result in an adverse affect on this species, the probability of adverse effects to western prairie fringed orchid are unlikely due to: 1) the low probability of a spill and 2) the low probability of the spill coinciding with the presence of western prairie fringed orchid.

3.2.5.7 Literature Cited

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Appendix A

Figures

Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Major Rivers
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

N E S W

0 25 50 100 Miles

0 25 50 100 Kilometers

Keystone Pipeline Project

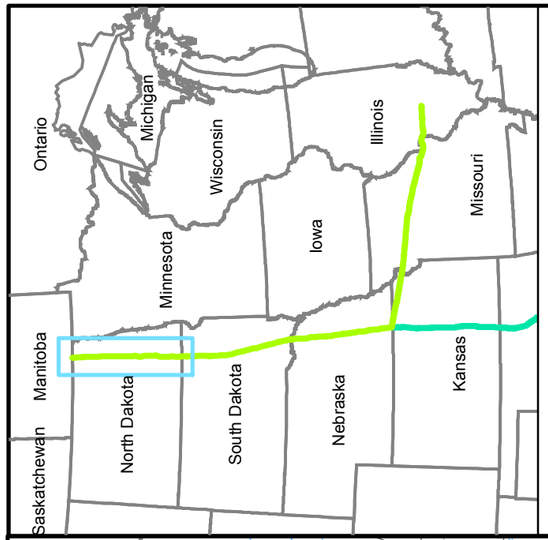
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Figure A-1

Project Overview

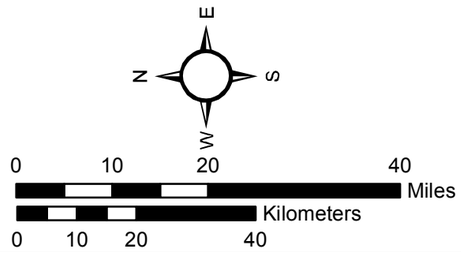
Canada
United States
Manitoba
North Dakota
Minnesota
South Dakota
Iowa
Nebraska
Kansas
Missouri
Oklahoma
Arkansas
Illinois
Red River of the North
Mississippi R.
Missouri R.
Platte R.
Arkansas R.
Canadian R.
Illinois R.
Minneapolis-St. Paul
Des Moines
Omaha
Lincoln
St. Louis
Kansas City
Wichita
Tulsa
Oklahoma City
Patoka Terminal
Wood River Terminal
Salisbury Terminal
Cushing Terminal
29
35
44
70
80
90
94
135
335
55

07/14/2006



Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Rivers and Streams
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

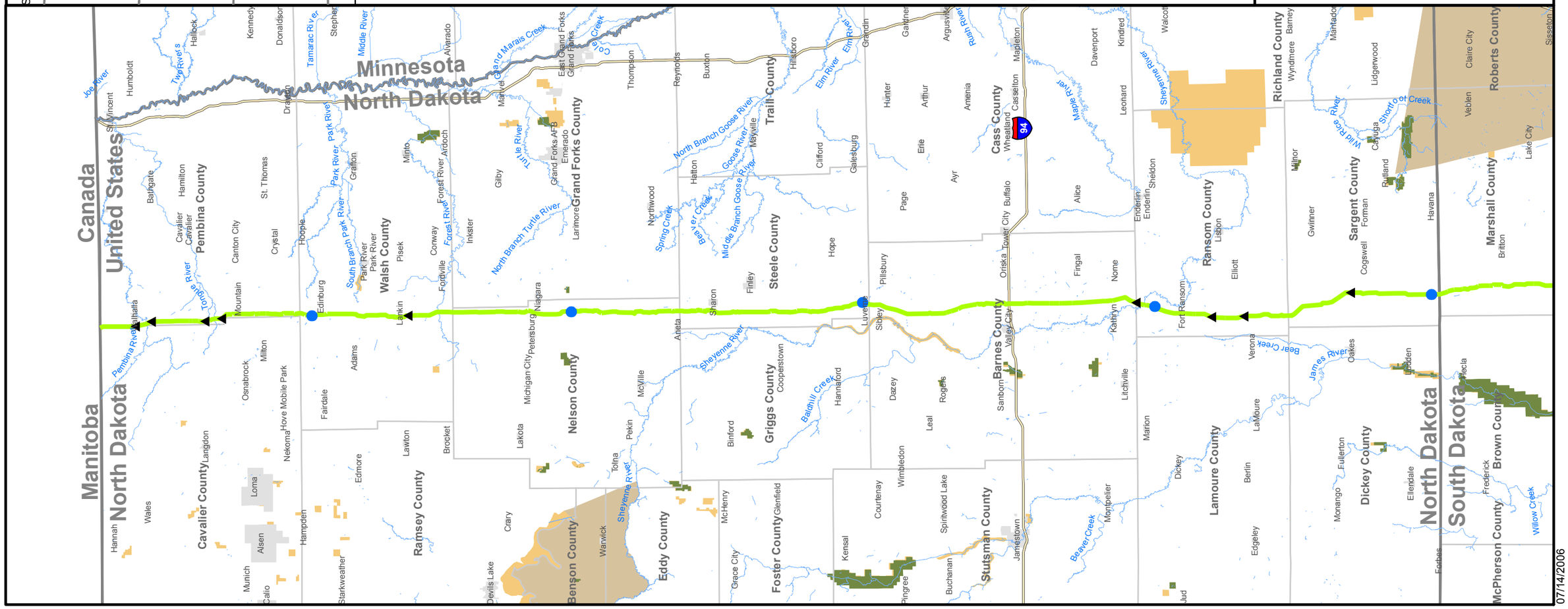


Keystone Pipeline Project

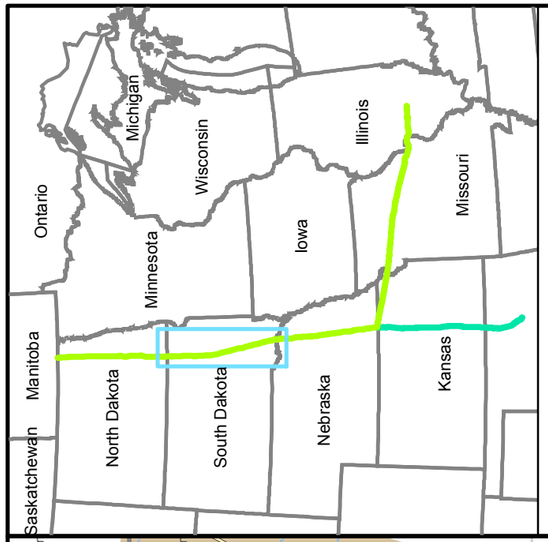
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Figure A-2

Project Overview
(North Dakota)



07/14/2006



Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Rivers and Streams
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

N E S W

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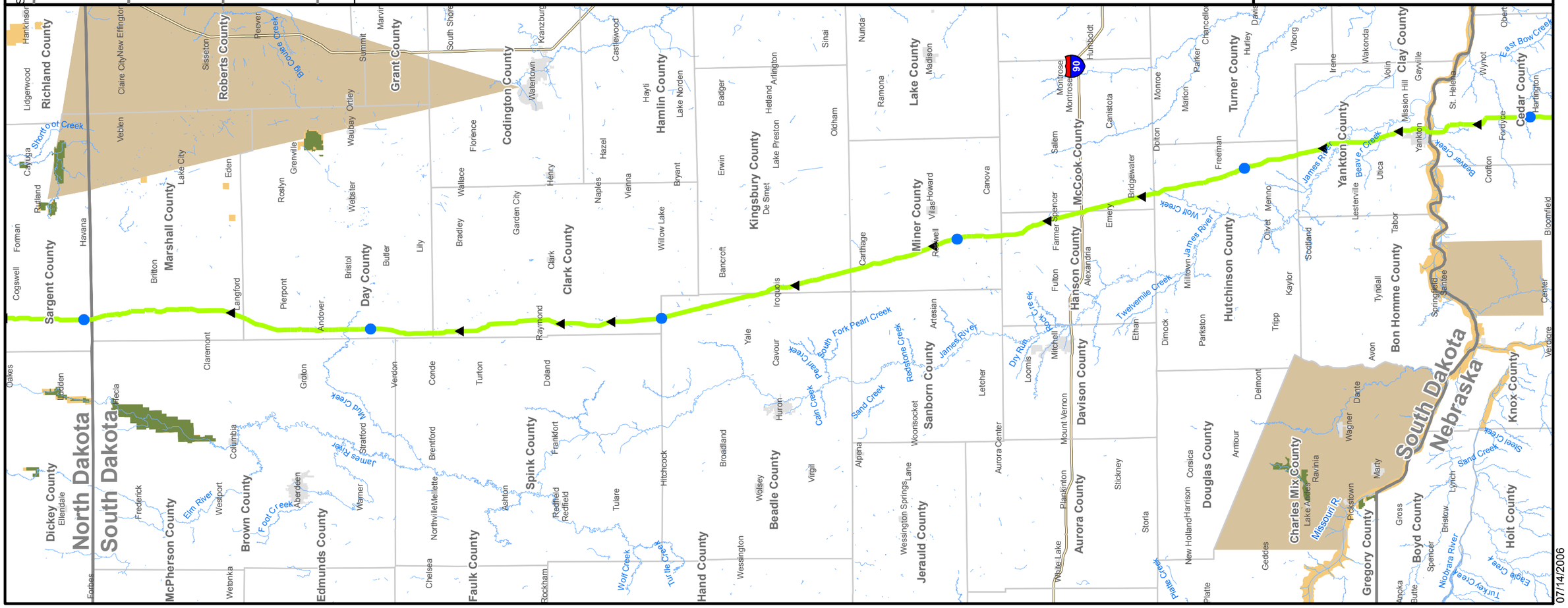
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Keystone Pipeline Project

TransCanada
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Figure A-3

Project Overview
(South Dakota)



Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Rivers and Streams
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

N E S W

0 10 20 40 Miles

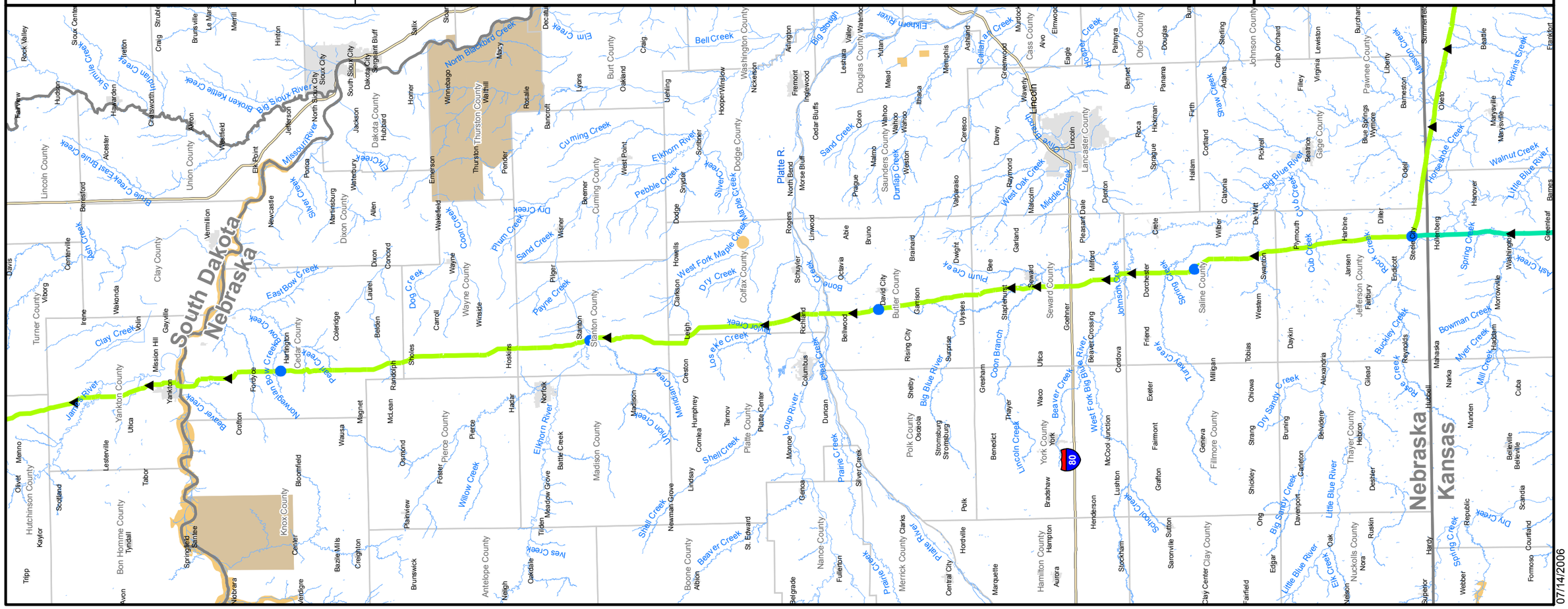
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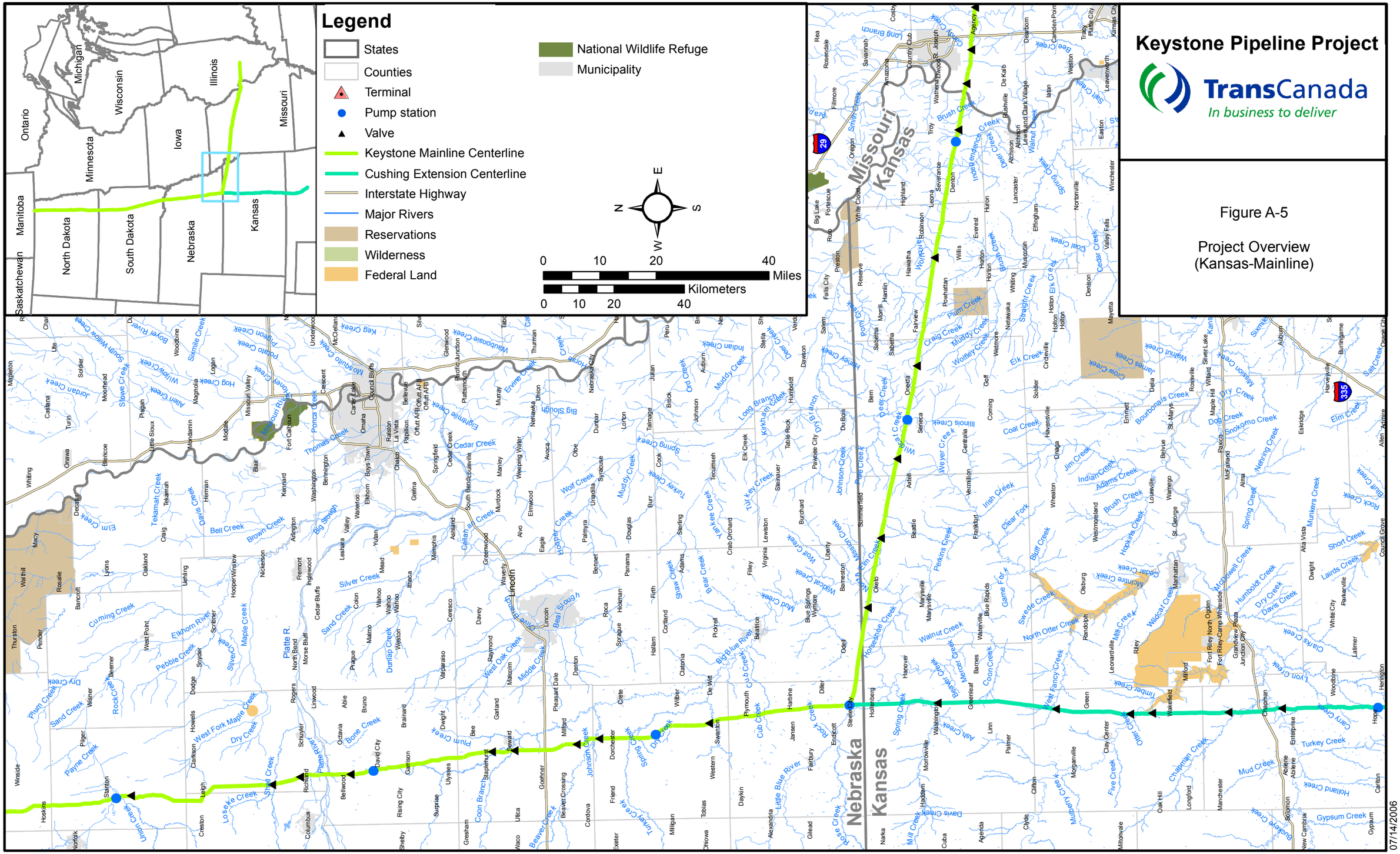
Keystone Pipeline Project

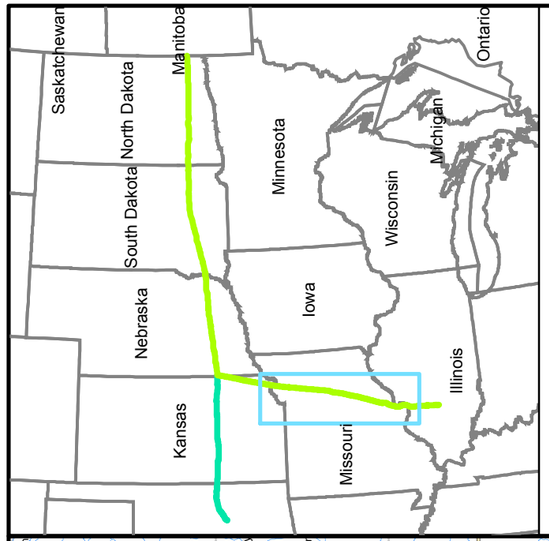
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Figure A-4

Project Overview
(Nebraska)


South Dakota
Nebraska
Kansas
Missouri River
Big Sioux River
James River
Platte R.
Elkhorn River
Loup River
Big Blue River
Little Blue River
Beaver Creek
Lincoln
Yankton
Hartington
Stanton
David City
Seward
Milford
Crete
Steele City
Sioux City
Dakota City
Norfolk
Columbus
Schuyler
Fremont
Omaha
Lincoln
Beatrice
Fairbury
Hebron
Clay Center
Hastings
Grand Island
Kearney
Central City
Aurora
York
Wahoo
Ashland
Plattsmouth
Nebraska City
Falls City
Tecumseh
Auburn
Peru
Brownville
Rulo
Superior
Franklin
Red Cloud
Blue Hill
Superior
Nelson
Guide Rock
Webster
Republic
Belleville
Scandia
Courtland
Formoso
Munden
Marysville
Hanover
Greenleaf
Bancroft
Wisner
Pilger
Beemer
Dixon
Laurel
Wayne
Winside
Carroll
Coleridge
Belden
Randolph
Hoskins
Creighton
Niobrara
Verdigre
Bloomfield
Wausa
Magnet
Osmond
Pierce
Plainview
Foster
Battle Creek
Madison
Norfolk
Meadow Grove
Tilden
Oakdale
Newman Grove
Lindsay
Cornlea
Humphrey
Creston
Leigh
Howells
Clarkson
Dodge
Snyder
Wakefield
Emerson
Thurston
Walthill
Winnebago
Macy
Rosalie
Decatur
Lyons
Oakland
Craig
Uehling
Hooper
Winslow
Nickerson
Washington County
Douglas County
Sarpy County
Cass County
Otoe County
Johnson County
Pawnee County
Gage County
Jefferson County
Thayer County
Nuckolls County
Clay County
Fillmore County
Saline County
Seward County
York County
Polk County
Hamilton County
Merrick County
Nance County
Boone County
Platte County
Madison County
Antelope County
Knox County
Cedar County
Dakota County
Dixon County
Wayne County
Colfax County
Butler County
Saunders County
Dodge County
Lancaster


Legend
States
Counties
Terminal
Pump station
Valve
Keystone Mainline Centerline
Cushing Extension Centerline
Interstate Highway
Major Rivers
Reservations
Wilderness
Federal Land
National Wildlife Refuge
Municipality
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Ontario
Manitoba
Saskatchewan
Minnesota
North Dakota
South Dakota
Iowa
Nebraska
Kansas
Missouri
Illinois
Wisconsin
Michigan
Missouri
Kansas
Nebraska
Kansas
Lincoln
Omaha
Keystone Pipeline Project
TransCanada
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Figure A-5
Project Overview
(Kansas-Mainline)
07/14/2006



Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Rivers and Streams
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

Please note change in map orientation for Missouri and Illinois

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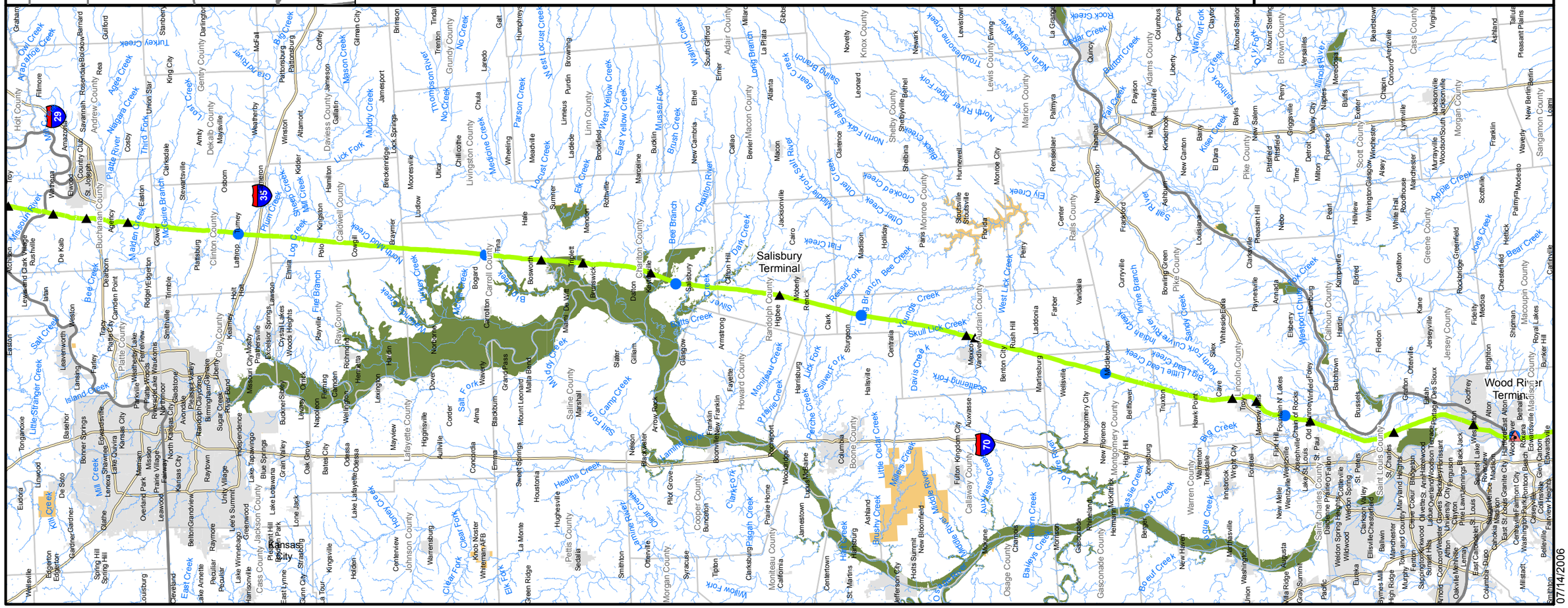
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Keystone Pipeline Project

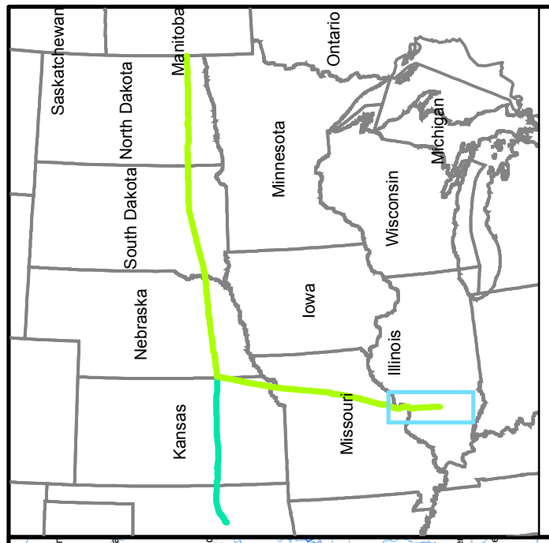
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Figure A-6

Project Overview
(Missouri)



07/14/2006



Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Rivers and Streams
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

Please note change in map orientation for Illiinois and Missouri

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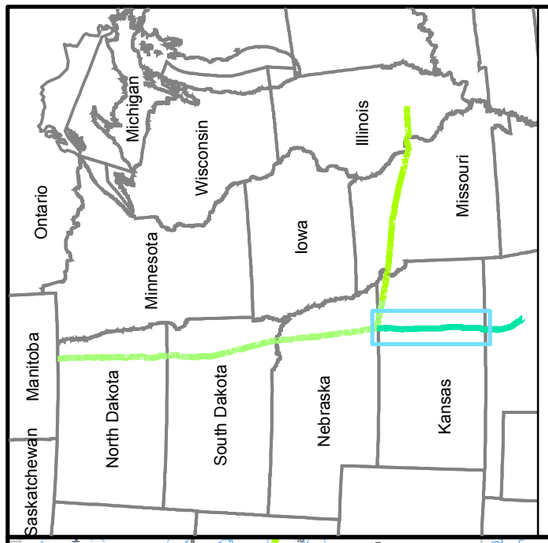
Keystone Pipeline Project

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Figure A-7

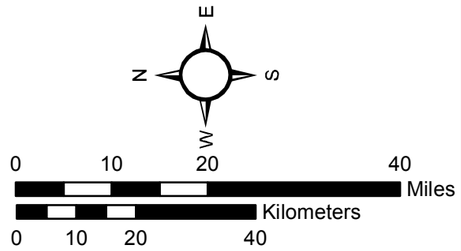
Project Overview
(Illinois)

Wood River Terminal
Patoka Terminal
St. Louis
Pike County
Greene County
Calhoun County
Jersey County
Macoupin County
Montgomery County
Fayette County
Effingham County
Crawford County
Lincoln County
Warren County
Saint Charles County
Saint Louis County
Madison County
Bond County
Clay County
Richland County
Lawrence County
Clinton County
Marion County
Jasper County
Franklin County
Jefferson County
Washington County
Perry County
Wayne County
Edwards County
Wabash County
White County
Hamilton County
Coles County
Cumberland County
Clark County
Shelby County
Morgan County
Scott County
Illinois River
Mississippi River
Wabash River
Big Muddy River
Kaskaskia River
Little Wabash River
Embarras River
Lost Creek
Ramsey Creek
Bear Creek
Shoal Creek
Beaver Creek
Flat Creek
Big Creek
Little Creek
Hurricane Creek
Sugar Creek
Wolf Creek
Becks Creek
Mitchell Creek
Robinson Creek
Drake Creek
Green Creek
Brush Creek
Fox River
Sugar Creek
Little Bonpas Creek
Fordice Creek
Elm River
Willow Creek
McNally Branch
Turkey Run
Mill Creek
Muddy Creek
Wet Weather Creek
Humanity Creek
Bishop Creek
Ramsey Creek
Lucas Creek
Brushy Creek
Carter Creek
Hurricane Creek
Sugar Creek
Prairie Creek
Big Creek
Little Muddy Creek
Big Muddy Creek
Wet Weather



Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Rivers and Streams
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

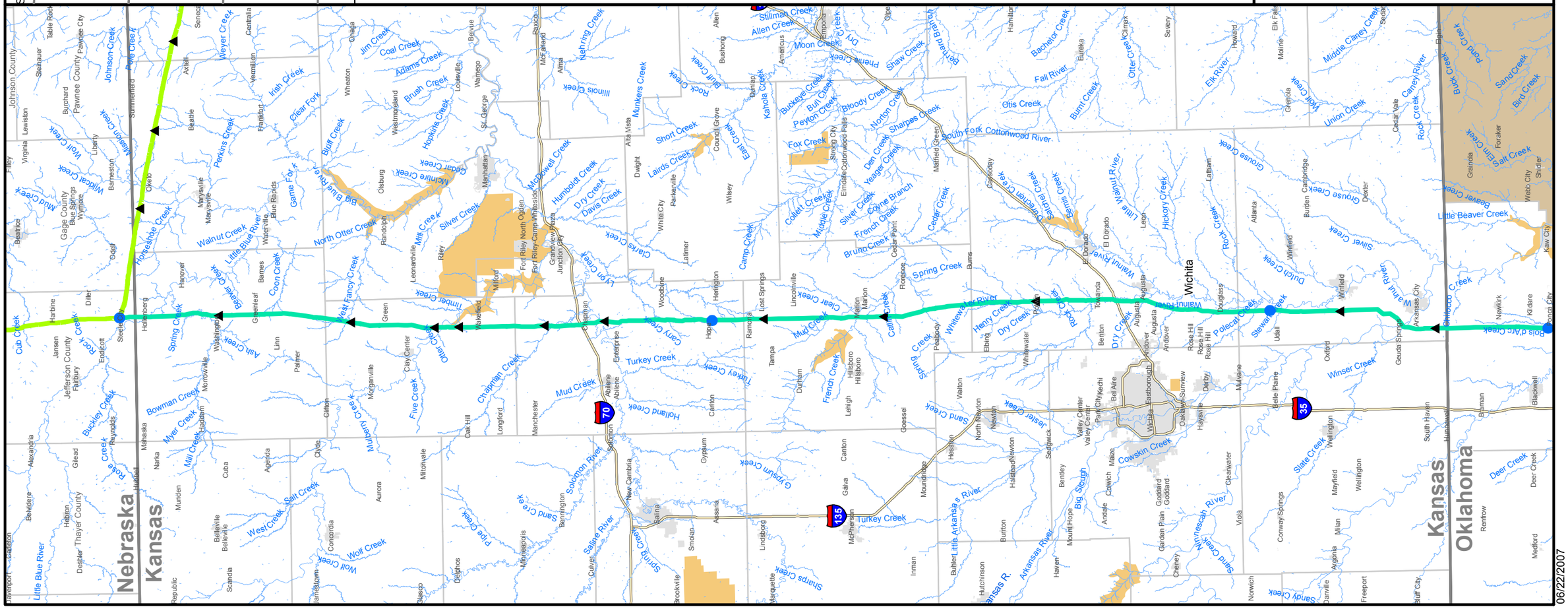


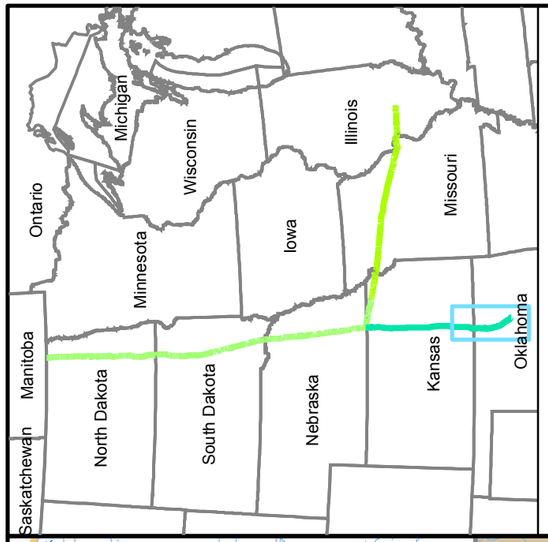
Keystone Pipeline Project

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Figure A-8

Project Overview
(Kansas - Cushing Extension)


Nebraska
Kansas
Oklahoma
Wichita
Keystone Mainline
Cushing Extension
Johnson County
Pawnee County
Gage County
Jefferson County
Thayer County
Harbine
Steele City
Beatrice
Fairbury
Hebron
Deshler
Belvidere
Alexandria
Hastings
Holstein
Glenvil
Clay Center
Geneva
Fairfield
Carleton
Davenport
Republic
Scandia
Concordia
Jamestown
Clyde
Aurora
Munden
Cuba
Agenda
Narka
Mahaska
Reynolds
Milton
Linn
Palmer
Morganville
Clifton
Green
Enterprise
Abilene
Chapman
Manchester
Oak Hill
Longford
Carlton
Solomon
New Cambria
Bennington
Salina
Gypsum
Assaria
Smolan
Brookville
Culver
Minneapolis
Delphos
Sterling
Lyons
Little Blue River
Rose Creek
Buckley Creek
Spring Creek
Cub Creek
Rock Creek
Ash Creek
Beaver Creek
Coon Creek
Game Fork
Blue Rapids
Marysville
Waterville
Randolph
Leonardville
Riley
Milford
Fort Riley North
Fort Riley
Camp Whiteside
Grandview Plaza
Junction City
Ogden
Manhattan
Olsburg
Wakefield
Clifton
Clay Center
Morganville
Milton
Longford
Oak Hill
Carlton
Gypsum
New Cambria
Bennington
Salina
Assaria
Smolan
Brookville
Culver
Minneapolis
Delphos
Lindsborg
Marquette
Galva
McPherson
Inman
Hutchinson
Burton
Haven
Mount Hope
Andale
Bentley
Sedgwick
Halstead
Newton
North Newton
Hesston
Moundridge
Goessel
Whitewater
Elbing
Peabody
Florence
Marion
Hillsboro
Lehigh
Canton
Galva
Durham
Tampa
Ramona
Lost Springs
Hope
Herington
Woodbine
Lincolnville
Latimer
Parkerville
White City
Wilsey
Dwight
Alta Vista
Council Grove
Dunlap
Bushong
Allen
Olpe
Americus
Emporia
Elmdale
Strong City
Cottonwood Falls
Matfield Green
Gladdy
Yeager
Elmdale
Cedar Point
Burns
Latham
Atlanta
Leon
El Dorado
Augusta
Andover
Rose Hill
Towanda
Benton
Douglass
Winfield
Arkansas City
Newkirk
Kildare
Ponca City
Udall
Stewart
Polecat Creek
Dry Creek
Whitewater
Henry Creek
Spring Creek
Turkey Creek
Mud Creek
Holland Creek
Chapman Creek
Five Creek
Otter Creek
Timber Creek
Walnut River
Little Walnut River
Hickory Creek
Rock Creek
Dutch Creek
Silver Creek
Grouse Creek
Beaver Creek
Little Beaver Creek
Bois d'Arc Creek
Winfield
Geuda Springs
Oxford
Winser Creek
Slate Creek
Deer Creek
Cowskin Creek
Big Slough
Arkansas River
Little Arkansas River
Ninnescah River
Sand Creek
Sandy Creek
Wellington
Mayfield
Milan
Argonia
Danville
Freeport
Conway Springs
Viola
Clearwater
Goddard
Garden Plain
Cheney
Maize
Colwich
Derby
Mulvane
Belle Plaine
Wellington
South Haven
Hunnewell
Blackwell
Braman
Ponca City
Kaw City
Webb City
Shidler
Grainola
Foraker
Burbank
Pawhuska
Elgin
Bird Creek
Sand Creek
Elm Creek
Salt Creek
Union Creek
Middle Caney Creek
Caney River
Cedar Vale
Elk River
Elk Falls
Howard
Severy
Otis Creek
Fall River
Eureka
Bachelor Creek
Burnt Creek
Moon Creek
Pipe Creek
Shaw Creek
Bloody Creek
Norton Creek
Sharpes Creek
Peyton Creek
Buckeye Creek
Kahola Creek
Munkers Creek
Short Creek
Lairds Creek
Illinois Creek
Rock Creek
Stillman Creek
Allen Creek
Dry Creek
Bachelor Creek
Fox Creek
Den Creek
Yeager Creek
Middle Creek
Colliat Creek
Bruno Creek
French Creek
Coyne Branch
Cedar Creek
Camp Creek
Humboldt Creek
Dry Creek
Davis Creek
Silver Creek
Mill Creek
Timber Creek
Walnut Creek
Little Blue River
North Otter Creek
Horseshoe Creek
West Fancy Creek
Big Blue River
Cedar Creek
Wilder Creek
Mud Creek
Barneston
Liberty
Virginia
Lewiston
Burchard
Pawnee City
Table Rock
Steinauer
Johnson Creek
Pete Creek
Wolf Creek
Weyer Creek
Centralia
Seneca
Axtell
Summerfield
Vermillion
Irish Creek
Clear Fork
Frankfort
Onaga
Wheaton
Jim Creek
Coal Creek
Adams Creek
Brush Creek
Westmoreland
Louisville
Wamego
St. George
Belvue
Paxico
McFarland
Alma
Nehring Creek
Illinois Creek
Rock Creek
Blue Creek
Bushong
Allen
Americus
Olpe
Hamilton
Severy
Howard
Elk Falls
Moline
Grenola
Elgin
Burbank
Pawhuska
Bird Creek
Sand Creek
Elm Creek
Salt Creek
Union Creek
Middle Caney Creek
Caney River
Cedar Vale
Rock Creek
Elk River



Legend

- States
- Counties
- Terminal
- Pump station
- Valve
- Keystone Mainline Centerline
- Cushing Extension Centerline
- Interstate Highway
- Rivers and Streams
- Reservations
- Wilderness
- Federal Land
- National Wildlife Refuge
- Municipality

N E S W

0 10 20 40 Miles

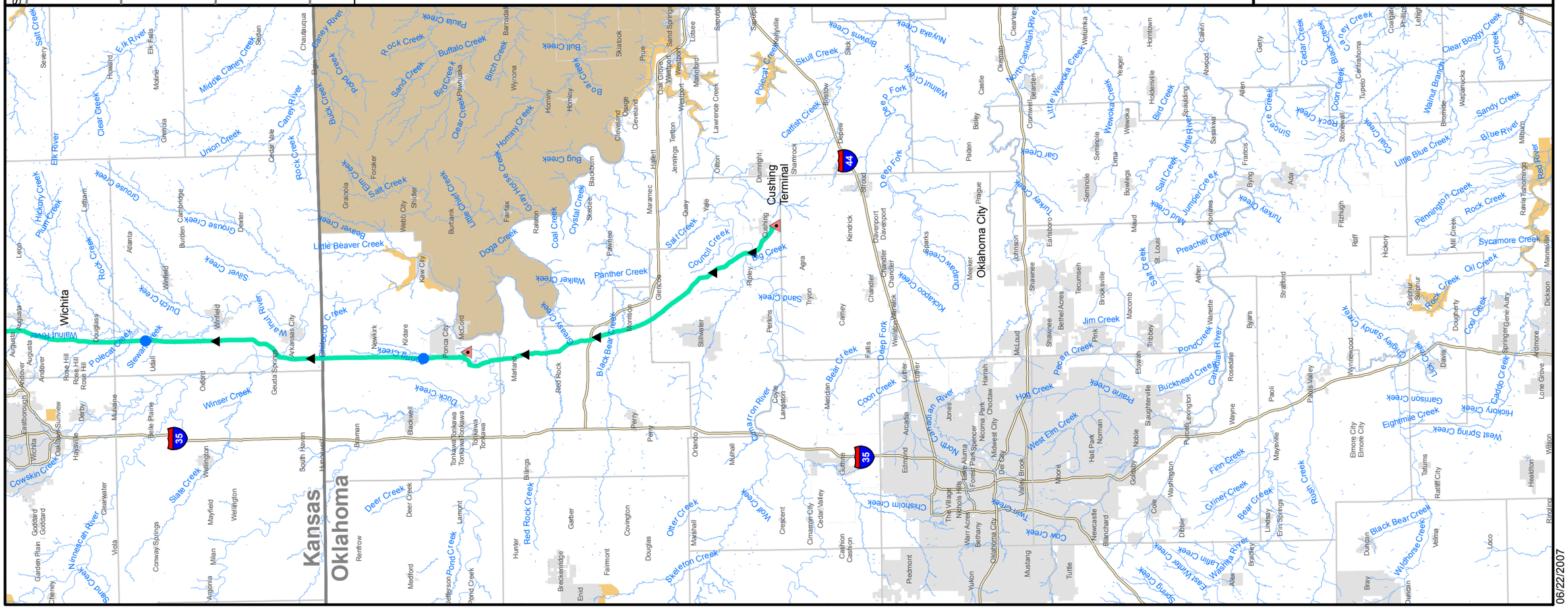
0 10 20 40 Kilometers

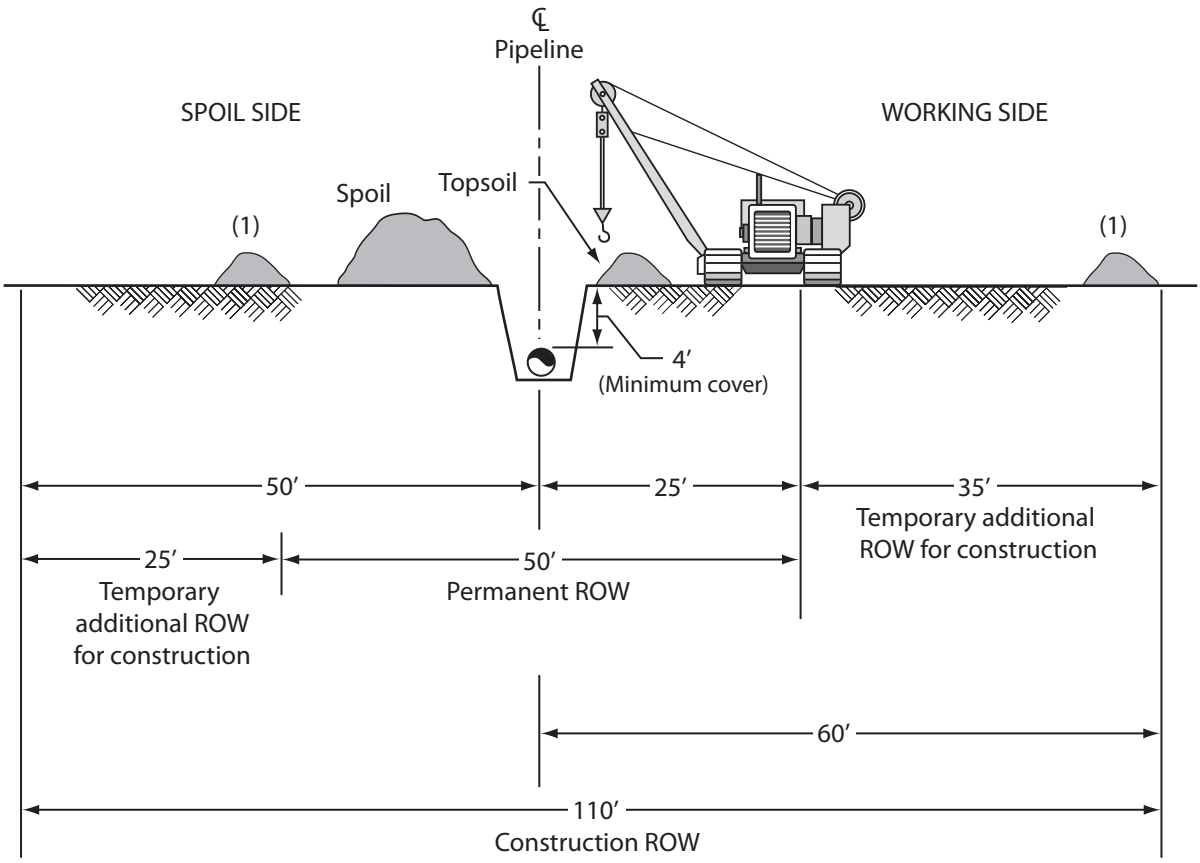
Keystone Pipeline Project

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Figure A-9

Project Overview
(Oklahoma - Cushing Extension)

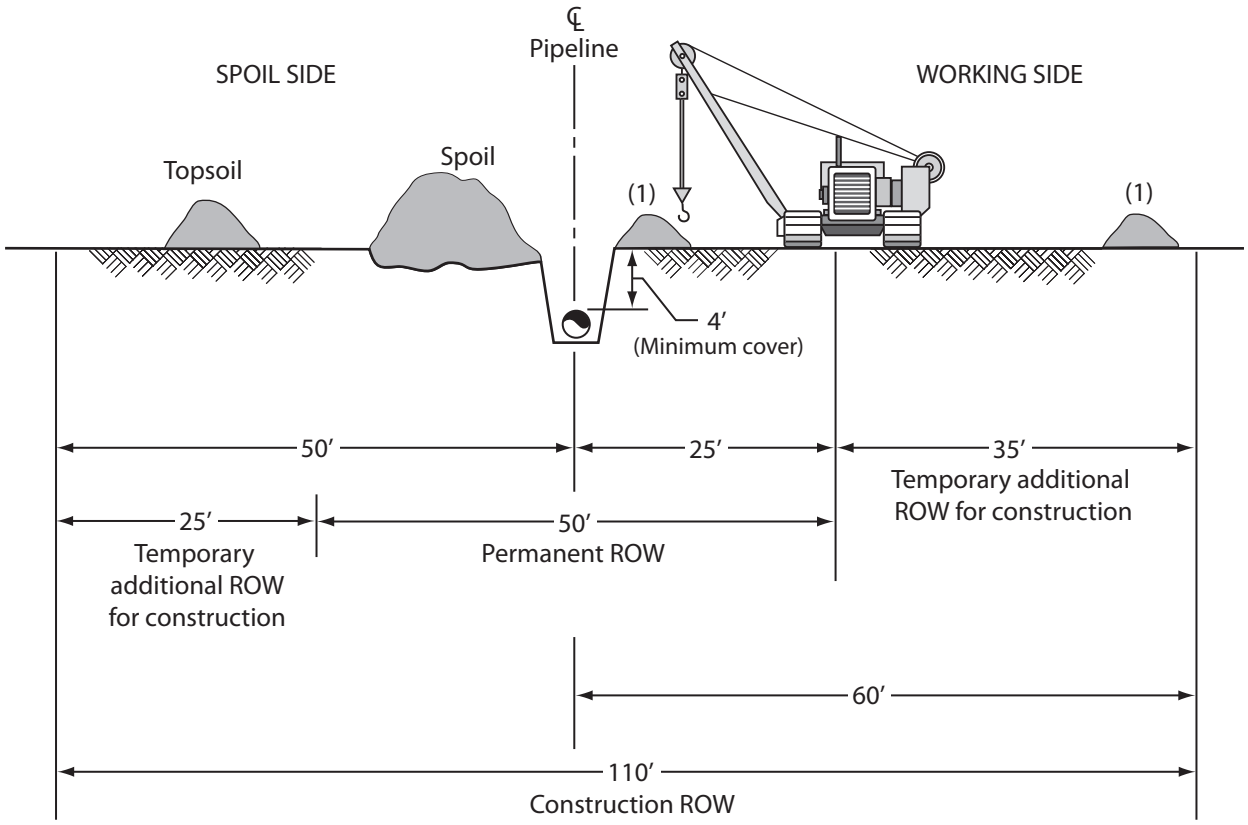

Cushing Terminal
Oklahoma City
Wichita
Kansas
Oklahoma
Salt Creek
Elk River
Middle Caney Creek
Caney River
Clear Creek
Union Creek
Rock Creek
Paula Creek
Buffalo Creek
Sand Creek
Bird Creek
Birch Creek
Bull Creek
Hominy Creek
Bois d'Arc Creek
Buy Creek
Gray Horse Creek
Little Caney Creek
Big Salt Creek
Beaver Creek
Little Beaver Creek
Doga Creek
Coal Creek
Crystal Creek
Panther Creek
Walker Creek
Salt Creek
Council Creek
Big Creek
Sand Creek
Kickapoo Creek
Quapaw Creek
Deep Fork
Skull Creek
Polecat Creek
Catfish Creek
Walnut Creek
Brown Creek
Nuyaka Creek
Little Wewoka Creek
Wewoka Creek
North Canadian River
Turkey Creek
Jumper Creek
Mud Creek
Preacher Creek
Jim Creek
Pecan Creek
Hog Creek
Prairie Creek
Buckhead Creek
Pond Creek
Coon Creek
Meridian Bear Creek
Black Bear Creek
Red Rock
Red Rock Creek
Deer Creek
Otter Creek
Work Creek
Skeleton Creek
Chisholm Creek
Twin Creek
Cow Creek
West Elm Creek
Cimarron River
North Canadian River
Walnut River
Polecat Creek
Stewart Creek
Winser Creek
Duck Creek
Dutch Creek
Silver Creek
Grouse Creek
Hickory Creek
Plum Creek
Rock Creek
Latham
Atlanta
Burden
Carmichael
Dexter
Winfield
Augusta
Andover
Rose Hill
Douglass
Udall
Oxford
Arkansas City
Geuda Springs
Newkirk
Kildare
Ponca City
McCord
Marland
Perry
Orlando
Mulhall
Guthrie
Edmond
Arcadia
Langston
Coyle
Stillwater
Glencoe
Pawnee
Yale
Quay
Cashion
Kingfisher
Hennessey
Kingfisher Creek
Turkey Creek
Uncle John Creek
Cottonwood Creek
Salt Fork Arkansas River
Chikaskia River
Slate Creek
Cowskin Creek
Oaklawn-Sunview
Derby
Haysville
Mulvane
Belle Plaine
Blackwell
Tonkawa
Ponca
Ponca Creek
Pond Creek
Lamont
Medford
Jefferson
Renfrow
Billings
Hunter
Garber
Covington
Douglas
Marshall
Crescent
Cimarron City
Cedar Valley
Fairmont
Enid
Breckenridge
Cashion
Piedmont
Yukon
Mustang
Tuttle
Newcastle
Blanchard
Dibble
Cole
Washington
Goldsby
Noble
Slaughterville
Lexington
Purcell
Norman
Moore
Del City
Valley Brook
Midwest City
Choctaw
Harrah
Jones
Luther
Edmond
Arcadia
Guthrie
Crescent
Cimarron City
Cedar Valley
Fairmont
Douglas
Marshall
Covington
Garber
Hunter
Billings



(1) Alternate topsoil placement locations

KEYSTONE PIPELINE PROJECT

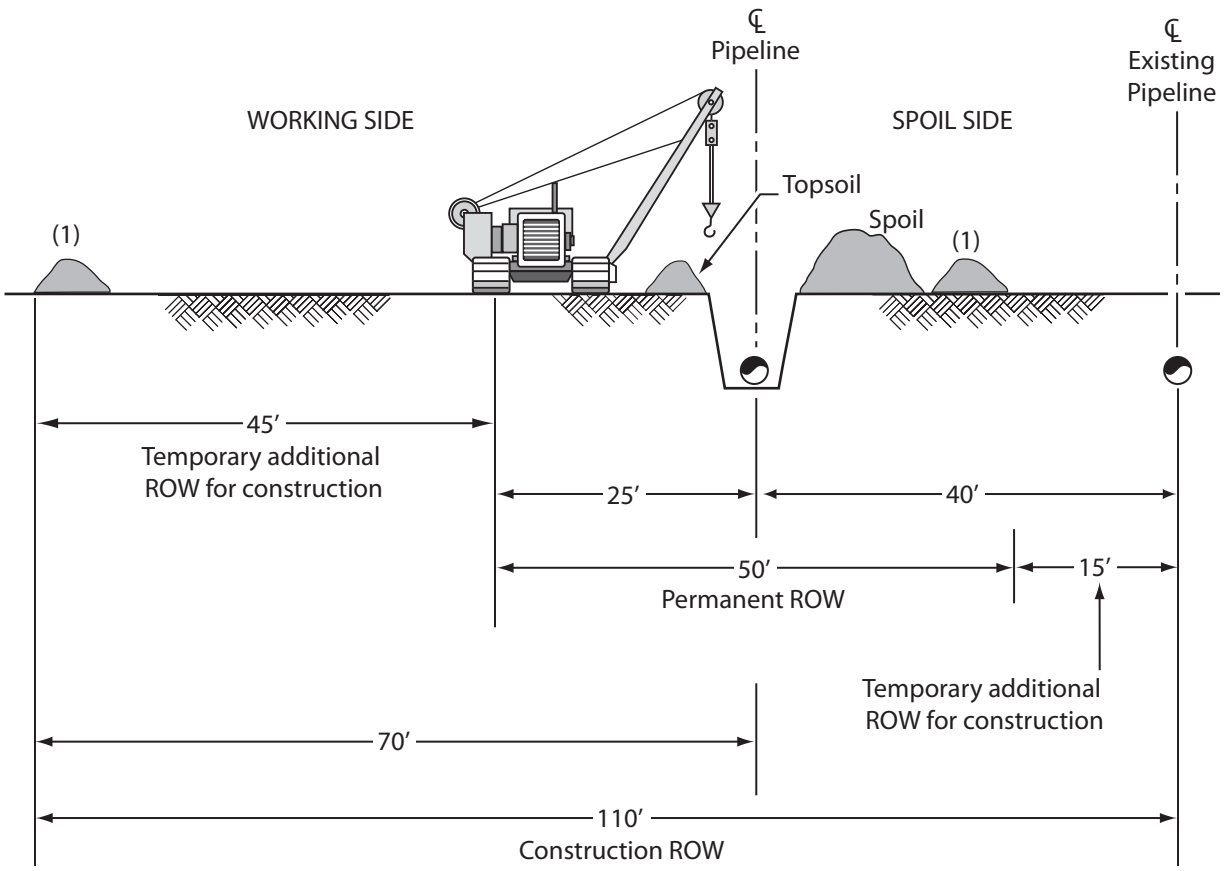
Figure A-10
Typical 110′ Construction Right-of-Way
(30- or 36-inch Pipeline)
with Topsoil Removal Only over Trench Line



(1) Alternate topsoil placment locations

KEYSTONE PIPELINE PROJECT

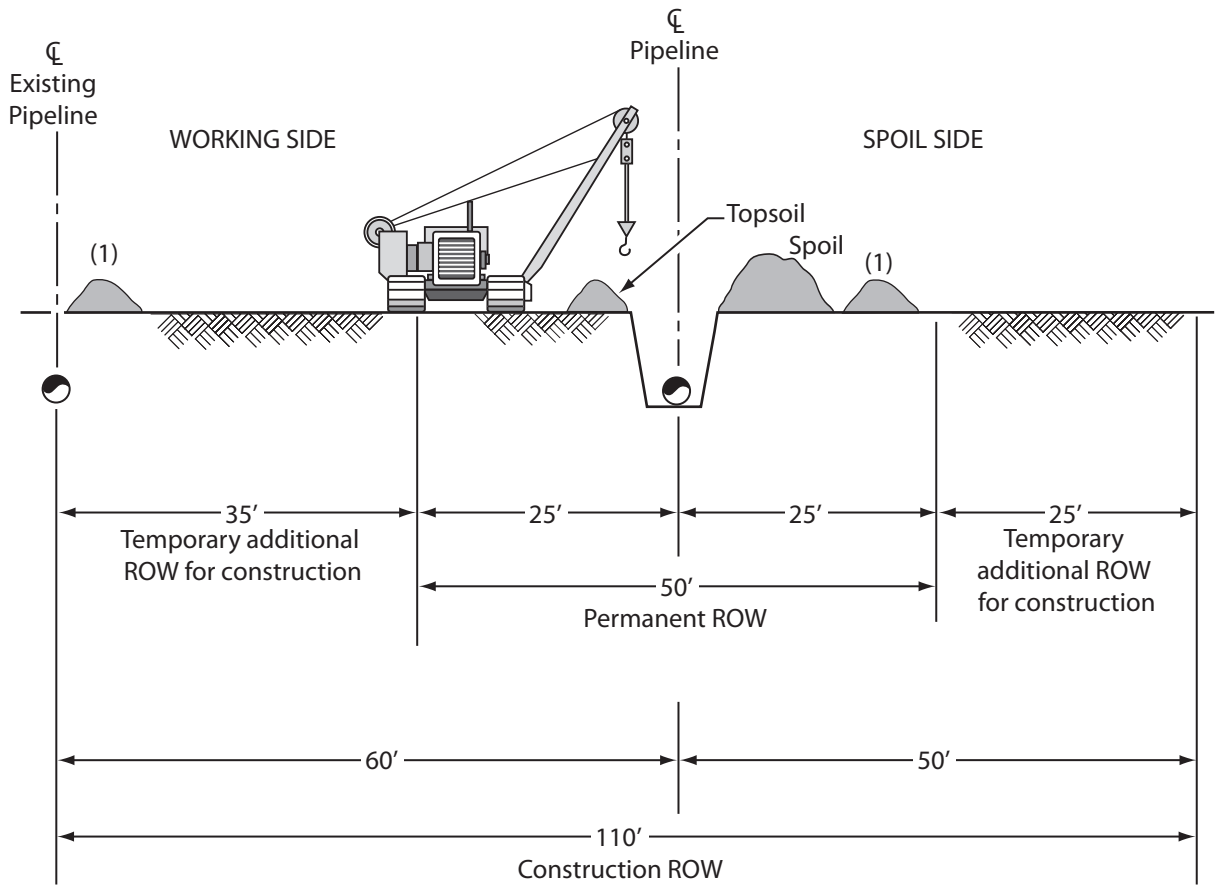
Figure A-11
Typical 110′ Construction Right-of-Way
(30- or 36-inch Pipeline)
with Topsoil Removal over Trench Line and Spoil Side



(1) Alternate topsoil placement locations

KEYSTONE PIPELINE PROJECT

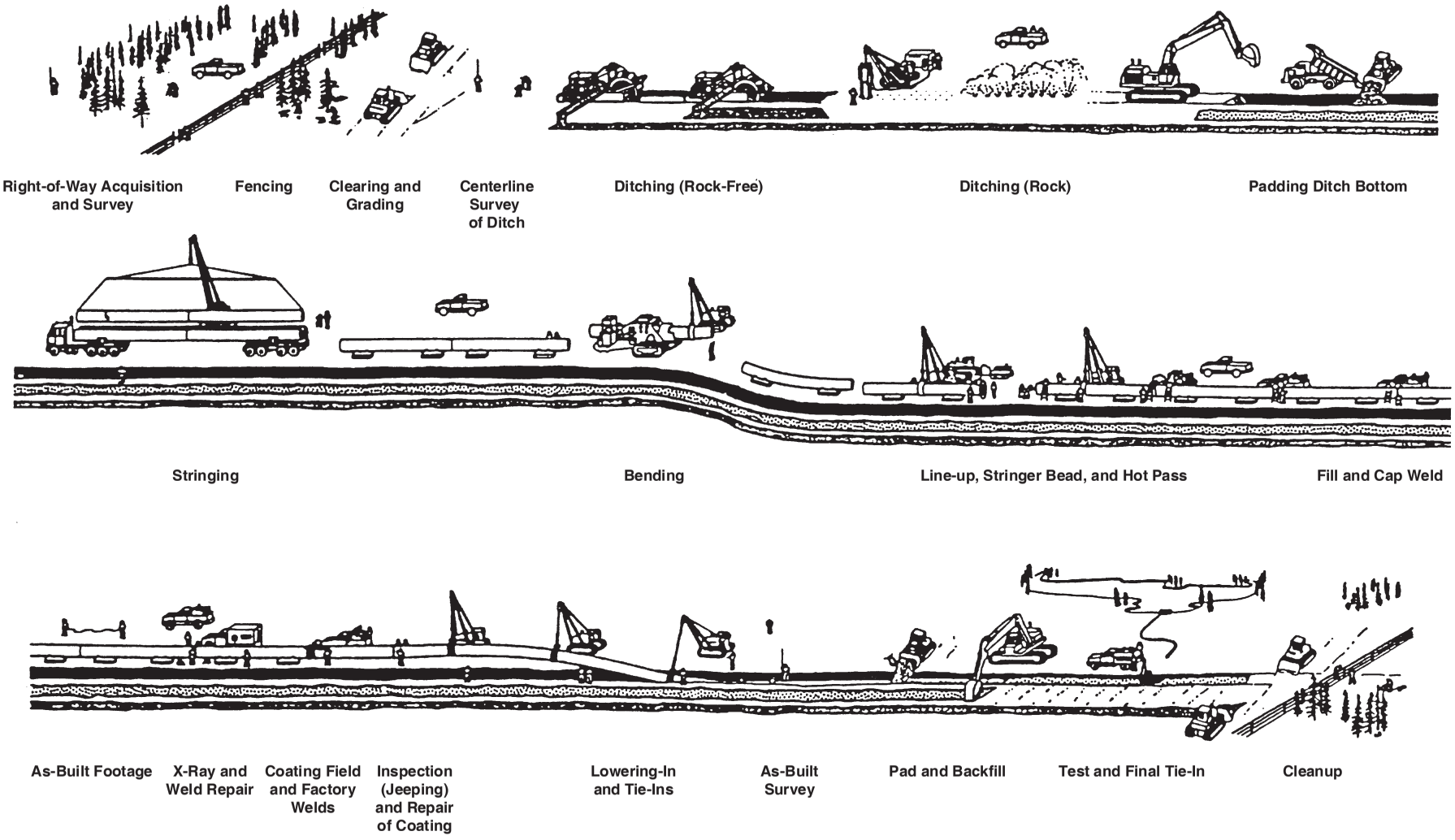
Figure A-12
Typical 110′ Construction
Right-of-Way
(30- or 36-inch Pipeline)
- Spoil Side Adjacent and
Parallel to Existing Pipeline



(1) Alternate topsoil placement locations

KEYSTONE PIPELINE PROJECT

Figure A-13
Typical 110′ Construction
Right-of-Way
(30- or 36-inch Pipeline)
- Working Side Adjacent and
Parallel to Existing Pipeline

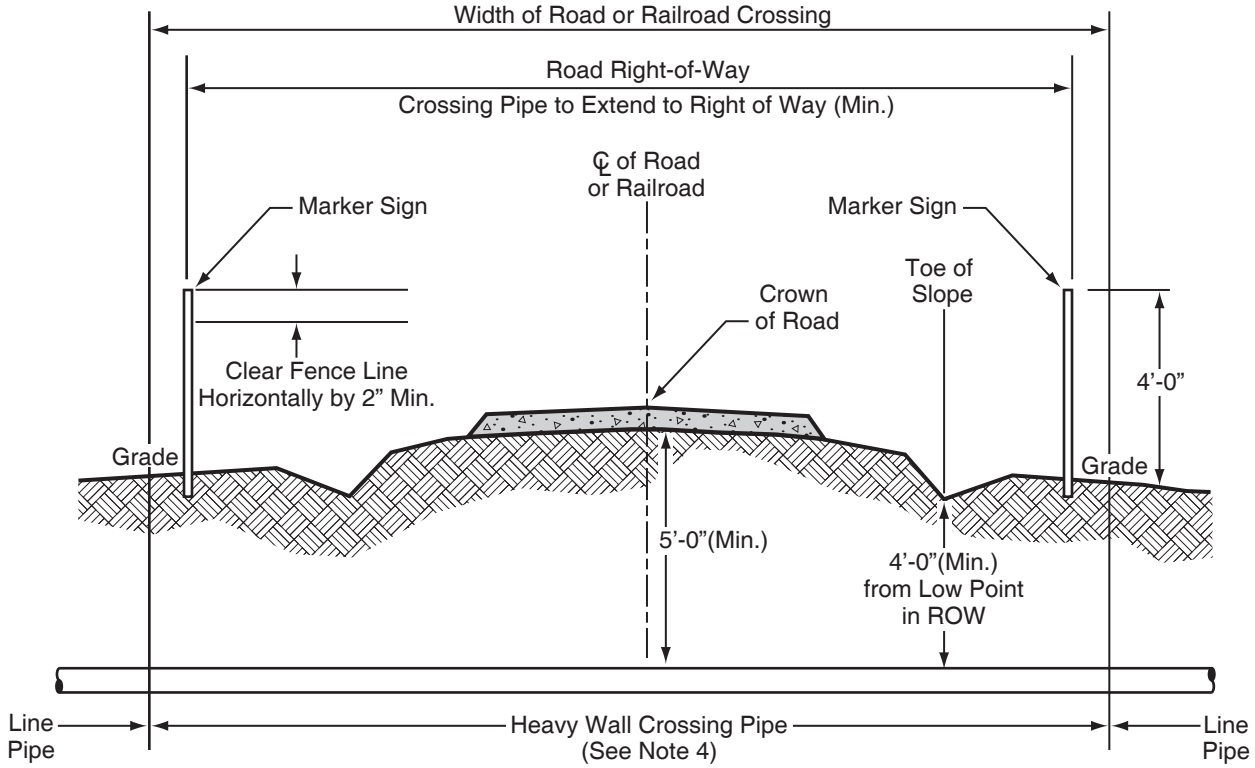


Not to Scale

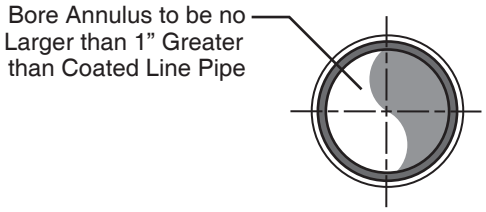
KEYSTONE PIPELINE PROJECT

Figure A-14

Typical Pipeline Construction Sequence



TYPICAL UNCASED ROAD CROSSING - BORED

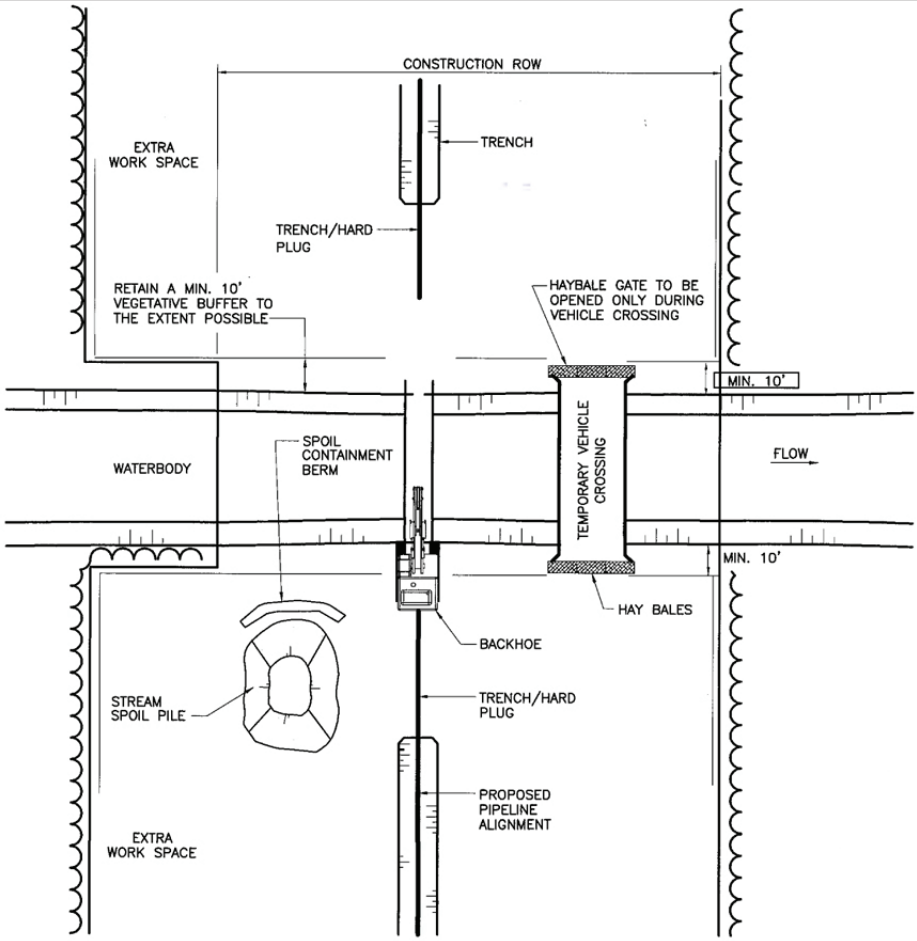


Notes:

1. Crossings shall be in accordance with applicable permit.
2. Road crossing pipe shall extend at minimum to right-of-way line.
3. The type and minimum required length of pipe for crossings of roads shall be as specified on alignment sheets.
4. Pipe for bored crossings to include abrasion-resistant (ARB) coating.
5. Pipeline marker and test stations to be installed on ROW line next to fence if possible.
6. The crossing pipe shall be straight with no vertical or horizontal bends within the road right-of-way.

KEYSTONE PIPELINE PROJECT

Figure A-15
Typical Uncased
Road or Railroad
Crossing - Bored



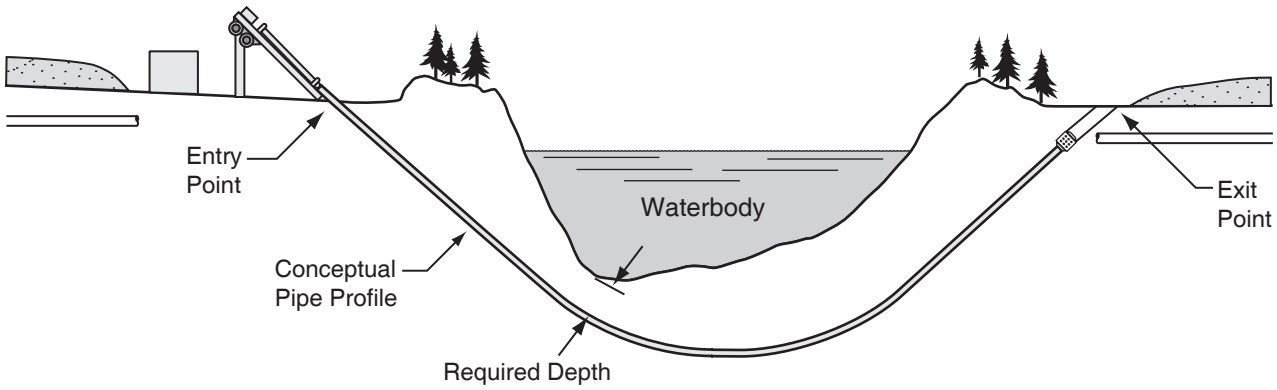
PLAN VIEW

CONSTRUCTION PROCEDURES:

1. RIGHT-OF-WAY BOUNDARIES AND WORK SPACE LIMITS SHALL BE CLEARLY DELINEATED. STAGING FOR MAKEUP SHALL BE LOCATED A MINIMUM OF 10 FEET FROM WATERBODY.
2. CLEARING LIMITS WILL BE CLEARLY DELINEATED AND A 10 FOOT VEGETATIVE BUFFER STRIP BETWEEN DISTURBED AREA AND THE WATERBODY SHALL BE MAINTAINED TO THE EXTENT POSSIBLE. ALL CLEARING SHALL BE MINIMIZED TO THE EXTENT POSSIBLE AND TO ONLY THAT NECESSARY FOR CONSTRUCTION. WOODY VEGETATION SHALL BE CUT AT GROUND LEVEL AND THE STUMPS/ROOTS LEFT IN PLACE TO THE EXTENT POSSIBLE.
3. TOPSOIL SHALL BE STRIPPED FROM THE DITCH LINE IN ALL WETLANDS RIPARIAN.
4. CONTRACTOR SHALL INSTALL SIGNS APPROXIMATELY 100 FEET MINIMUM FROM EACH WATERBODY AND WETLAND TO IDENTIFY THE HAZARDOUS MATERIALS EXCLUSION AREA.
5. EROSION AND SEDIMENT CONTROL
   A. CONTRACTOR SHALL SUPPLY, INSTALL AND MAINTAIN SEDIMENT CONTROL STRUCTURES, AS DEPICTED OR ALONG DOWN GRADIENT SIDES OF WORK AREAS AND STAGING AREAS SUCH THAT NO HEAVILY SILT LADEN WATER ENTERS WATERBODY OR WETLAND.
   B. NO HEAVILY SILT LADEN WATER SHALL BE DISCHARGED DIRECTLY OR INDIRECTLY INTO THE WATERBODY. ALL EROSION AND SEDIMENT CONTROL STRUCTURE LOCATIONS AS DEPICTED ARE APPROXIMATE AND MAY BE ADJUSTED AS DIRECTED BY THE COMPANY INSPECTOR TO SUIT ACTUAL SITE CONDITIONS. SILT FENCE OR STRAW BALE INSTALLATIONS SHALL INCLUDE REMOVABLE SECTIONS TO FACILITATE ACCESS DURING CONSTRUCTION.
   C. SEDIMENT LADEN WATER FROM TRENCH DEWATERING SHALL BE DISCHARGED TO A WELL VEGETATED UPLAND AREA, INTO A STRAW BALE DEWATERING STRUCTURE OR GEOTEXTILE FILTER BAG. SEDIMENT CONTROL STRUCTURES MUST BE IN PLACE AT ALL TIMES ACROSS THE DISTURBED CONSTRUCTION RIGHT OF WAY EXCEPT DURING EXCAVATION/INSTALLATION OF THE CROSSING PIPE.
   D. SOFT DITCH PLUGS MUST REMAIN IN PLACE AT CONVENIENT LOCATIONS TO SEPARATE MAINLINE DITCH FROM THE WATERBODY CROSSING UNTIL THE WATER CROSSING IS INSTALLED AND BACKFILLED.
   E. TRENCH BREAKERS ARE TO BE INSTALLED AT THE SAME SPACING AND IMMEDIATELY UPSLOPE OF PERMANENT SLOPE BREAKERS, OR AS DIRECTED BY THE COMPANY.
6. CONTRACTOR SHALL MAINTAIN HARD PLUGS IN THE DITCH AT THE WATERBODY UNTIL JUST PRIOR TO PIPE INSTALLATION. CONTRACTOR SHALL EXCAVATE TRENCH AND INSTALL PIPE AS EXPEDIENTLY AS PRACTICAL TO REDUCE THE DURATION OF WORK ACTIVITIES IN THE WATERBODY BED.
7. CONTRACTOR SHALL PLACE TRENCH SPOIL ONLY IN CERTIFICATED WORK SPACE AND A MINIMUM OF 10 FEET FROM THE WATERBODY BANKS TO PREVENT ENTRY OF SPOIL INTO THE WATERBODY. SPOIL SHALL BE CONTAINED AS NECESSARY USING EITHER A STRAW BALE BARRIER OR AN EARTH/ROCK BERM.
8. CONTRACTOR SHALL RESTORE THE WATERBODY AND BANKS TO APPROXIMATE PRECONSTRUCTION CONTOURS, UNLESS OTHERWISE APPROVED BY THE COMPANY. CONTRACTOR SHALL INSTALL PERMANENT EROSION AND SEDIMENT CONTROL STRUCTURES AS INDICATED. ANY MATERIALS PLACED IN THE WATERBODY TO FACILITATE CONSTRUCTION SHALL BE REMOVED DURING RESTORATION. BANKS SHALL BE STABILIZED AND TEMPORARY SEDIMENT BARRIERS INSTALLED AS SOON AS POSSIBLE AFTER CROSSING, BUT WITHIN 24 HOURS OF COMPLETING THE CROSSING. MAINTAIN A SILT FENCE OR STRAW BALE BARRIER ALONG THE WATERBODY AND WETLAND BOUNDARIES UNTIL VEGETATION IS ESTABLISHED IN ADJACENT DISTURBED AREAS.
9. VEHICLE CROSSING CAN BE CONSTRUCTED USING EITHER A FLUME CROSSING OR A TEMPORARY BRIDGE. VEHICLE CROSSING ONLY REQUIRED IF STREAM SUPPORTS A STATE DESIGNATED FISHERY.

KEYSTONE PIPELINE PROJECT

Figure A-16
Typical Waterbody Crossing
Open Cut Trench



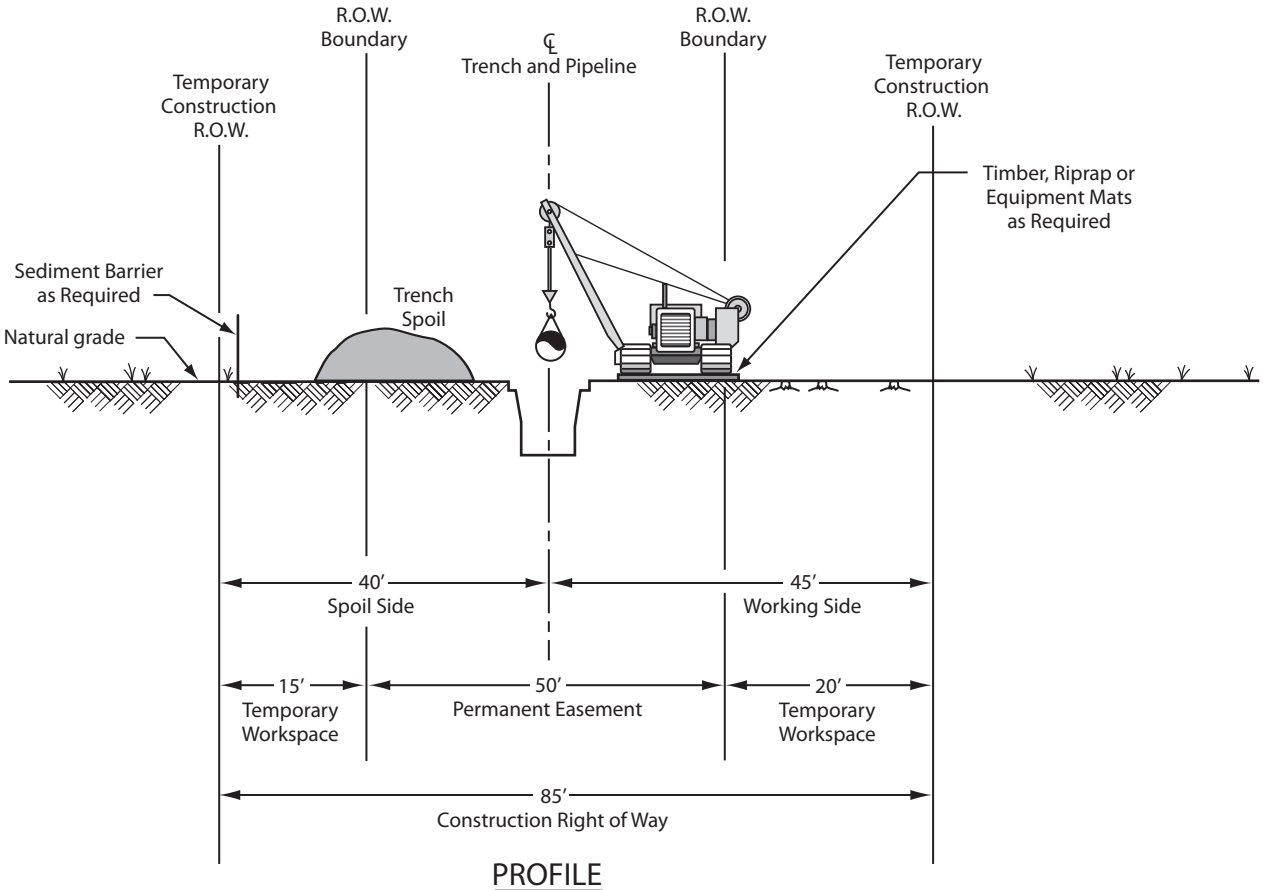
PROFILE

Notes:

1. Set up drilling equipment a minimum of 100 feet from the edge of the watercourse. Limit clearing between drill entry and exit point to brush clearing of a 10-foot wide strip as necessary to monitor drilling activities and obtain water for hydrostatic testing and drilling mud.
2. Ensure that only bentonite-based drilling mud is used.
3. Install suitable drilling mud tanks or sumps to prevent contamination of watercourse.
4. Install berms downslope from the drill entry and anticipated exit points to contain any release of drilling mud.
5. Dispose of drilling mud in accordance with the appropriate regulatory authority requirements.

KEYSTONE PIPELINE PROJECT

Figure A-17
Waterbody Crossing
Typical Horizontal
Directional Drill



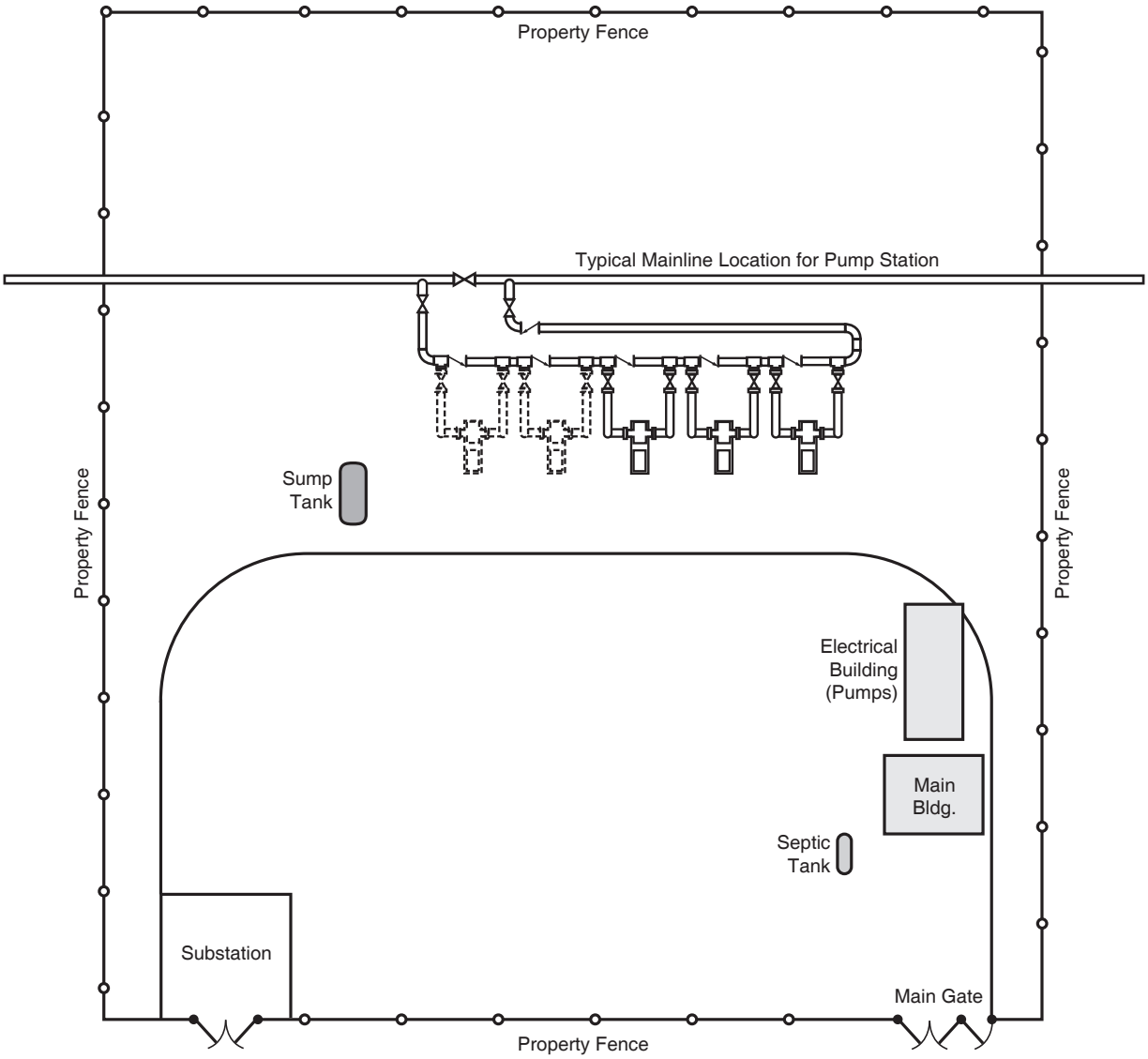
PROFILE

Notes:

1. Flag wetland boundaries prior to clearing.
2. No refueling of mobile equipment is allowed within 100 feet of wetland. Place "No Fueling" sign posts 100 feet back from wetland boundary. Refuel stationary equipment as per Keystone's spill prevention procedures.
3. Install temporary slope breaker upslope within 100 feet of wetland boundary if directed by Keystone.
4. Install timber mats/riprap through entire wetland area. Equipment necessary for right-of-way clearing may make one (1) pass through the wetland before mats are installed.
5. Aviod adjacent wetlands. Install sediment barriers (straw bales and/or silt fence) at downslope edge of right-of-way and along wetland edge as required.
6. Restrict root grubbing to only that area over the ditchline and ditch spoil areas and remove from wetland for disposal.
7. Topsoil stripping shall not be required in saturated soil conditions
8. Leave hard plugs at edge of wetland until just prior to trenching.
9. Pipe section may be fabricated within the wetland and adjacent to alignment, or in staging area outside the wetland and walked in.
10. Trench through wetland.
11. Lower-in pipe, install trench plugs at wetland edges as required and backfill immediately.
12. Remove timber mats or prefabricated mats from wetland upon completion.
13. Restore grade to near pre-construction topography, replace topsoil, and install permanent erosion control.

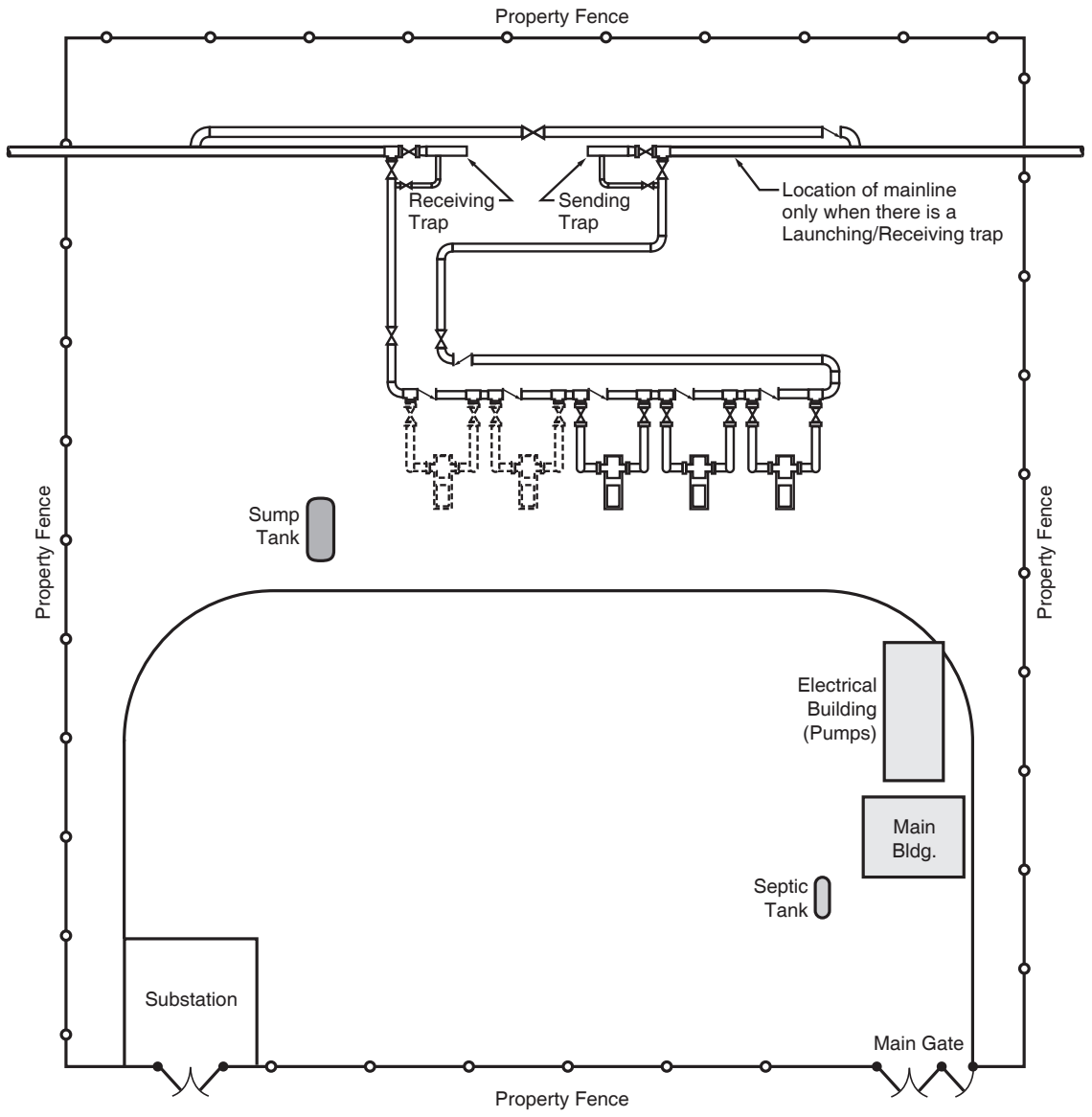
KEYSTONE PIPELINE PROJECT

Figure A-18
Typical Standard
Wetland Crossing



KEYSTONE PIPELINE PROJECT

Figure A-19
Typical Pump Station without Pigging Facilities



KEYSTONE PIPELINE PROJECT

Figure A-20
Typical Pump Station with Pigging Facilities

Appendix B

Indiana Bat Impact Analysis

B-1 – Missouri Bat Habitat Report

Prepared for:
Keystone Pipeline Project



Summer Habitat Assessment for the Indiana Bat (*Myotis sodalis*) Along the Keystone Mainline in Missouri

ENSR Corporation
November 2007
Document No.: 10623-004

ENSR | AECOM

PN: 0987.012-001 & 002 November 20, 2007

ASSESSMENT OF INDIANA BAT SUMMER HABITAT ALONG THE PROPOSED KEYSTONE PIPELINE IN MISSOURI

Prepared for:
ENSR Corporation
1601 Prospect Parkway
Fort Collins, CO 80525

Prepared by:
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11733 Chesterdale Rd.
Cincinnati, OH 45246-4131
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Figure 2. Diagrams of Keystone Pipeline Project survey corridor where the pipeline is stand-alone (A) and where it is co-located with the REX-West pipeline right-of-way (B).

APPENDICES

Appendix A. USFWS Concurrence with Study Plan

Appendix B. Wooded Areas Identified for Field Investigation within the Proposed Keystone Survey Corridor in Missouri.

Appendix C. Field Data Sheets

Appendix D. Field GPS Data and Site Photographs

EXECUTIVE SUMMARY

BHE Environmental, Inc. (BHE) was contracted by ENSR Corporation (ENSR) on behalf of the Keystone Pipeline Project (Keystone) to implement a bat summer habitat investigation similar to that described in *Proposed Indiana Bat Investigations: REX-West Pipeline through Seven Missouri Counties*, dated August 2006. On November 21, 2006, Rick Hansen, U.S. Fish and Wildlife Service, gave signed concurrence that the same survey approach could be applied to the Keystone Pipeline Project. BHE conducted the study in the ten Missouri counties traversed by the Keystone Project: Buchanan, Clinton, Caldwell, Carroll, Chariton, Randolph, Audrain, Montgomery, Lincoln, and St. Charles. Specifically, BHE sought to evaluate the quality of Indiana bat summer habitat at 238 wooded areas crossed by the Keystone Project. Of the 238 forest crossings initially identified for assessment, 208 sites have been assessed in the field to date. Of the remaining 30 woodlots, two woodlots were determined to be continuous with other woodlots and thus were combined, field inspection of one woodlot revealed the absence of trees at the location, five were cleared of trees by REX-West, and access permission was denied at 22 woodlots. The quality of Indiana bat summer habitat was evaluated within the portion of the 208 forested tracts crossed by the 200-ft wide survey corridor, using a quantitative assessment method. Of the 208 sites assessed in the field to date, there were 51 sites where habitat suitability was 0.6 or higher based upon criteria established in the August 2006 study plan.

1.0 INTRODUCTION

Keystone proposes to construct and operate an interstate crude oil transmission system from an oil supply hub near Hardisty, Alberta, in Canada to destinations in the U.S. In the U.S., the Keystone Mainline will consist of approximately 1,082 miles (1741 km)of new pipeline constructed from the U.S./Canadian border in Cavalier County, North Dakota, to existing terminals and refineries in Wood River (Madison County) and Patoka (Marion County), Illinois. The Cushing Extension will consist of approximately 296 miles (476 km) of additional pipeline commencing in Jefferson County near the Nebraska-Kansas border and terminating at existing crude oil terminals in Cushing (Payne County), Oklahoma. Approximately 283 miles (455 km) of the Keystone Mainline would parallel the proposed Rockies Express Pipeline - West (REX-West) Project in Kansas and Missouri.

This report addresses implementation of investigations described in the study plan developed for work to be conducted in Missouri. *Proposed Indiana Bat Investigations: REX-West Pipeline through Seven Missouri Counties*, dated August 2006, describes methodology for assessment of parcels located in Missouri (BHE 2006). A letter from BHE Environmental, Inc. (BHE) to Rick Hansen, U.S. Fish and Wildlife Service (USFWS), signed on November 21, 2006, indicates that the same survey approach and methods developed for the REX-West Pipeline Project may also be applied to the Keystone Mainline Project (Appendix A). Specifically, BHE evaluated the quality of Indiana bat summer habitat at 238 areas where the Keystone Mainline route crosses forested parcels. Of the 238 forest crossings initially identified for assessment, 208 have been assessed in the field to date. Of the 30 sites not surveyed, two woodlots were determined to be continuous with other woodlots and thus were combined, field inspection of one woodlot revealed the absence of trees at the location, five were cleared of trees by REX-West, and access was denied to 22 woodlots. The quality of Indiana bat summer habitat was evaluated within the portion of the 208 total forested tracts that was within the 200-ft wide survey corridor, using a quantitative assessment method. The area of wooded habitat surveyed at the 208 total sites ranged from approximately one acre to 30.5 acres.

Indiana bats are assumed present between April 1 and September 30 in all Missouri counties crossed by the Keystone Mainline route. Known summer occurrences in the ten counties are limited to captures in Clinton and Chariton counties in 1985 and 1983, respectively, and from Randolph County in 2007 (**Figure 1**). The 1983 record from Chariton County was of a maternity roost tree. The 1985 record from Clinton County was an "other occurrence" (non-reproductive) record. Netting in these areas in recent years did not detect the presence of Indiana bats. Indiana bats have more recently been identified at the Swan Lake National Wildlife Refuge in Chariton County approximately 6 miles (9.6 km) north of the August 2006 Keystone alignment. BHE captured a reproductive female Indiana bat in Randolph County in May 2007 while performing mist netting efforts on the REX-West pipeline project. The nearest known confirmed winter occurrences (two hibernacula) are more than 5 miles (8 km) south of the Keystone Mainline route in Boone County. USFWS records also indicate presence of a hibernaculum in St. Louis County, approximately 15 miles (24 km) south of the Keystone Mainline (Andrew King, pers comm.). Indiana bats are not known to occur in North Dakota, South Dakota, Nebraska, or Kansas (**Figure 1**); assessment of Indiana bat summer habitat quality was limited to Missouri and Illinois. Assessment of Indiana bat summer habitat quality in Illinois is described in a separate report.

2.0 METHODS

2.1 AGENCY COORDINATION AND SAMPLE AREA SELECTION

The study plan titled *Proposed Indiana Bat Investigations: REX-West Pipeline through Seven Missouri Counties,* dated August 2006, describes methodology for assessment of Indiana bat habitat in parcels located in Missouri (BHE 2006). This study plan was developed to investigate the presence of Indiana bat summer habitat along the proposed REX-West pipeline that is adjacent to and parallels the proposed Keystone Mainline through the western half of Missouri. A letter from BHE to Rick Hansen, U.S. Fish and Wildlife Service (USFWS), signed on November 21, 2006, indicates that the same survey approach and methods developed for the REX-West Pipeline Project could also be applied to the Keystone Pipeline Project (Appendix A).

2.1.1 Habitat Identification

Investigations began with identification of wooded areas traversed by the route that may provide habitat for the Indiana bat. Data pertinent to this assessment were collected during field investigations completed by ENSR in 2006. ENSR and BHE identified all instances where the Keystone Mainline route crossed areas with deciduous trees – these crossings range from wooded fencerows and tree lines to small woodlots and more extensive forests. Wooded areas crossed by pipe or contractor yards, and/or electric transmission corridors were not identified or assessed as part of this report.

Recognizing that larger forested parcels bear greater long-term potential for suitable foraging and roosting habitat relative to smaller wooded areas, BHE identified all instances in which the route crossed 200 or more linear feet (61 m) of wooded areas (BHE 2006).

BHE next evaluated Indiana bat habitat at the crossings where the route crossed 200 or more linear feet of wooded areas based upon the existence of forested habitat near each crossing. Considering data available in recent published literature (Murray and Kurta 2004, Sparks et al. 2005, Butchkoski and Hassinger 2002), BHE evaluated the amount of forest cover within 2.2 miles (3.5 km) of the crossings where the route crossed 200 or more linear feet of wooded areas. Rommé et al. (1995) indicate that even with all other summer habitat attributes being ideal, wooded areas with 13 percent forest cover in the analysis area can score no higher than 0.32 on a scale of 0.0 (no habitat value) to 1.0 (ideal habitat).

Forest cover within 2.2 miles of the crossings where the route crossed 200 or more linear feet of wooded areas was calculated using vegetative cover data (30-meter pixels) from the Missouri Spatial Data Information Service, Natural Resources – Landcover. These data are based on circa 2000-2004 satellite imagery, in conjunction with ancillary data from the National Wetlands Inventory and the Wetlands Restoration Program. For purposes of this analysis, forest cover was compiled from the vegetation classifications Deciduous Forest, Evergreen Forest, Mixed Forest, Deciduous Woody/Herbaceous, and Woody Dominated Wetland.

Forest cover within 2.2 miles of 238 forest crossings greater than 200 ft in length exceeds 13 percent (BHE 2006). This report describes field studies implemented in August, September, and December 2006, and in February, July, August, and September 2007 to evaluate the

quality of summer habitat at these crossings. Each woodlot was assigned a unique alpha-numeric identifier (Appendix B-Table 1). Feature ID numbers adhered to one of two naming conventions.

Feature ID protocol for sites located on Keystone-only right-of-way:
(Surveys conducted in December 2006, and February, July, August, and September 2007)

- FFFNNNSSCCXXXAA
    - FFF = Feature Type ("BAT" for bat habitat natural feature)
    - NNN= Team Number
        - December 2006 Field Effort
            - BH1 - Becky Braeutigam and Drew Carson (BHE)
            - BH2 – Dave Norcross and Samantha Williams (BHE)
            - BH3 - Chad Kinney (BHE) and Laura Vrabel (SCI)
            - BH4 – Lisa Winhold and John Alexander (BHE)
        - February 2007 Field Effort
            - BH1 –Lisa Winhold and John Alexander (BHE)
        - July & August 2007 Field Effort
            - BH1 – Chad Kinney and Brad Schroeder (BHE)
            - BH2 – Samantha Williams and Jennifer Wolff (BHE)
        - September 2007 Field Effort
            - BH1 – Lisa Winhold and Brad Schroeder (BHE)
    - SS = State
        - Missouri (MO)
    - CC = County Code
        - Buchanan (BC)
        - Clinton (CL)
        - Caldwell (CA)
        - Carroll (CR)
        - Chariton (CI)
        - Randolph (RA)
        - Audrain (AU)
        - Montgomery (MO)
        - Lincoln (LI)
        - St. Charles (SC)
    - XXX = Feature number (001-999 for the Keystone alignment)
    - AA = Alignment date of original alignment
        - August (AU)
        - November (NO)
        - March (MA)

Or

Feature ID protocol for Keystone sites co-located on shared right-of-way:
(Surveys conducted in August and September 2006, and February 2007)

- FFFNNCCXXX
    - FFF = Feature Type ("NAT" for natural feature)
    - NN = Team Number
        - August and September 2006 Field Efforts

        - 8A - Becky Braeutigam and John Alexander (BHE)
        - 9A - Chad Kinney and Samantha Williams (BHE)
        - 10A – Doug Kibbe and Paul Swartzinski (ENSR)
    - February 2007 Field Effort
        - BH1 – Lisa Winhold and John Alexander (BHE)
- CC = County Code
    - Buchanan (BC)
    - Clinton (CL)
    - Caldwell (CA)
    - Carroll (CR)
    - Chariton (CI)
    - Randolph (RA)
    - Audrain (AU)
- XXX = Feature number (001-999)

Of the 238 forest crossings initially identified for assessment, 208 have been assessed in the field to date. Of the remaining 30 woodlots, 22 were inaccessible due to access denial. Two woodlots were determined to be continuous with other woodlots and thus were combined; NAT8ABC018 and NAT8ABC019 were combined into NAT8ABC018/019, and NAT10ARA117 and NAT10ARA118 were combined into NAT10ARA117/118. Field inspection of woodlot NAT__BC026, proved it to be without trees. Five woodlots were cleared of trees as part of the REX-West project (Appendix B-Table 1) prior to our field investigations described herein.

2.1.2 Habitat Assessment

Summer habitat quality was evaluated within the forested tracts using a quantitative assessment method. Rommé et al. (1995) provide perhaps the most comprehensive assessment tool available for this effort; however, this Habitat Suitability Index (HSI) model requires intensive data collection efforts more suitable to smaller project areas. Another model utilizes a subset (three) of the assessment variables from the Rommé et al. model (Farmer et al. 2002). Farmer et al. recommend evaluation of a single variable, density of suitable roost trees, as appropriate for landscape scale assessments. We utilized this approach during the field investigations. For purposes of this investigation, "potential roost trees" (PRTs) had the following characteristics:

- ≥22 cm dbh (diameter at breast height)
- ≥3 m in height
- no overarching canopy
- no understory canopy within 2 m of the trunk of the tree
- ≥25% of the tree covered by exfoliating bark
- bole of tree is free of obstructing vines

A density equal to or greater than 14 roost trees per hectare (see Rommé et al. 1995) defines ideal habitat.

2.2 FIELD METHODS

The density of potential roost trees was assessed quantitatively within the wooded tracts during August, September, and December 2006, and February, July, August, and September

2007. The woodlots were either surveyed in their entirety (census), or plot(s) were established to sample the woodlot. Plots were placed only within the survey corridor where access permission had been granted. In areas where the Keystone Mainline parallels the REX-West corridor, the width of the survey corridor was 65 feet on the co-located side, and 100 feet on the greenfield side. In all other areas along the Keystone Mainline route, the survey corridor was 200 feet centered on the proposed centerline (**Figure 2**). Approximately one 0.1 ha plot was examined per 2 acres of wooded area to be cleared. In wooded areas less than 2 acres, a minimum of one 0.1 ha plot was completed, or a census of the entire tract was completed.

A single point within each plot was documented with GPS. Data regarding the presence of PRTs in each plot were recorded on hardcopy field forms (Appendix C) and were also recorded electronically utilizing a data dictionary developed by ENSR with support from BHE (Appendix D). While at the sites, biologists made notes based on other attributes of the stand that may provide useful information in assessing summer habitat quality. These attributes included:

- ocular estimates of average percent canopy cover
- ocular estimates of average overstory tree dbh
- dominant overstory tree species (up to 3)
- presence of apparently suitable mist net survey sites.

2.3 ANALYTICAL METHODS

Field data were analyzed to calculate an HSI between 0.0 and 1.0 for each wooded tract. The USFWS has agreed that those sites with an HSI value based upon the density of PRTs equaling or exceeding 0.6 may be considered suitable habitat for Indiana bats. The HSI value is calculated from the density of PRTs in a woodlot as follows:

1. Determine the number of PRTs in the plot(s) or woodlot. If multiple plots were surveyed, sum the PRTs found in all plots.
2. Determine the area of the woodlot surveyed, in hectares. This is either the sum of the areas of all of the plot(s), or the entire area of the woodlot within the corridor, depending on the measurement made in the field.
3. The density of PRTs, (D) in PRT/ha, is the value calculated in step 1 divided by the value calculated in step 2.
4. The single-variable HSI is calculated by comparing the density to the ideal density of ≥14 PRT/ha:
    - If D ≥ 14, then HSI =1.0,
    - Otherwise HSI = D/14.

3.0 RESULTS

As discussed in the methods section, of the 238 woodlots initially identified for assessment, 208 woodlots having been assessed in the field to date (Appendix B-Table 1). Of the 208 woodlots assessed in the field to date, most (75%, n=157) were of low habitat quality, with 43% (n=90) having HSI values of 0.0, and 32% (n=67) having HSI values from 0.1 to 0.5

(Appendix B-Table 1). We calculated an HSI value of 0.6 or greater for 51 (25%) of the woodlots (Appendix B-Table 1; **Table 1**).

Of the 51 woodlots with HSI values ≥0.6, 19 had HSI values of 0.6 to 0.9 and 32 had HSI values of 1.0 (Appendix B-Table 1). Woodlots with HSI values of 0.6 or greater were present in eight of the ten Missouri counties crossed by the Keystone Mainline; however, the majority of these woodlots were in Clinton (7), Caldwell (10), Carroll (12), Randolph (5), and Lincoln (8) counties. Within the counties, woodlots with HSI values ≥0.6 tended to be grouped together. Seven of the 51 woodlots with HSI values ≥0.6 were in Clinton (7) County, where there has been documented summer occurrence of Indiana bats.

Acreage estimates for all woodlots identified for field survey within the proposed Keystone survey corridor in Missouri were determined based on the 200-foot wide survey corridor (Appendix B-Table 1). Additionally, more precise acreage estimates were determined for woodlots surveyed to date that had an HSI of 0.6 or greater where they cross the Keystone Pipeline Project construction corridor (i.e., that portion of the 200-foot wide survey corridor that will be disturbed during construction) and associated extra temporary work spaces (EWSs) (Appendix B-Table 2).

Based on the 200-foot wide survey corridor, approximately 940.4 acres have been surveyed to date at the 208 sites. Based on the 200-foot wide survey corridor, approximately 320.5 acres were found to have HSI values of 0.6 or greater. There are approximately 136.4 wooded acres within the 200-foot wide survey corridor at the 22 woodlots not yet surveyed (Appendix B-Table 1).

Based on the boundaries of the construction corridor associated with the Keystone Pipeline Project alignment and the boundaries of associated EWSs filed with the Department of State in September 2007, the total wooded acreage to be impacted within the 51 woodlots with an HSI score of 0.6 or above is 191.8 acres. Of these 51 woodlots, 35 are co-located with woodlots impacted by the REX-West Pipeline. Within these 35 woodlots, approximately 43.0 acres to be impacted overlap with the REX-West pipeline corridor, and 35.3 acres will be impacted solely by the Keystone Pipeline Project. Therefore, of the 191.8 acres of suitable habitat identified to date, only approximately 148.8 acres will be impacted solely by the Keystone Pipeline Project (Appendix B-Table 2).

4.0 LITERATURE CITED

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TABLES

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
NAT8ABC018/019	Plot 1	164	65	0	NONE	50	10	*Gleditsia triacanthos, Juglans nigra, Ulmus rubra.*
NAT8ABC018/019	Plot 2	164	65	0	NONE	70	8	*Ulmus Americana, Quercus sp. Ulmus rubra.*
NAT8ABC018/019	Plot 3	164	65	4	*Quercus alba* (3), Unknown sp.	65	22	*Quercus alba, Ulmus americana.*
NAT8ABC018/019	Plot 4	164	65	0	NONE	45	12	*Quercus rubra, Ulmus rubra, Juglans nigra*
BATBH1MOBC002AU	Plot 1	ALL	ALL	11	*Juglans nigra* (2); *Ulmus americana* (4); *Quercus rubra*; Unknown dead (4).	50-75	8	*Celtis occidentalis, Quercus rubra, Gleditsia triacanthos.*
NAT8ABC024	Plot 1	164	65	1	*Ulmus sp.*	60	15	*Ulmus Americana, Platanus occidentalis, Salix alba.*
NAT8ABC033	Plot 1	164	65	5	*Gleditsia triacanthos* (2), Unknown (3).	50	22	*Ulmus rubra, Juglans nigra, Gleditsia triacanthos.*
NAT8ABC033	Plot 2	164	65	2	*Tilia americana,* Unknown snag.	65	20	*Juglans nigra, Gleditsia triacanthos, Ulmus americana.*
NAT9ACL038	Plot 1	ALL	ALL	6	*Acer negundo, Acer saccharinum* (4), *Populus deltoides.*	50	18	*Acer saccharinum, Populus deltoides.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
NAT9ACL039	Plot 1	164	65	0	NONE	40	16	*Juglans nigra, Carya cordiformis, Carya ovata.*
NAT9ACL039	Plot 2	164	65	3	Unkonwn dead trunk, *Juglans nigra, Fraxinus spp.*	40	16	*Juglans nigra, Carya cordiformis, Carya ovata.*
NAT9ACL045	Plot 3	165	64	0	NONE	70	12	*Quercus imbricaria.*
NAT9ACL046	Plot 1	165	64	2	*Ulmus americana* (2).	45	16	*Quercus imbricaria, Quercus macrocarpa, Juglans nigra.*
NAT9ACL047	Plot 1	ALL	ALL	2	*Crateagus sp., Juglans nigra.*	40	14	*Juglans nigra, Gleditsia triacanthos, Quercus macrocarpa.*
NAT9ACL049	Plot 1	165	64	3	Unknown dead tree, *Gleditsia triacanthos* (2).	50	16	*Celtis occidentalis, Juglans nigra.*
NAT9ACL050	Plot 2	165	64	0	NONE	45	14	*Celtis occidentalis, Juglans nigra, Gleditsia triacanthos.*
BATBH2MOCL002NO	Plot 1	ALL	ALL	16	*Carya ovata* (16).	75-100	18	*Carya ovata, Carya tomentosa.*
BATBH1MOCL004NO	Plot 1	ALL	ALL	42	*Ulmus americana* (22), *Carya ovata* (20)	50-75	14	Quesrcus alba, Carya ovata, Gleditsia triacanthos.

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
NAT10ACA051	Plot 1	175	60	2	*Ulmus americana, Quercus imbricaria.*	70	10	*Gleditsia triacanthos, Salix nigra, Quercus imbricaria.*
NAT10ACA052	Plot 1	175	60	0	NONE	90	14	*Populus sp., Quercus alba, Celtis occidentalis.*
NAT10ACA052	Plot 2	175	60	2	*Quercus stellata, Carya ovata.*	80	15	*Quercus stellata, Carya ovata.*
NAT10ACA058	Plot 1	175	60	1	*Ulmus americana.*	95	9	*Juglans nigra, Populus occidentalis, Celtis sp.*
NAT10ACA059	Plot 1	175	60	1	*Carya ovata.*	90	12	*Populus sp., Celtis sp., Carya sp.*
NAT10ACA060	Plot 1	175	60	2	Dead *Celtis sp.*	70	7	*Juglans nigra, Acer saccharinum, Gleditsia triacanthos.*
NAT10ACA061	Plot 1	175	60	0	NONE	95	10	*Juglans nigra, Gleditsia triacanthos, Maclura pomifera.*
NAT10ACA061	Plot 2	175	60	2	*Ulmus americana.*	95	8	*Gleditsia triacanthos, Juglans nigra.*
NAT10ACA062	Plot 1	175	60	1	Dead *Ulmus americana.*	90	10	*Acer negundo, Gleditsia triacanthos, Quercus imbricaria.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
NAT10ACA067	Plot 1	175	60	1	*Carya ovata.*	45	8	*Carya ovata, Juglans nigra, Celtis occidentalis, Quercus muehlenbergii.*
NAT10ACA067	Plot 2	175	60	2	*Ulmus americana,* Unknown.	30	8	*Quercus rubra, Carya cordiformis, Carya ovata.*
NAT10ACA068	Plot 1	175	60	1	*Gleditsia triacanthos.*	90	10	*Quercus macrocarpa, Carya ovata, Carya cordiformis.*
NAT10ACA068	Plot 2	175	60	1	*Quercus sp.*	80	8	*Juglans nigra, Quercus stellata, Gleditsia triacanthos.*
NAT10ACA069	Plot 1	175	60	1	*Carya ovata.*	95	10	*Carya ovata, Juglans nigra.*
NAT10ACA069	Plot 2	175	60	1	*Carya ovata.*	80	10	*Celtis occidentalis, Carya ovata.*
NAT9ACR077	Plot 1	165	64	1	*Ulmus americana.*	30	12	*Prunus serotina, Ulmus americana, Gleditsia triacanthos.*
NAT9ACR078	Plot 1	165	64	1	*Ulmus americana.*	20	12	*Celtis ociddentalis, Maclura pomifera, Ulmus americana.*
NAT9ACR078	Plot 2	165	64	2	*Juglans nigra, Ulmus americana.*	40	14	*Juglans nigra, Gleditsia triacanthos, Celtis occidentalis.*
NAT9ACR081	Plot 1	ALL	ALL	4	*Ulmus americana* (4).	50	16	*Juglans nigra.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
NAT9ACR082	Plot 1	165	64	6	*Carya ovata*, *Quercus alba* (2), *Juglans nigra.*	60	18	*Quercus alba*, *Carya ovata*, *Quercus rubra.*
NAT9ACR082	Plot 2	165	64	4	*Quercus alba* (4).	50	18	*Quercus Alba*, *Juglans nigra*.
NAT9ACR082	Plot 3	165	64	4	*Ulmus americana*, *Quercus muehlenbergii*, *Carya ovata* (2).	50	20	*Quercus alba, Quercus muehlenbergii, Carya ovata.*
NAT9ACR083	Plot 1	165	64	5	*Carya ovata* (3), Unknown (2).	60	16	*Quercus alba, Quercus rubra, Carya ovata.*
NAT9ACR083	Plot 2	165	64	4	*Carya cordiformis* (2), *Carya ovata* (2).	70	20	*Carya glabra, Celtis occidentalis, Carya ovata.*
NAT9ACR084	Plot 1	165	64	7	*Carya ovata* (4), *Quercus alba* (2), *Quercus rubra.*	60	18	*Quercus alba*, *Quercus rubra*, *Carya ovata.*
NAT9ACR084	Plot 2	165	64	4	*Quercus alba* (2), *Carya ovata* (2).	60	18	*Quercus alba*, *Carya ovata.*
NAT9ACR084	Plot 3	165	64	4	*Carya ovata, Quercus sp.* (2), *Quercus alba.*	60	20	*Quercus alba*, *Carya ovata.*
NAT9ACR085	Plot 1	165	64	3	*Quercus alba* (2), *Ulmus americana.*	60	18	*Quercus alba, Tilia americana, Juglans nigra.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
NAT9ACR086	Plot 1	165	64	3	*Carya ovata* (3).	60	20	*Quercus alba, Carya ovata, Ulmus americana.*
NAT9ACR086	Plot 2	165	64	6	*Quercus rubra, Quercus alba, Carya ovata, Gleditsia triacanthos* (3).	50	18	*Quercus alba, Gleditsia triacanthos, Carya ovata.*
NAT9ACR086	Plot 3	165	64	6	*Quercus alba* (4), *Carya ovata* (2).	50	16	*Quercus alba, Quercus rubra, Carya ovata.*
NAT9ACR087	Plot 1	165	64	6	*Carya ovata* (4), *Ulmus americana* (2).	40	16	*Carya ovata.*
NAT9ACR090	Plot 1	165	64	1	*Gleditsia triacanthos.*	70	16	*Carya cordiformis, Quercus macrocarpa.*
NAT9ACR091	Plot 1	ALL	ALL	4	*Maclura pomifera, Carya ovata* (3).	60	16	*Carya ovata, Gleditsia triacanthos, Maclura pomifera.*
NAT9ACR096	Plot 1	165	64	0	NONE	60	16	*Quercus rubra, Diospyros virginiana.*
NAT9ACR096	Plot 2	165	64	3	*Ulmus americana, Acer saccharinum, Carya illinoensis.*	60	18	*Quercus rubra, Ulmus americana.*
NAT9ARA112	Plot 1	165	64	1	*Ulmus americana.*	40	18	*Gleditsia triacanthos.*
NAT9ARA113	Plot 1	165	64	7	*Carya ovata* (6), *Quercus alba.*	40	16	*Juglans nigra, Platanus occidentalis, Carya ovata.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
NAT9ARA114	Plot 1	165	64	3	*Ulmus americana*, *Carya ovata* (2).	50	16	*Carya ovata*, *Quercus imbricaria*, *Quercus palustris.*
NAT9ARA115	Plot 1	ALL	ALL	4	*Carya ovata* (3), Dead *Ulmus americana.*	40	14	*Carya ovata, Juglans nigra, Celtis occidentalis.*
BATBH1MORA003NO	Plot 1	ALL	ALL	111	*Carya ovata* (106), *Quercus* sp. (3), *Quercus alba*, Unknown dead	50-75	8	*Carya ovata*
NAT10AAU121	Plot 1	164	65	2	*Quercus sp.*	90	10	*Celtis occidentalis, Juglans nigra, Fraxinus sp.*
BATBH1MOMO005AU	Plot 1	165	65	4	*Carya ovata* (2), *Quercus rubra*, *Quercus alba.*	25-50	14	*Quercus alba*, *Carya ovata*, *Quercus rubra.*
BATBH1MOMO005AU	Plot 2	165	65	0	N/A	0-25	4	*Quercus rubra*, *Quercus stellata.*
BATBH1MOMO005AU	Plot 3	165	65	5	*Quercus alba* (4), *Carya ovata.*	25-50	14	*Quercus alba*, *Carya ovata.*
BATBH2MOMO022	Plot 1	ALL	ALL	18	*Carya ovata* (15), *Gleditsia triacanthos* (2), *Acer saccharinum.*	50-75	16	*Carya ovata*, *Celtis occidentalis*, *Acer saccharinum.*
BATBH2MOMO023	Plot 1	ALL	ALL	30	*Carya ovata* (30).	25-50	14	*Carya ovata, Juglans nigra, Quercus imbricaria.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH1MOMO027AU	Plot 1	165	65	10	*Carya ovata* (9), *Ulmus americana.*	25-50	8	*Carya ovata, Quercus imbricaria.*
BATBH1MOMO027AU	Plot 2	165	65	7	*Carya ovata* (6), *Ulmus americana.*	25-50	10	*Carya ovata, Ulmus americana, Celtis occidentalis.*
BATBH1MOLI007AU	Plot 1	165	65	4	*Prunus serotina, Quercus alba* (2), *Ulmus americana.*	50-75	9	*Quercus alba, Ulmus americana, Fraxinus americana.*
BATBH1MOLI007AU	Plot 2	165	65	2	*Carya ovata* (2).	25-50	10	*Quercus alba, Carya ovata.*
BATBH1MOLI007AU	Plot 3	165	65	1	*Quercus alba.*	25-50	10	*Quercus alba.*
BATBH1MOLI008AU	Plot 1	165	65	3	*Quercus alba* (3).	25-50	12	*Quercus alba, Acer saccharum.*
BATBH1MOLI008AU	Plot 2	165	65	0	N/A	25-50	10	*Quercus alba, Acer saccharum.*
BATBH1MOLI008AU	Plot 3	165	65	4	*Quercus alba* (3), *Acer saccharum.*	25-50	11	*Quercus alba, Acer saccharum.*
BATBH1MOLI008AU	Plot 4	165	65	1	*Quercus alba.*	25-50	11	*Quercus alba, Carya ovata, Fraxinus americana.*
BATBH1MOLI011AU	Plot 1	165	65	3	*Fraxinus americana* (3).	25-30	12	*Quercus rubra, Acer saccharum, Carya ovata.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH1MOLI011AU	Plot 2	330	65	8	*Carya ovata* (6), *Quercus alba* (2).	25-50	11	*Quercus alba, Carya ovata, Acer saccharum.*
BATBH1MOLI011AU	Plot 3	165	65	0	N/A	75-100	8	*Quercus alba, Acer saccharum.*
BATBH1MOLI011AU	Plot 4	165	65	3	*Quercus alba* (3).	25-50	12	*Quercus alba, Acer saccharum.*
BATBH1MOLI011AU	Plot 5	165	65	3	*Quercus alba* (3).	25-50	12	*Quercus alba, Acer saccharum.*
BATBH1MOLI014AU	Plot 1	165	65	2	*Ulmus americana* (2).	25-50	6	*Quercus alba, Quercus rubra, Carya ovata.*
BATBH1MOLI014AU	Plot 2	165	65	6	*Quercus alba* (5), *Carya ovata.*	25-50	11	*Quercus alba, Quercus rubra.*
BATBH1MOLI014AU	Plot 3	165	65	2	*Quercus alba* (2).	25-50	10	*Quercus alba, Quercus rubra.*
BATBH1MOLI020AU	Plot 1	165	65	7	*Quercus alba* (3), *Quercus rubra* (4).	25-50	11	*Quercus alba, Quercus rubra, Carya ovata.*
BATBH1MOLI020AU	Plot 2	165	65	7	*Quercus alba* (6), *Ulmus americana.*	25-50	12	*Quercus alba, Carya ovata, Quercus rubra.*
BATBH1MOLI020AU	Plot 3	165	65	0	N/A	25-50	12	*Quercus alba, Quercus rubra, Acer saccharum.*
BATBH1MOLI020AU	Plot 4	165	65	1	*Quercus alba.*	25-50	9	*Quercus alba, Quercus rubra, Acer saccharum.*

Table 1. Characteristics of 51 wooded areas with an HSI value ≥0.6 within the proposed Keystone survey corridor in Missouri.

Woodlot ID	Plot No.	Length of Plot (ft)	Width of Plot (ft)	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH2MOLI025AU	Plot 1	165	65	0	N/A	50-75	22	*Quercus alba*, *Carya tomentosa.*
BATBH2MOLI025AU	Plot 2	165	65	4	*Quercus alba* (3), *Carya ovata*.	50-75	18	*Quercus alba*, *Quercus muehlenbergii.*
BATBH2MOLI025AU	Plot 3	165	65	7	*Carya ovata* (7).	50-75	18	*Quercus alba*, *Quercus muehlenbergii.*
BATBH2MOLI025AU	Plot 4	165	65	2	*Quercus alba* (2).	50-75	20	*Quercus alba*, *Platanus occidentalis*, *Robinia pseudoacacia.*
BATBH2MOLI025AU	Plot 5	165	65	2	*Carya ovata* (2).	25-50	18	*Quercus rubra*, *Platanus occidentalis.*
BATBH2MOLI027AU	Plot 4	165	65	20+	*Carya ovata* (20+, ~70% of trees in woodlot, all PRTs).	50-75	20	*Carya ovata, Quercus alba, Juglans nigra*.
BATBH2MOLI031AU	Plot 1	ALL	ALL	20+	*Carya ovata* (20+, ~80% of trees in woodlot, all PRTs).	25-50	18	*Carya ovata*, *Gleditsia triacanthos*.

FIGURES

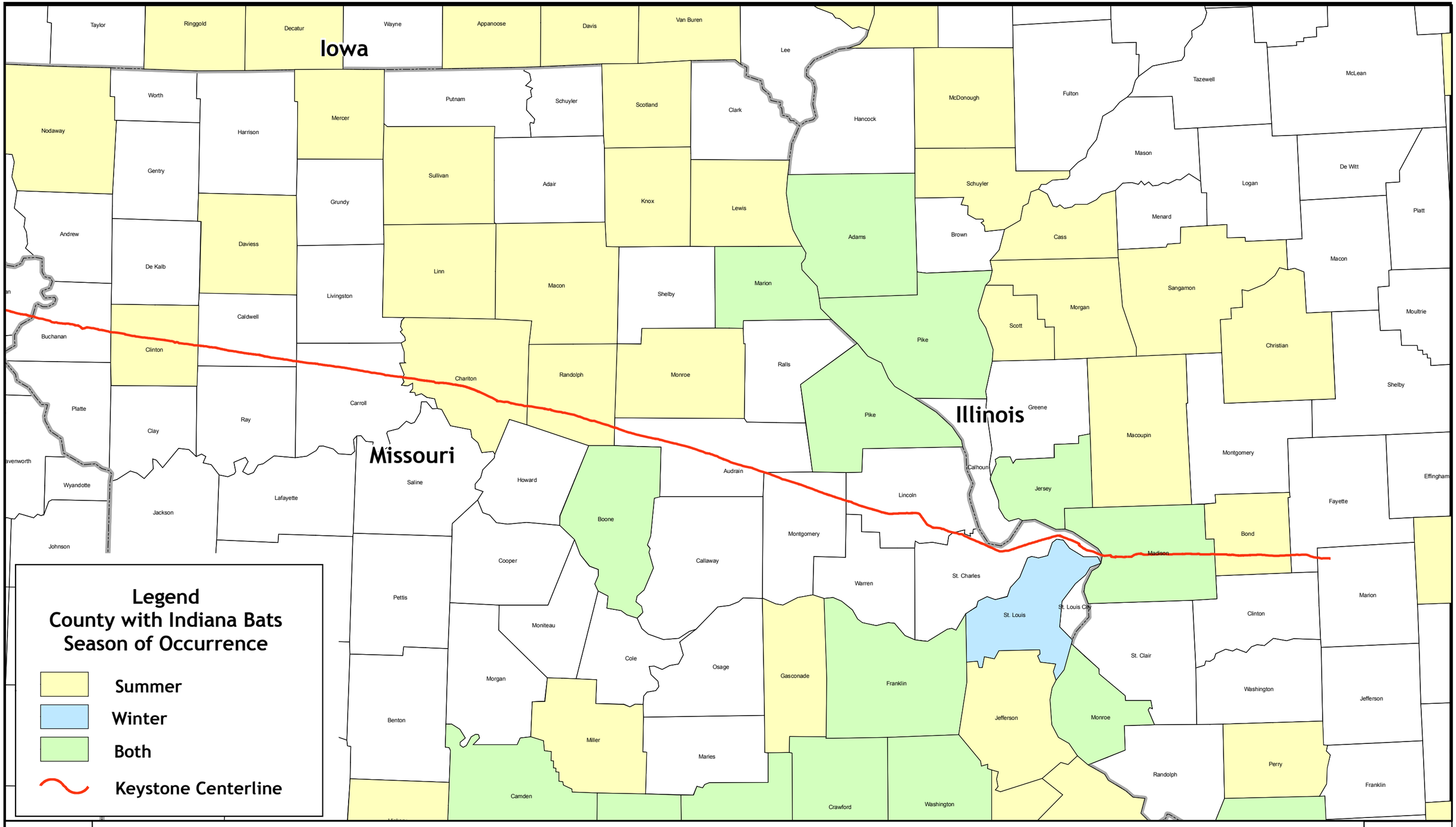


Figure 1: Location of the Keystone Pipeline Project in Missouri and Illinois

November 2007

Project No : 0987.012

Base Map: 2005 ESRI Data and Maps

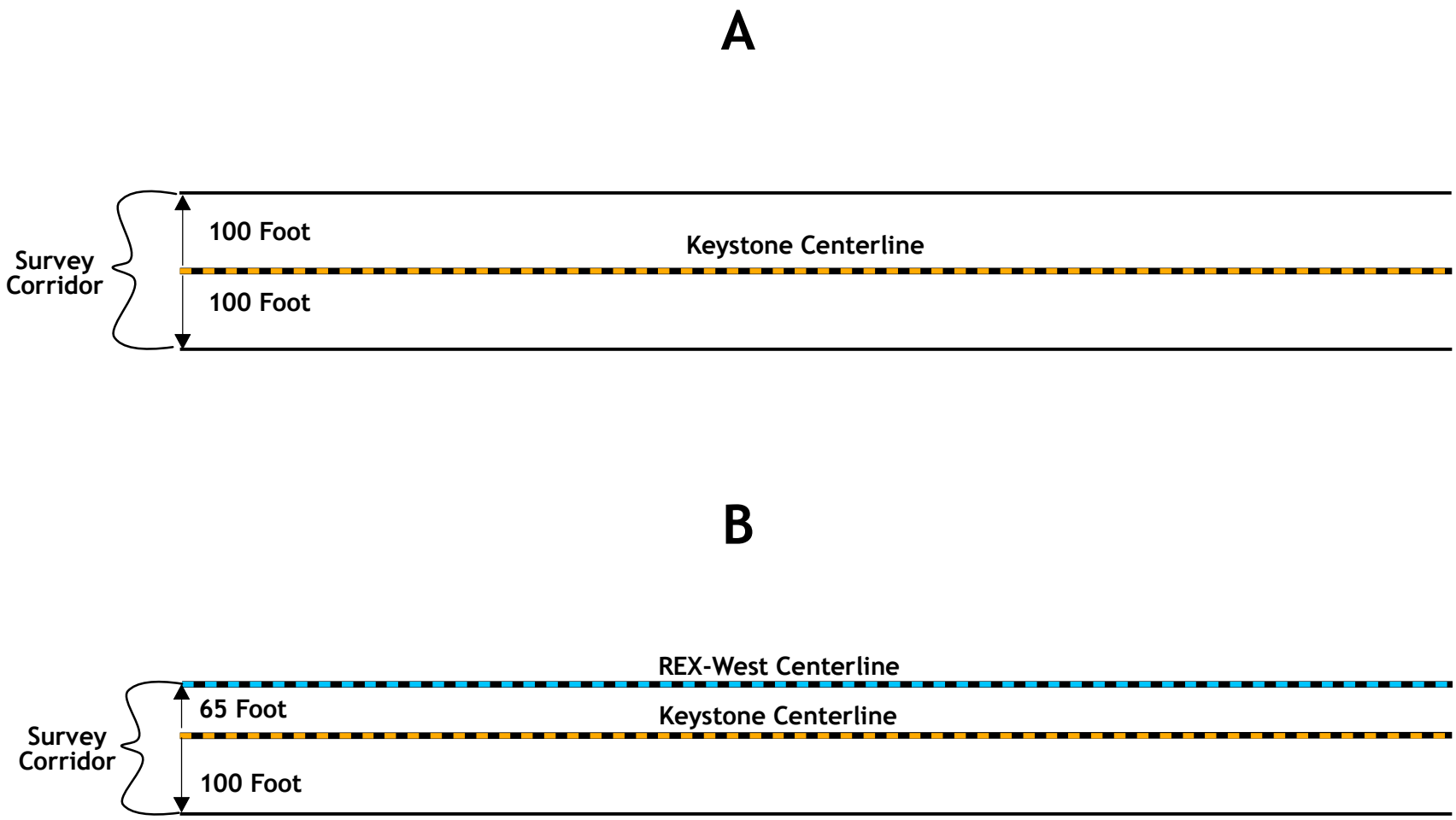


Figure 2. Diagrams of Keystone Pipeline Project survey corridor where the pipeline is stand-alone (A) and where it is co-located with the REX-West pipeline right-of-way (B).

Project No. 0987.012	March 2007	Feet 100 0 100 200

BHE ENVIRONMENTAL

APPENDICES

Appendix A. USFWS Concurrence with Study Plan

11733 Chesterdale Road, Cincinnati, Ohio 45246 513.326.1500 / Fax 513.326.1550

November 7, 2006

Mr. Charles M. Scott
Field Supervisor
Missouri Ecological Services Field Office
U.S. Fish & Wildlife Service
Department of the Interior
101 Park DeVille Drive, Suite A
Columbia, MO 65203-0007

Subject: Indiana Bat Habitat Surveys for the Keystone Pipeline Project

Dear Mr. Scott:

We wish to confirm several points regarding assessment of effects to Indiana bats and their habitat on the Keystone Pipeline right-of-way (ROW) in Missouri.

First, based on phone conversations with Rick Hansen in your office and with you on September 18, 2006, we understand that the Service is comfortable with the approach for the assessment of Indiana bat habitat developed earlier in September for the REX-West Pipeline Project in Missouri, and that approach should be repeated for the Keystone project in Missouri. The approach is summarized later in this letter.

Second, it is our understanding that Indiana bat habitat assessment need not be repeated for areas where the Keystone and REX West pipelines are parallel and adjacent (within ~200 ft). We have already completed an on-site assessment for 109 woodlots where the REX West ROW crosses woodlots in Buchanan, Clinton, Caldwell, Carroll, Chariton, Randolph, and western Audrain counties.

In areas where the two pipelines are not adjacent, either in the counties listed above, or in eastern Audrain, Montgomery, Lincoln, and St. Charles counties, we propose to follow the same approach as used on the REX-West Pipeline Project. In brief, the approach consisted of a desk-top analysis, followed by field work:

- Identify all woodlots crossed by the pipeline ROW.
- Eliminate from further assessment those woodlots crossed by less than 200 ft. of the ROW
- Eliminate from further assessment those woodlots with less than 13% forest cover within 3.5 km of the center of the woodlot crossing.
- Visit each of the remaining woodlots and determine the number of potential roost trees (PRTs) per hectare. Ratio this number to the optimum number of 14 or greater PRTs per hectare. If the ratio is 0.60 or greater, then further investigation of the site is warranted.

This habitat assessment field work for the Keystone Pipeline Project is tentatively scheduled to begin in late November. Once the field work is completed, we will consult with the Service about the findings.

If the USFWS concurs with this approach, this letter can be used to indicate your concurrence and authorization for Keystone/BHE to proceed. Please sign and return one copy of this letter to us. To expedite finalization of this approval, you may fax a signed copy of this letter to us at (513) 326-1178 or scan a signed copy and e-mail it to vhand@bheenvironmental.com. We would still appreciate receiving a signed original copy at your convenience.

BHE Environmental, Inc.

Vincent C. Hand, Ph.D.
Director, Natural Resources Management

✓ CONCUR	Signature Rick L Hansen
	Name (print) Rick L Hansen
____ DO NOT CONCUR	Title Acting Field Supervisor
	Date 21 November 2006

Appendix B. Wooded Areas Identified for Field Investigation within the Proposed Keystone Survey Corridor in Missouri.

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Missouri.
Rows in gray represent woodlots that have not been assessed in the field (see Comments column for details).

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
NAT9ABC001	Buchanan	754.96	755.05	755.13	898	4.1	29	Census	0	0	No	Already Surveyed
NAT9ABC002	Buchanan	755.14	755.18	755.22	422	1.9	30	Census	0	0	No	Already Surveyed
NAT9ABC003	Buchanan	755.28	755.31	755.33	317	1.5	32	Census	2	0.5	No	Already Surveyed
NAT9ABC004	Buchanan	755.39	755.65	755.90	2693	12.4	37	3	2	0.5	No	Already Surveyed
NATBH1BC005	Buchanan	756.38	756.41	756.44	370	1.7	43	Census	1	0.1	No	Already Surveyed
BATBH1MOBC001NO	Buchanan	756.87	757.16	757.44	2957	13.6	41	Census	3	0.0	No	Already Surveyed
BATBH1MOBC002NO	Buchanan	757.55	757.60	757.65	528	2.4	40	Census	1	0.1	No	Already Surveyed
BATBH1MOBC003NO	Buchanan	757.67	758.01	758.36	3590	16.5	38	Census	11	0.1	No	Already Surveyed
NAT8ABC011	Buchanan	758.68	758.72	758.74	370	1.7	38	Census	0	0	No	Already Surveyed
NAT8ABC012	Buchanan	758.80	758.84	758.87	370	1.7	38	Census	1	0.2	No	Already Surveyed
NAT8ABC013	Buchanan	759.04	759.14	759.22	950	4.4	38	Census	1	0.1	No	Already Surveyed
NAT8ABC014	Buchanan	759.37	759.48	759.55	1003	4.6	36	1	0	0	No	Already Surveyed
NAT8ABC015	Buchanan	759.99	760.04	760.08	475	2.2	32	Census	0	0	No	Already Surveyed
NAT8ABC016	Buchanan	760.10	760.13	760.15	211	1.0	31	Census	1	0.3	No	Already Surveyed
NAT8ABC017	Buchanan	760.20	760.29	760.37	950	4.4	31	Census	2	0.1	No	Already Surveyed
NAT8ABC018/019	Buchanan	760.41	760.64	760.86	2376	10.9	31	4	4	0.7	Yes	NAT8ABC018 & NAT8ABC019 are continuous and were combined into a single woodlot (NAT8ABC018/019)
BATBH1MOBC001AU	Buchanan	760.89	761.13	761.35	2429	11.2	29	Census	24	0.4	No	Already Surveyed
BATBH1MOBC002AU	Buchanan	761.46	761.51	761.56	581	2.7	29	Census	11	0.7	Yes	Already Surveyed
NAT8ABC020	Buchanan	761.76	761.79	761.80	581	2.7	28	Census	0	0	No	Already Surveyed
NAT8ABC021	Buchanan	761.93	761.97	761.99	264	1.2	27	Census	0	0	No	Already Surveyed
NAT8ABC022	Buchanan	762.07	762.11	762.14	370	1.7	27	1	0	0	No	Already Surveyed
NAT8ABC023	Buchanan	762.60	762.68	762.76	422	1.9	24	1	0	0	No	Already Surveyed
NAT8ABC024	Buchanan	762.92	763.04	763.15	792	3.6	22	1	1	0.7	Yes	Already Surveyed
NAT8ABC025	Buchanan	763.33	763.35	763.37	1214	5.6	19	1	0	0	No	Already Surveyed
NAT__BC026	Buchanan	763.44	763.49	763.54	211	1.0	18	N/A	N/A	N/A	N/A	No Woodlot Was Present At This Site
NAT8ABC027	Buchanan	765.44	765.51	765.57	528	2.4	14	Census	0	0	No	Already Surveyed
NAT8ABC028	Buchanan	766.07	766.14	766.20	739	3.4	14	Census	0	0	No	Already Surveyed
NAT8ABC029	Buchanan	766.95	767.00	767.04	686	3.2	16	Census	0	0	No	Already Surveyed
NAT8ABC030	Buchanan	767.16	767.19	767.22	475	2.2	16	Census	2	0.5	No	Already Surveyed
BATBH2MOBC004NO	Buchanan	767.30	767.36	767.40	528	2.4	17	Census	0	0.2	No	Already Surveyed
BATBH2MOBC005NO	Buchanan	767.49	767.51	767.53	264	1.2	18	Census	4	0.2	No	Already Surveyed
BATBH1MOBC006NO	Buchanan	767.90	767.92	767.95	317	1.5	19	Census	1	0.1	No	Already Surveyed
BATBH1MOBC007NO	Buchanan	768.31	768.38	768.44	739	3.4	18	Census	1	0.1	No	Already Surveyed
NAT8ABC033	Buchanan	769.14	769.21	769.27	634	2.9	15	2	7	1	Yes	Already Surveyed
BATBH1MOBC008NO	Buchanan	770.28	770.31	770.33	211	1.0	13	Census	0	0.0	No	Already Surveyed

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Missouri.
Rows in gray represent woodlots that have not been assessed in the field (see Comments column for details).

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
BATBH1MOCL001NO	Clinton	774.50	774.54	774.57	317	1.5	19	Census	0	0.0	No	Already Surveyed
NAT9ACL036	Clinton	774.90	774.94	774.98	422	1.9	15	Census	0	0	No	Already Surveyed
NAT9ACL037	Clinton	775.01	775.07	775.14	739	3.4	15	1	0	0	No	Already Surveyed
NAT9ACL038	Clinton	775.32	775.36	775.39	370	1.7	15	Census	6	1	Yes	Already Surveyed
NAT9ACL039	Clinton	775.70	775.84	775.98	1478	6.8	14	2	3	1	Yes	Already Surveyed
BATBH2MOCL002NO	Clinton	784.10	784.13	784.15	845	3.9	17	Census	16	0.7	Yes	Already Surveyed
BATBH2MOCL003NO	Clinton	784.22	784.34	784.46	1320	6.1	17	Census	0	0	No	Already Surveyed
BATBH1MOCL004NO	Clinton	788.07	788.32	788.56	2640	12.1	19	Census	42	0.6	Yes	Already Surveyed
BATBH1MOCL005NO	Clinton	788.91	788.92	788.94	634	2.9	20	Census	5	0.3	No	Already Surveyed
BATBH1MOCL006NO	Clinton	789.07	789.20	789.33	1373	6.3	19	Census	14	0.4	No	Already Surveyed
NAT9ACL046	Clinton	789.39	789.45	789.51	581	2.7	16	1	2	1	Yes	Already Surveyed
NAT9ACL047	Clinton	789.61	789.67	789.71	475	2.2	16	Census	2	0.6	Yes	Already Surveyed
NAT9ACL048	Clinton	790.66	790.68	790.71	317	1.5	15	Census	0	0	No	Already Surveyed
NAT9ACL049	Clinton	790.81	790.85	790.89	422	1.9	16	1	3	1	Yes	Already Surveyed
BATBH_MOCL007NO	Clinton	791.18	791.24	791.32	792	3.6	20	N/A	N/A	N/A	N/A	Access Denied
BATBH2MOCL008NO	Clinton	792.08	792.12	792.16	422	1.9	18	Census	2	0.2	No	Already Surveyed
BATBH2MOCL009NO	Clinton	792.19	792.21	792.23	264	1.2	18	Census	1	0.1	No	Already Surveyed
BATBH2MOCL010NO	Clinton	792.45	792.53	792.61	1003	4.6	19	Census	2	0.1	No	Already Surveyed
NAT10ACA051	Caldwell	793.86	793.88	793.91	211	1.0	18	1	2	1	Yes	Already Surveyed
BATBH_MOCA001NO	Caldwell	794.86	794.94	795.00	845	3.9	20	N/A	N/A	N/A	N/A	Access Denied
BATBH1MOCA002NO	Caldwell	795.07	795.11	795.17	634	2.9	21	Census	1	0.1	No	Already Surveyed
NAT10ACA052	Caldwell	796.88	796.98	797.08	1056	4.8	21	2	2	0.7	Yes	Already Surveyed
NAT10ACA053	Caldwell	797.62	797.67	797.71	475	2.2	21	1	0	0	No	Already Surveyed
NAT10ACA054	Caldwell	798.06	798.12	798.18	528	2.4	21	1	0	0	No	Already Surveyed
NAT__CA055	Caldwell	798.18	798.22	798.28	634	2.9	21	N/A	N/A	N/A	N/A	Cleared of trees by REX-West
NAT__CA056	Caldwell	798.66	798.75	798.84	950	4.4	21	N/A	N/A	N/A	N/A	Cleared of trees by REX-West
NAT__CA057	Caldwell	798.87	798.90	798.93	317	1.5	21	N/A	N/A	N/A	N/A	Cleared of trees by REX-West
NAT10ACA058	Caldwell	799.09	799.12	799.15	317	1.5	22	1	1	0.7	Yes	Already Surveyed
NAT10ACA059	Caldwell	799.15	799.22	799.29	686	3.2	22	1	1	0.7	Yes	Already Surveyed
BATBH1MOCA003NO	Caldwell	800.01	800.02	800.03	211	1.0	24	Census	1	0.2	No	Already Surveyed
NAT10ACA060	Caldwell	800.85	800.87	800.89	211	1.0	18	1	2	1	Yes	Already Surveyed
NAT10ACA061	Caldwell	801.46	801.56	801.65	1003	4.6	14	2	2	0.7	Yes	Already Surveyed
NAT10ACA062	Caldwell	801.74	801.77	801.79	317	1.5	15	1	1	0.7	Yes	Already Surveyed
NAT10ACA063	Caldwell	803.86	803.90	803.93	370	1.7	15	Census	0	0	No	Already Surveyed
NAT10ACA064	Caldwell	804.22	804.26	804.29	370	1.7	15	Census	1	0.2	No	Already Surveyed
NAT10ACA065	Caldwell	804.30	804.34	804.38	422	1.9	15	1	0	0	No	Already Surveyed
NAT10ACA066	Caldwell	804.93	804.97	805.01	422	1.9	15	1	0	0	No	Already Surveyed

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Missouri.
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Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
NAT10ACA067	Caldwell	810.33	810.44	810.52	1003	4.6	19	2	3	1	Yes	Already Surveyed
NAT10ACA068	Caldwell	810.55	810.61	810.67	634	2.9	20	2	2	0.7	Yes	Already Surveyed
NAT10ACA069	Caldwell	810.82	810.95	811.08	1373	6.3	21	2	2	0.7	Yes	Already Surveyed
NAT10ACA070	Caldwell	811.19	811.32	811.46	1426	6.5	22	3	2	0.5	No	Already Surveyed
NAT10ACA071	Caldwell	811.49	811.54	811.58	475	2.2	22	Census	0	0	No	Already Surveyed
NAT10ACA072	Caldwell	812.39	812.42	812.44	370	1.7	21	1	0	0	No	Already Surveyed
NAT10ACA073	Caldwell	812.58	812.64	812.69	528	2.4	20	1	0	0	No	Already Surveyed
NAT10ACA074	Caldwell	812.70	812.74	812.78	422	1.9	20	1	0	0	No	Already Surveyed
NAT10ACA075	Caldwell	812.83	812.91	812.97	686	3.2	19	2	0	0	No	Already Surveyed
NAT10ACA076	Caldwell	814.81	814.88	814.94	739	3.4	16	1	0	0	No	Already Surveyed
BATBH_MOCA004NO	Caldwell	816.14	816.18	816.22	422	1.9	15	N/A	N/A	N/A	N/A	Access Denied
BATBH2MOCA005NO	Caldwell	816.23	816.26	816.28	317	1.5	15	Census	1	0.1	No	Already Surveyed
NAT9ACR077	Carroll	818.07	818.15	818.22	792	3.6	23	1	1	0.7	Yes	Already Surveyed
NAT9ACR078	Carroll	818.48	818.64	818.79	1531	7.0	21	2	3	1	Yes	Already Surveyed
NAT9ACR079	Carroll	818.98	819.09	819.19	1109	5.1	19	1	0	0	No	Already Surveyed
NAT__CR080	Carroll	819.30	819.33	819.36	370	1.7	18	N/A	N/A	N/A	N/A	Cleared of trees by REX-West
NAT9ACR081	Carroll	823.18	823.20	823.23	317	1.5	27	Census	4	1	Yes	Already Surveyed
BATBH1MOCR001NO	Carroll	823.84	823.86	823.88	370	1.7	35	Census	0	0.0	No	Already Surveyed
NAT9ACR082	Carroll	824.29	824.45	824.60	1584	7.3	40	3	14	1	Yes	Already Surveyed
NAT9ACR083	Carroll	824.75	824.84	824.93	950	4.4	41	2	9	1	Yes	Already Surveyed
NAT9ACR084	Carroll	825.37	825.52	825.66	1584	7.3	41	3	15	1	Yes	Already Surveyed
NAT9ACR085	Carroll	825.80	825.85	825.89	475	2.2	40	1	3	1	Yes	Already Surveyed
NAT9ACR086	Carroll	825.97	826.15	826.33	1901	8.7	40	3	15	1	Yes	Already Surveyed
NAT9ACR087	Carroll	827.44	827.51	827.61	739	3.4	33	1	6	1	Yes	Already Surveyed
NAT9ACR088	Carroll	827.99	828.07	828.15	845	3.9	28	1	0	0	No	Already Surveyed
NAT9ACR089	Carroll	828.20	828.23	828.25	264	1.2	27	1	0	0	No	Already Surveyed
NAT9ACR090	Carroll	828.64	828.70	828.77	686	3.2	25	1	1	0.7	Yes	Already Surveyed
NAT9ACR091	Carroll	828.77	828.80	828.83	370	1.7	24	Census	4	0.9	Yes	Already Surveyed
NAT9ACR092	Carroll	828.95	829.03	829.12	845	3.9	23	1	0	0	No	Already Surveyed
NAT9ACR093	Carroll	829.77	829.82	829.85	475	2.2	22	1	0	0	No	Already Surveyed
BATBH1MOCR002NO	Carroll	830.41	830.47	830.54	634	2.9	20	Census	1	0.1	No	Already Surveyed
BATBH1MOCR003NO	Carroll	830.65	830.66	830.68	211	1.0	19	Census	0	0.0	No	Already Surveyed
NAT9ACR095	Carroll	831.17	831.24	831.31	686	3.2	14	1	0	0	No	Already Surveyed
NAT9ACR096	Carroll	843.06	843.16	843.25	1003	4.6	14	2	3	1	Yes	Already Surveyed
NAT__CI097	Chariton	843.45	843.54	843.62	898	4.1	14	N/A	N/A	N/A	N/A	Cleared of trees by REX-West
BATBH1MOCI001NO	Chariton	851.10	851.13	851.15	211	1.0	20	Census	0	0.0	No	Already Surveyed
BATBH1MOCI002NO	Chariton	851.38	851.44	851.48	317	1.5	20	Census	0	0.0	No	Already Surveyed

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Missouri.
Rows in gray represent woodlots that have not been assessed in the field (see Comments column for details).

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
BATBH_MOCI003NO	Chariton	851.80	852.00	852.17	2218	10.2	20	N/A	N/A	N/A	N/A	Access Denied
BATBH1MOCI004NO	Chariton	852.36	852.61	852.86	2693	12.4	20	Census	8	0.1	No	Already Surveyed
BATBH1MOCI005NO	Chariton	852.95	852.97	852.99	422	1.9	20	Census	0	0.0	No	Already Surveyed
NAT9ACI101	Chariton	854.96	855.04	855.13	845	3.9	23	Census	3	0.3	No	Already Surveyed
BATBH1MOCI006NO	Chariton	855.88	855.91	855.93	211	1.0	23	Census	0	0.0	No	Already Surveyed
BATBH1MOCI007NO	Chariton	856.12	856.15	856.19	422	1.9	22	Census	0	0.0	No	Already Surveyed
BATBH1MOCI008NO	Chariton	869.46	869.49	869.52	317	1.5	14	Census	0	0.0	No	Already Surveyed
BATBH1MOCI009NO	Chariton	869.57	869.60	869.65	422	1.9	15	Census	0	0.0	No	Already Surveyed
BATBH1MOCI010NO	Chariton	869.66	869.92	870.23	2851	13.1	19	Census	0	0.0	No	Already Surveyed
BATBH1MOCI011NO	Chariton	874.15	874.17	874.18	211	1.0	17	Census	0	0.0	No	Already Surveyed
BATBH1MOCI012NO	Chariton	874.33	874.58	874.83	2640	12.1	18	Census	0	0.0	No	Already Surveyed
NAT8ARA104	Randolph	877.38	877.41	877.45	422	1.9	14	Census	0	0	No	Already Surveyed
NAT8ARA105	Randolph	877.59	877.68	877.76	950	4.4	14	Census	3	0.4	No	Already Surveyed
NAT8ARA106	Randolph	877.88	877.99	878.11	1320	6.1	15	Census	1	0	No	Already Surveyed
NAT8ARA107	Randolph	879.17	879.18	879.20	264	1.2	22	Census	1	0.3	No	Already Surveyed
BATBH1MORA001NO	Randolph	879.29	879.40	879.53	1267	5.8	23	Census	7	0.2	No	Already Surveyed
BATBH1MORA002NO	Randolph	879.61	879.62	879.66	211	1.0	24	Census	0	0.0	No	Already Surveyed
BATBH1MORA003NO	Randolph	879.84	879.97	880.12	1373	6.3	25	Census	111	1.0	Yes	Already Surveyed
BATBH1MORA004NO	Randolph	880.18	880.26	880.36	845	3.9	26	Census	2	0.1	No	Already Surveyed
BATBH1MORA005NO	Randolph	880.53	880.66	880.79	1320	6.1	27	Census	3	0.1	No	Already Surveyed
NAT9ARA112	Randolph	882.52	882.56	882.63	475	2.2	37	1	1	0.7	Yes	Already Surveyed
NAT9ARA113	Randolph	882.66	882.77	882.85	739	3.4	37	1	7	1	Yes	Already Surveyed
NAT9ARA114	Randolph	883.21	883.28	883.35	792	3.6	37	1	3	1	Yes	Already Surveyed
NAT9ARA115	Randolph	883.49	883.53	883.58	370	1.7	38	Census	4	0.8	Yes	Already Surveyed
BATBH1MORA006NO	Randolph	883.88	883.94	884.02	634	2.9	39	Census	4	0.2	No	Already Surveyed
BATBH1MORA007NO	Randolph	884.12	884.32	884.54	2112	9.7	38	Census	6	0.1	No	Already Surveyed
NAT10ARA117/118	Randolph	885.56	885.78	886.01	2429	11.2	30	5	1	0.1	No	NAT10ARA117 & NAT10ARA118 are continuous and were combined into a single woodlot (NAT10ARA117/118)
NAT10ARA119	Randolph	886.13	886.29	886.46	1690	7.8	24	4	3	0.5	No	Already Surveyed
BATBH1MORA008NO	Randolph	896.95	897.00	897.05	528	2.4	13	Census	0	0	No	Already Surveyed
NAT10AAU120	Audrain	917.86	917.90	917.92	370	1.7	14	Census	0	0	No	Already Surveyed
NAT10AAU121	Audrain	918.22	918.29	918.35	581	2.7	14	1	2	1	Yes	Already Surveyed
BATBH1MOAU001NO	Audrain	919.06	919.13	919.21	792	3.6	17	Census	0	0	No	Already Surveyed
BATBH_1MOAU002NO	Audrain	921.37	921.40	921.42	211	1.0	17	Census	0	0	No	Already Surveyed
BATBH_MOMO001AU	Montgomery	943.88	943.91	943.93	211	1.0	13	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOMO002AU	Montgomery	944.04	944.06	944.07	264	1.2	14	N/A	N/A	N/A	N/A	Access Denied

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Missouri.
Rows in gray represent woodlots that have not been assessed in the field (see Comments column for details).

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
BATBH1MOMO003AU	Montgomery	945.18	945.23	945.27	475	2.2	18	Census	0	0	No	Already Surveyed
BATBH1MOMO004AU	Montgomery	945.33	945.62	945.91	3010	13.8	19	3	2	0.5	No	Already Surveyed
BATBH1MOMO005AU	Montgomery	945.96	946.39	946.78	4171	19.2	19	3	9	1	Yes	Already Surveyed
BATBH1MOMO006AU	Montgomery	946.86	946.93	947.00	739	3.4	18	Census	0	0	No	Already Surveyed
BATBH1MOMO007AU	Montgomery	947.10	947.14	947.18	634	2.9	18	Census	2	0.1	No	Already Surveyed
BATBH1MOMO008AU	Montgomery	947.20	947.26	947.33	686	3.2	18	Census	0	0	No	Already Surveyed
BATBH1MOMO009AU	Montgomery	947.41	947.44	947.47	422	1.9	17	Census	0	0	No	Already Surveyed
BATBH1MOMO010AU	Montgomery	947.50	947.52	947.52	211	1.0	17	Census	0	0	No	Already Surveyed
BATBH1MOMO011AU	Montgomery	948.94	949.03	949.13	1003	4.6	20	Census	2	0.1	No	Already Surveyed
BATBH1MOMO012AU	Montgomery	949.74	949.76	949.78	528	2.4	23	Census	0	0	No	Already Surveyed
BATBH1MOMO013AU	Montgomery	950.09	950.13	950.16	290	1.3	24	Census	0	0	No	Already Surveyed
BATBH1MOMO014AU	Montgomery	950.17	950.57	950.98	4198	19.3	25	Census	9	0.1	No	Already Surveyed
BATBH1MOMO015AU	Montgomery	951.03	951.04	951.08	290	1.3	25	Census	3	0.4	No	Already Surveyed
BATBH1MOMO016AU	Montgomery	951.13	951.31	951.48	1927	8.8	25	Census	6	0.1	No	Already Surveyed
BATBH1MOMO017AU	Montgomery	951.55	951.56	951.58	264	1.2	26	Census	0	0	No	Already Surveyed
BATBH1MOMO018AU	Montgomery	951.72	951.85	951.99	1373	6.3	27	Census	3	0.1	No	Already Surveyed
BATBH1MOMO019AU	Montgomery	952.45	952.53	952.61	845	3.9	27	Census	0	0	No	Already Surveyed
BATBH2MOMO020	Montgomery	953.15	953.26	953.36	1135	5.2	25	Census	0	0	No	Already Surveyed
BATBH2MOMO021	Montgomery	953.69	953.74	953.80	686	3.2	23	Census	2	0.1	No	Already Surveyed
BATBH2MOMO022	Montgomery	954.06	954.15	954.25	1056	4.8	22	Census	18	0.7	Yes	Already Surveyed
BATBH2MOMO023	Montgomery	954.41	954.48	954.56	792	3.6	22	Census	30	1	Yes	Already Surveyed
BATBH_MOMO024AU	Montgomery	954.64	954.71	954.79	607	2.8	24	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOMO025AU	Montgomery	954.78	954.88	954.98	1109	5.1	25	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOMO026AU	Montgomery	955.05	955.07	955.11	317	1.5	27	N/A	N/A	N/A	N/A	Access Denied
BATBH1MOMO027AU	Montgomery	955.46	955.70	955.95	2640	12.1	34	2	17	1	Yes	Already Surveyed
BATBH_MOMO028AU	Montgomery	956.29	956.62	956.95	3538	16.2	43	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOMO029AU	Montgomery	956.98	956.99	957.01	211	1.0	45	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI001AU	Lincoln	957.16	957.85	958.51	7234	33.2	51	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI002AU	Lincoln	958.56	958.89	959.24	3485	16.0	55	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI003AU	Lincoln	959.26	959.28	959.30	211	1.0	54	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI004AU	Lincoln	959.34	959.40	959.46	634	2.9	53	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI005AU	Lincoln	959.60	959.76	959.94	1690	7.8	54	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI006AU	Lincoln	959.99	960.04	960.10	581	2.7	54	N/A	N/A	N/A	N/A	Access Denied
BATBH1MOLI007AU	Lincoln	960.16	960.49	960.81	3379	15.5	54	3	7	1	Yes	Already Surveyed
BATBH1MOLI008AU	Lincoln	961.05	961.38	961.71	3485	16.0	57	4	8	1	Yes	Already Surveyed
BATBH1MOLI009AU	Lincoln	961.72	961.82	961.92	1056	4.8	56	Census	0	0	No	Already Surveyed
BATBH1MOLI010AU	Lincoln	961.92	961.98	962.04	634	2.9	56	Census	0	0	No	Already Surveyed

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Missouri.
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Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
BATBH1MOLI011AU	Lincoln	962.05	962.61	963.17	5914	27.2	54	5	17	1	Yes	Already Surveyed
BATBH1MOLI012AU	Lincoln	963.18	963.20	963.22	211	1.0	55	Census	0	0	No	Already Surveyed
BATBH1MOLI013AU	Lincoln	963.25	963.43	963.61	1901	8.7	55	Census	11	0.2	No	Already Surveyed
BATBH1MOLI014AU	Lincoln	963.66	963.84	964.02	1901	8.7	55	3	10	1	Yes	Already Surveyed
BATBH1MOLI015	Lincoln	964.05	964.16	964.26	1214	5.6	54	Census	13	0.4	No	Already Surveyed
BATBH1MOLI016AU	Lincoln	964.47	964.49	964.50	211	1.0	53	Census	0	0	No	Already Surveyed
BATBH1MOLI017	Lincoln	964.51	964.53	964.53	211	1.0	53	Census	0	0	No	Already Surveyed
BATBH1MOLI018	Lincoln	964.61	964.68	964.74	634	2.9	52	Census	1	0.1	No	Already Surveyed
BATBH1MOLI019AU	Lincoln	964.74	964.88	965.02	1531	7.0	50	2	1	0.4	No	Already Surveyed
BATBH1MOLI020AU	Lincoln	965.04	965.66	966.29	6653	30.5	45	4	15	1	Yes	Already Surveyed
BATBH2MOLI021	Lincoln	966.30	966.34	966.40	475	2.2	41	Census	1	0.1	No	Already Surveyed
BATBH2MOLI022	Lincoln	966.44	966.57	966.70	1373	6.3	40	Census	9	0.3	No	Already Surveyed
BATBH2MOLI023	Lincoln	966.81	966.84	966.89	581	2.7	38	Census	1	0.1	No	Already Surveyed
BATBH2MOLI024AU	Lincoln	966.92	966.97	967.00	475	2.2	37	Census	0	0	No	Already Surveyed
BATBH1MOLI025AU	Lincoln	967.15	967.53	967.91	4039	18.5	33	5	15	1	Yes	Already Surveyed
BATBH2MOLI026AU	Lincoln	967.97	968.09	968.18	1373	6.3	31	Census	5	0.1	No	Already Surveyed
BATBH2MOLI027AU	Lincoln	968.64	968.71	968.78	713	3.3	33	Census	20	1.0	Yes	Already Surveyed
BATBH2MOLI028AU	Lincoln	968.84	968.97	969.09	1320	6.1	34	Census	0	0	No	Already Surveyed
BATBH2MOLI029AU	Lincoln	969.14	969.16	969.17	211	1.0	34	Census	0	0	No	Already Surveyed
BATBH2MOLI030AU	Lincoln	969.25	969.27	696.29	211	1.0	34	Census	1	0.2	No	Already Surveyed
BATBH2MOLI031AU	Lincoln	969.46	969.53	969.61	792	3.6	33	Census	20	1.0	Yes	Already Surveyed
BATBH2MOLI032AU	Lincoln	969.83	969.89	969.95	634	2.9	33	Census	1	0.1	No	Already Surveyed
BATBH2MOLI033AU	Lincoln	970.07	970.09	970.11	211	1.0	32	Census	0	0	No	Already Surveyed
BATBH2MOLI034AU	Lincoln	970.14	970.30	970.44	1637	7.5	32	Census	20	0.5	No	Already Surveyed
BATBH2MOLI035AU	Lincoln	970.47	970.63	970.80	1795	8.2	29	Census	0	0	No	Already Surveyed
BATBH2MOLI036AU	Lincoln	970.82	971.11	971.40	3010	13.8	26	Census	20	0.3	No	Already Surveyed
BATBH2MOLI037AU	Lincoln	971.47	971.51	971.54	475	2.2	25	Census	0	0	No	Already Surveyed
BATBH2MOLI038AU	Lincoln	971.68	971.87	972.05	1954	9.0	24	Census	20	0.4	No	Already Surveyed
BATBH2MOLI039AU	Lincoln	972.19	972.30	972.40	1162	5.3	22	Census	4	0.1	No	Already Surveyed
BATBH2MOLI040AU	Lincoln	972.40	972.48	972.53	739	3.4	21	Census	0	0	No	Already Surveyed
BATBH2MOLI041AU	Lincoln	972.58	972.64	972.70	634	2.9	20	Census	0	0	No	Already Surveyed
BATBH2MOLI042AU	Lincoln	972.79	972.84	972.90	1003	4.6	18	Census	7	0.3	No	Already Surveyed
BATBH2MOLI043AU	Lincoln	973.24	973.35	973.44	1056	4.8	19	Census	0	0	No	Already Surveyed
BATBH2MOLI044AU	Lincoln	973.57	973.66	973.73	1056	4.8	21	Census	3	0.1	No	Already Surveyed
BATBH1MOLI001NO	Lincoln	974.24	974.25	974.27	211	1.0	27	Census	0	0	No	Already Surveyed
BATBH_MOLI002NO	Lincoln	974.29	974.32	974.35	422	1.9	28	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI003NO	Lincoln	975.15	975.19	975.22	264	1.2	32	N/A	N/A	N/A	N/A	Access Denied

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Missouri.
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Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
BATBH_MOLI004NO	Lincoln	975.23	975.26	975.30	317	1.5	33	N/A	N/A	N/A	N/A	Access Denied
BATBH3MOLI051	Lincoln	975.91	975.93	975.95	264	1.2	26	Census	0	0	No	Already Surveyed
BATBH3MOLI052	Lincoln	976.07	976.09	976.11	264	1.2	25	Census	0	0	No	Already Surveyed
BATBH3MOLI053	Lincoln	976.83	976.90	976.96	686	3.2	22	Census	0	0	No	Already Surveyed
BATBH4MOLI054	Lincoln	977.36	977.42	977.48	686	3.2	19	Census	0	0	No	Already Surveyed
BATBH4MOLI055	Lincoln	977.59	977.61	977.63	211	1.0	18	Census	0	0	No	Already Surveyed
BATBH2MOLI056AU	Lincoln	979.90	979.93	979.96	370	1.7	15	Census	0	0	No	Already Surveyed
BATBH_MOLI001MA	Lincoln	980.16	980.21	980.26	2640	12.1	19	N/A	N/A	N/A	N/A	Access Denied
BATBH_MOLI002MA	Lincoln	980.59	980.62	980.65	1690	7.8	20	N/A	N/A	N/A	N/A	Access Denied
BATBH1MOLI003MA	Lincoln	981.04	981.16	981.28	1320	6.1	18	Census	3	0.1	No	Already Surveyed
BATBH1MOLI004MA	Lincoln	981.42	981.55	981.68	2772	12.7	16	Census	4	0.1	No	Already Surveyed
BATBH1MOSC001MA	St. Charles	988.82	988.92	989.02	1346	6.2	14	Census	3	0.1	No	Already Surveyed
BATBH1MOSC002MA	St. Charles	989.20	989.30	989.40	1109	5.1	16	Census	2	0.1	No	Already Surveyed
BATBH1MOSC003MA	St. Charles	989.45	989.51	989.57	634	2.9	16	Census	1	0.1	No	Already Surveyed
BATBH1MOSC004MA	St. Charles	989.78	989.84	989.91	792	3.6	17	Census	3	0.1	No	Already Surveyed
BATBH1MOSC005MA	St. Charles	989.95	989.97	989.98	370	1.7	17	Census	0	0	No	Already Surveyed
BATBH1MOSC006MA	St. Charles	990.04	990.21	990.39	1874	8.6	18	Census	17	0.3	No	Already Surveyed
BATBH1MOSC007MA	St. Charles	990.58	990.67	990.76	950	4.4	21	Census	0	0	No	Already Surveyed

Table 2. Wooded areas within the proposed Keystone survey corridor in Missouri with HSI values of 0.6 or greater.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Woodlot Area Based on July 2007 Construction Corridor & EWSs (acres)	Woodlot Area Co-located With REX-West (acres)	"Keystone Only" Woodlot Area (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
NAT8ABC018/019	Buchanan	760.41	760.64	760.86	2376	10.9	6.8	3.5	3.3	31	4	4	0.7	Yes	NAT8ABC018 & NAT8ABC019 are continuous and were combined into a single woodlot (NAT8ABC018/019)
BATBH1MOBC002AU	Buchanan	761.46	761.51	761.56	581	2.7	1.3	n/a	n/a	29	Census	11	0.7	Yes	Already Surveyed
NAT8ABC024	Buchanan	762.92	763.04	763.15	792	3.6	3.1	1.2	2.0	22	1	1	0.7	Yes	Already Surveyed
NAT8ABC033	Buchanan	769.14	769.21	769.27	634	2.9	2.0	0.9	1.1	15	2	7	1	Yes	Already Surveyed
NAT9ACL038	Clinton	775.32	775.36	775.39	370	1.7	1.0	0.6	0.4	15	Census	6	1	Yes	Already Surveyed
NAT9ACL039	Clinton	775.70	775.84	775.98	1478	6.8	3.5	2.2	1.3	14	2	3	1	Yes	Already Surveyed
BATBH2MOCL002NO	Clinton	784.10	784.13	784.15	845	3.9	0.4	n/a	n/a	17	Census	16	0.7	Yes	Already Surveyed
BATBH1MOCL004NO	Clinton	788.07	788.32	788.56	2640	12.1	7.0	n/a	n/a	19	Census	42	0.6	Yes	Already Surveyed
NAT9ACL046	Clinton	789.39	789.45	789.51	581	2.7	1.4	0.9	0.6	16	1	2	1	Yes	Already Surveyed
NAT9ACL047	Clinton	789.61	789.67	789.71	475	2.2	0.8	0.7	0.1	16	Census	2	0.6	Yes	Already Surveyed
NAT9ACL049	Clinton	790.81	790.85	790.89	422	1.9	1.3	0.6	0.7	16	1	3	1	Yes	Already Surveyed
NAT10ACA051	Caldwell	793.86	793.88	793.91	211	1.0	0.6	0.3	0.3	18	1	2	1	Yes	Already Surveyed
NAT10ACA052	Caldwell	796.88	796.98	797.08	1056	4.8	2.3	1.6	0.7	21	2	2	0.7	Yes	Already Surveyed
NAT10ACA058	Caldwell	799.09	799.12	799.15	317	1.5	0.8	0.5	0.3	22	1	1	0.7	Yes	Already Surveyed
NAT10ACA059	Caldwell	799.15	799.22	799.29	686	3.2	1.8	1.0	0.8	22	1	1	0.7	Yes	Already Surveyed
NAT10ACA060	Caldwell	800.85	800.87	800.89	211	1.0	0.5	0.3	0.2	18	1	2	1	Yes	Already Surveyed
NAT10ACA061	Caldwell	801.46	801.56	801.65	1003	4.6	2.6	1.5	1.1	14	2	2	0.7	Yes	Already Surveyed
NAT10ACA062	Caldwell	801.74	801.77	801.79	317	1.5	0.8	0.5	0.3	15	1	1	0.7	Yes	Already Surveyed
NAT10ACA067	Caldwell	810.33	810.44	810.52	1003	4.6	2.6	1.5	1.1	19	2	3	1	Yes	Already Surveyed
NAT10ACA068	Caldwell	810.55	810.61	810.67	634	2.9	1.8	0.9	0.8	20	2	2	0.7	Yes	Already Surveyed
NAT10ACA069	Caldwell	810.82	810.95	811.08	1373	6.3	4.0	2.0	2.0	21	2	2	0.7	Yes	Already Surveyed
NAT9ACR077	Carroll	818.07	818.15	818.22	792	3.6	2.3	1.2	1.1	23	1	1	0.7	Yes	Already Surveyed
NAT9ACR078	Carroll	818.48	818.64	818.79	1531	7.0	4.2	2.3	2.0	21	2	3	1	Yes	Already Surveyed
NAT9ACR081	Carroll	823.18	823.20	823.23	317	1.5	0.7	0.5	0.3	27	Census	4	1	Yes	Already Surveyed
NAT9ACR082	Carroll	824.29	824.45	824.60	1584	7.3	3.7	2.4	1.3	40	3	14	1	Yes	Already Surveyed
NAT9ACR083	Carroll	824.75	824.84	824.93	950	4.4	2.6	1.4	1.2	41	2	9	1	Yes	Already Surveyed
NAT9ACR084	Carroll	825.37	825.52	825.66	1584	7.3	4.1	2.4	1.7	41	3	15	1	Yes	Already Surveyed
NAT9ACR085	Carroll	825.80	825.85	825.89	475	2.2	1.3	0.7	0.6	40	1	3	1	Yes	Already Surveyed
NAT9ACR086	Carroll	825.97	826.15	826.33	1901	8.7	5.1	2.8	2.2	40	3	15	1	Yes	Already Surveyed
NAT9ACR087	Carroll	827.44	827.51	827.61	739	3.4	2.2	1.1	1.1	33	1	6	1	Yes	Already Surveyed
NAT9ACR090	Carroll	828.64	828.70	828.77	686	3.2	2.0	1.0	1.0	25	1	1	0.7	Yes	Already Surveyed
NAT9ACR091	Carroll	828.77	828.80	828.83	370	1.7	0.7	0.6	0.1	24	Census	4	0.9	Yes	Already Surveyed
NAT9ACR096	Carroll	843.06	843.16	843.25	1003	4.6	2.7	1.5	1.2	14	2	3	1	Yes	Already Surveyed
BATBH1MORA003NO	Randolph	879.84	879.97	880.12	1373	6.3	3.6	n/a	n/a	25	Census	111	1.0	Yes	Already Surveyed
NAT9ARA112	Randolph	882.52	882.56	882.63	475	2.2	1.4	0.7	0.7	37	1	1	0.7	Yes	Already Surveyed
NAT9ARA113	Randolph	882.66	882.77	882.85	739	3.4	2.5	1.1	1.4	37	1	7	1	Yes	Already Surveyed

Table 2. Wooded areas within the proposed Keystone survey corridor in Missouri with HSI values of 0.6 or greater.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Woodlot Area Based on July 2007 Construction Corridor & EWSs (acres)	Woodlot Area Co-located With REX-West (acres)	"Keystone Only" Woodlot Area (acres)	Percent Forest Cover Within 3.5 km	Number of Plots	Total Number of PRTs	Woodlot HSI	HSI ≥ 0.6	Comments
NAT9ARA114	Randolph	883.21	883.28	883.35	792	3.6	2.1	1.2	0.9	37	1	3	1	Yes	Already Surveyed
NAT9ARA115	Randolph	883.49	883.53	883.58	370	1.7	1.0	0.6	0.4	38	Census	4	0.8	Yes	Already Surveyed
NAT10AAU121	Audrain	918.22	918.29	918.35	581	2.7	1.7	0.9	0.9	14	1	2	1	Yes	Already Surveyed
BATBH1MOMO005AU	Montgomery	945.96	946.39	946.78	4171	19.2	9.4	n/a	n/a	19	3	9	1	Yes	Already Surveyed
BATBH2MOMO022	Montgomery	954.06	954.15	954.25	1056	4.8	2.7	n/a	n/a	22	Census	18	0.7	Yes	Already Surveyed
BATBH2MOMO023	Montgomery	954.41	954.48	954.56	792	3.6	2.4	n/a	n/a	22	Census	30	1	Yes	Already Surveyed
BATBH1MOMO027AU	Montgomery	955.46	955.70	955.95	2640	12.1	5.5	n/a	n/a	34	2	17	1	Yes	Already Surveyed
BATBH1MOLI007AU	Lincoln	960.16	960.49	960.81	3379	15.5	8.8	n/a	n/a	54	3	7	1	Yes	Already Surveyed
BATBH1MOLI008AU	Lincoln	961.05	961.38	961.71	3485	16.0	12.2	n/a	n/a	57	4	8	1	Yes	Already Surveyed
BATBH1MOLI011AU	Lincoln	962.05	962.61	963.17	5914	27.2	20.0	n/a	n/a	54	5	17	1	Yes	Already Surveyed
BATBH1MOLI014AU	Lincoln	963.66	963.84	964.02	1901	8.7	4.6	n/a	n/a	55	3	10	1	Yes	Already Surveyed
BATBH1MOLI020AU	Lincoln	965.04	965.66	966.29	6653	30.5	23.1	n/a	n/a	45	4	15	1	Yes	Already Surveyed
BATBH1MOLI025AU	Lincoln	967.15	967.53	967.91	4039	18.5	10.4	n/a	n/a	33	5	15	1	Yes	Already Surveyed
BATBH2MOLI027AU	Lincoln	968.64	968.71	968.78	713	3.3	1.2	n/a	n/a	33	Census	20	1.0	Yes	Already Surveyed
BATBH2MOLI031AU	Lincoln	969.46	969.53	969.61	792	3.6	0.8	n/a	n/a	33	Census	20	1.0	Yes	Already Surveyed
						320.5	**191.8**	**43.0**	**35.3**						

Appendix C. Field Data Sheets

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: NATBH1BC005 Plot No.: 1

Date: 28 Feb 2007 Start Time: 1045

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Unknown (dead)	N/A	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Black cherry (Prunus Serotina)
* Box elder (Acer negundo)
* Cottonwood (Populus deltoides)
* Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across Stream
⊥ to treeline

Comments (include access comments):

Stream has very steep banks

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOBC0001AU Plot No.: 1

Date: 22 Feb 2007 Start Time: 1358

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus amer. (dead) Ulmus americana (dead) Unknown (dead) " Carya ovata (alive)	Quercus rubra (alive) - dead branches Quercus alba (dead) " Carya ovata (alive) " Ulmus rubra (dead) Quercus rubra (dead) Ulmus amer (dead)	Quercus alba (dead) Unknown (dead) Juglans nigra (alive) - dead branches " Carya ovata (alive) Prunus serotina (alive) - dead branches	N/A	Juglans nigra (alive) - dead branch Quercus rubra (alive) - dead branches

Total No. of PRTs: 24

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

White oak (Quercus alba)
Red oak (Quercus rubra)
Shagbark (Carya ovata)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing ROW
across Antrim

Comments (include access comments):

firearm shooting range, trap/skeet shooting area, & archery areas near site
site on Pigeon Creek Conservation Area
trees in pipeline area are marked & project area flagged

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOBC000JAU Plot No.: 1

Date: 22 Feb 2007 Start Time: 1134

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Juglans nigra (dead) 11	Ulmus americana (dead) 11	N/A	N/A	Quercus rubra (alive) - dead branches
Unknown (dead) 111	Unknown (dead) 1			
Ulmus americana (dead) 11				

Total No. of PRTs: 11

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

* Hackberry (Celtis occidentalis)
* Red oak (Quercus rubra)
* Honeylocust (Gleditsia triacanthos)
American elms (Ulmus americana)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

1 to treeline

Comments (include access comments):

many trees have been girdled

trees in pipeline area are marked & project area flagged

Site on Pigeon Creek conservation Area

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOBL002NO Plot No.: 1

Date: 21 Feb 2007 Start Time: 1245

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus amer. (dead) II Ulmus sp. (dead)	N/A	N/A	N/A	N/A

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Black willow (Salix nigra)
Honey locust (Gleditsia triacanthos)
Black walnut (Juglans nigra)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across stream
across track that intersects lot
⊥ treeline

Comments (include access comments):

Stream has very steep banks
many hard-to-cross fences

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHMORBC0002WO Plot No.: 1

Date: 21 Feb 2007 Start Time: 1225

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Acer negundo (ashW) - dead at top	N/A	N/A	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus alba (White oak)

Maclura pomifera (Osage-orange)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

⊥ to treeline

Comments (include access comments):

old cow pasture

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOBL0003NO Plot No.: 1

Date: 21 Feb 2007 Start Time: 1100

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus amer. (dead)	Ulmus amer. (dead) Carya sp. (dead) Carya sp. (dead) Carya ovata (alive) Quercus alba (dead)	Ulmus amer. (alive) - dead branch Carya ovata (alive) Quercus rubra (alive) - dead branch	N/A	N/A

Total No. of PRTs: 11

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus alba (White oak)
Quercus rubra (red oak)
Carya ovata (Shagbark Hickory)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Across 2-track
⊥ to treeline

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2 NO BC 004 NO Plot No.: 1

Date: 3 August 2007 Start Time: 1630

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14"

Robinia pseudoacacia

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photo: 001 N
002 S

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2WOBC0005NU Plot No.: 1

Date: 3 August 2007 Start Time: 1020

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
none	Juglans (3) nigra (dead)	none	QRW none	Quercus sp. (dead)

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14"

Juglans nigra
Gleditsia triacanthos
Morus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

PHOTO: ODIW
ODIE

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOBCWOODLND Plot No.: 1

Date: 20 Feb 2007 Start Time: 1215

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	Ulmus americana (dead)	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Honeylocust (Gleditsia triacanthos)
American elm (Ulmus americana)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
none

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: GATEHMOBC007NO Plot No.: 1

Date: 20 Feb 2007 Start Time: 1300

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Celtis occid. (dead)	N/A	N/A	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Hackberry (Celtis occidentalis)

Bitternut Hickory (Carya cordiformis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

1 to treeline

across Stream (steep banks & ~6 m wide)

Comments (include access comments):

Streams have steep banks

Site intersected by barbed wire fence

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMORC008 NO Plot No.: 1

Date: 21 Feb 2007 Start Time: 0930

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Black Willow (Salix nigra)
Cottonwood (Populus deltoides)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

Spoke with Steve Ostrander. He is not aware of the location of the Keystone pipeline + would rather it not go through the stand of trees. He would also like a detailed map of current location of proposed pipeline (the BHE GIS maps
Contact info on back →

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCLDDINO Plot No.: 1

Date: 18 Feb 2022 Start Time: 1715

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: Ø

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Shagbark Hickory (Carya ovata) - too young for PRTs
Black Willow (Salix nigra)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

⊥ to treeline

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBMOCL0002NO Plot No.: 1

Date: 5 August Start Time: 1345

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Carya ovata (alive) (3)	Carya ovata (8) (alive)	Carya ovata (alive) (4)	Carya ovata (alive)	none

Total No. of PRTs: 16

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Carya ovata

Carya tomentosa

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

marshy pond

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2WOCL(003N) Plot No.: 1

Date: 3 August 2017 Start Time: 1403

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22"

Maclura pomifera

Gleditsia triacanthos

Quercus alba

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E

002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCL004NO Plot No.: 1

Date: 19Feb 2007 Start Time: 2945

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus americana (dead) IIII IIII IIII I	Carya ovata (alive) IIII IIII III Ulmus americana (dead) IIII	Carya ovata (alive) III Ulmus americana (dead) I	Carya ovata (alive) II	Carya ovata (alive) I

Total No. of PRTs: 42 (U.amer=22)(C.ovata=20)

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

{White oak (Quercus alba)*
{Shagbark (Carya ovata)*
{Hackberry (Celtis occidentalis)
{American Elm (Ulmus americana)

{Shingle oak (Quercus imbricaria)
{Honey locust (Gleditsia triacanthos)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
across stream
⊥ to treeline

Comments (include access comments):
Saw bald eagle in field near site (along west treeline)

RBH1 0227b&c

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH1 MOCL0205NJO Plot No.: 1

Date: 21 Feb 2007 Start Time: 930

Length of East/West Plot Edge (ft): 66

Length of North/South Plot Edge (ft): 66

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus amer. (dead)	Ulmus americana (dead)	Acer negundo (dying)	N/A	N/A
	Unknown (dead)	Acer negundo (dying)		

Total No. of PRTs: 5

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Acer negundo (Box elder)

Ulmus Americana (American elm)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

+ to treeline

Comments (include access comments):

Road to C. is very muddy + rutted deeply

↓

280th St

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATCHIMOCL0026/10 Plot No.: 1

Date: 27 Feb 2007 Start Time: 1030

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus americana (dead) ~3 m tall Ulmus americana (dead) III Unknown (dead	Prunus serotina (dead) Quercus rubra (dead) Ulmus americana (dead) IIII Tall connected at base	Fraxinus pennsylvanica (alive) - dead branch	N/A	Acer sacc Populus deltoides (alive) - dead branches Populus deltoides (alive)

Total No. of PRTs: 14

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Shagbark (Carya ovata)
Red oak (Quercus rubra)
Shingle Oak (Quercus imbricaria)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

+ to treelines
across stream

Comments (include access comments):

Road to south (250th) requires 4WD to pass (muddy + deeply rutted)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOCL0008NU Plot No.: 1

Date: 3 August 2007 Start Time: 1231

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
none	none	none	Robinia pseudoacacia (2) (dead)	none

Total No. of PRTs: 2

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10"

Salix nigra

Robinia pseudoacacia

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photo: 001W
000E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOCL009NO Plot No.: 1

Date: 3 August 2007 Start Time: 1200

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
none	Unknown dead trunk	none	none	none

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Juglans nigra
Populus deltoides
Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photo: 001W
002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MACLODNO Plot No.: 1

Date: 3 August 2007 Start Time: 1120

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
none	Acer negundo (dead)	Juglans nigra (dead)	dogw	none

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Celtis occidentalis Robinia pseudoacacia Juglans nigra Estimated Average Overstory dbh (in): 18"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

Photos: 00E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBTH1 WOCA002NO Plot No.: 1

Date: 13 Feb. 2007 Start Time: 1445

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Ulmus americana (dead) - partially overgrown by live tree	N/A	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

1) Black willow (Salix nigra)
2) Osage orange (Maclura pomifera)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

1 to treeline

Comments (include access comments):

live electric fence intersects site

huge snag (cottonwood? - large furrows) w/ >2 cavities that had been struck by lightning + hollowed (no bark except up high so no PRT)

saw 2 adult male bald eagles flying over neighboring field

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATCH1 MOCA003NO Plot No.: 1

Date: 18 Feb 2007 Start Time: 1400

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	Salix nigra (dying)

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Cottonwood (Populus deltoides)
Silvermaple (Acer Saccharinum)
Black Willow (Salix nigra)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

4 to treeline

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATRH2MOCA005NO Plot No.: 1

Date: 3 August 2007 Start Time: 0852

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
none	none	none	Juglans nigra (dead)	none

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Juglans nigra Estimated Average Overstory dbh (in): 17"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

pond

Comments (include access comments):

photo W E
S

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCR001NO Plot No.: 1

Date: 2-6-07 Start Time: 1330

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: ∅

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Black walnut (Juglans nigra)
Shagbark hickory (Carya ovata)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

in cow pasture surrounded by barbed wire & electric fencing (all in one fence)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCR002NO Plot No.: 1

Date: 8-(o-07 Start Time: 1400

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus americana (dead)	N/A	N/A	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Honey locust (Gleditsia triacanthos)
Shingle oak (Quercus imbricaria)
Pin oak (Quercus palustris)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

barb wire fence around woodlot
Cow pasture (pies but no visible cows)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOCR0023NO Plot No.: 1

Date: 2-6-07 Start Time: 1500

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Honey locust (Gleditsia triacanthos)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

1. to treeline

Comments (include access comments):

abandoned well (stone lined, no cover) at west border of treeline (near centerline)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI001NO Plot No.: 1

Date: 17 Feb 2007 Start Time: 1420

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Sycamore (Platanus occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

⊥ to treeline

Comments (include access comments):

* GPS enter pt ≈ 60' west of actual enter point (couldn't cross stream)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI002NO Plot No.: 1

Date: 2-6-07 Start Time: 1010

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): River birch (Betula nigra)

Estimated Average Overstory dbh (in): 18

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

in cow pasture

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI004NO Plot No.: 1

Date: 17 Feb 2007 Start Time: 1230

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus rubra (dying)	Ulmus rubra (dying)	N/A	[illegible]	Juglans nigra (alive) - some dead branches
Ulmus americana (dead)	Carya sp. (dead)		Juglans nigra (dead)	
	Unknown (dead)		Juglans nigra (dying)	
			[illegible]	

Total No. of PRTs: 8

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Hackberry (Celtis occidentalis)
River birch (Betula nigra)
White oak (Quercus alba)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing flow

Comments (include access comments):

hunting blind near center point
barbed wire fences to mid east end
2 streams (too narrow to net) w/ steep bank
* GPS exit ≈ 300' east of actual exit point (stream not passable)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI005NO Plot No.: 1

Date: 17 Feb 2007 Start Time: 1145

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: Ø

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Hackberry (Celtis occidentalis)
Pin Oak (Quercus palustris)
American elm (Ulmus americana)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

⊥ to treeline across existing ROW

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI006NO Plot No.: 1

Date: 17 Feb 2007 Start Time: 1115

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Cottonwood (Populus deltoides)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI007NO Plot No.: 1

Date: 17 Feb 2007 Start Time: 1045

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

American elm (Ulmus americana)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

1 to treeline

Comments (include access comments):

huge live Am. elm (~60-70 cm dbh)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI009NO Plot No.: 1

Date: 16 Feb 2007 Start Time: 1440

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 7

Black locust (Robinia pseudoacacia)
Shingle Oak (Quercus imbricaria)
Pin Oak (Quercus palustris)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOCI009NO Plot No.: 1

Date: 16 Feb 2017 Start Time: 1420

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 4

Black Cherry (Prunus Serotina)
Hackberry (Celtis occidentalis)
Black Willow (Salix nigra)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

on edge of pond

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BHIMOCI0I0NO Plot No.: 1

Date: 16 Feb 2007 Start Time: 1325

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Osage orange (Maclura pomifera)
Hackberry (Celtis occidentalis)
Honey locust (Gleditsia triacanthos)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

access existing powerline ROW

Comments (include access comment):

East end accessable through gate to Salisbury Municipal Golf Course.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCIDIINO Plot No.: 1

Date: 16 Feb 2007 Start Time: 1110

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Quercus rubra
Quercus prinus

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

white board in image says "W" instead of "S".
Photo was facing S not W.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOCI0012NO Plot No.: 1

Date: 16 Feb 2007 Start Time: 1150

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 4

1. Acer saccharinum
2. Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across trail (~4m)

across stream (~10m), steep bank

Comments (include access comments):

Can possibly drive through site (trail is wide enough + level except where enters woodlot on west end, follows stream)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATCH1MORA00IN0 Plot No.: 1

Date: 2-7-07 Start Time: 1230

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus americana (dead)	Ulmus americana (dead)	N/A	N/A	N/A
Ulmus americana (dead)	Ulmus americana (dead)			
	Carya ovata (dead)			
Ulmus americana (dead)	Ulmus americana (dead)			

Total No. of PRTs: 7

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Amer. elm (Ulmus americana)
Sycamore (Platanus occidentalis)
Black walnut (Juglans nigra)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing ROW

Comments (include access comments):

must cross several barbed fences to get to site

878.25-878.29

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMORA002NO Plot No.: 1

Date: 8-7-07 Start Time: 1300

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Honey locust (Gleditsia triacanthos)
Black locust (Robinia pseudoacacia)
American elm (Ulmus americana)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

in cow pasture

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MORA003NO Plot No.: 1

Date: 2-1-07 Start Time: 1400

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Carya ovata (alive)	Carya ovata (alive)	Fagus sp. (dead)	Carya ovata (alive)	N/A
Quercus sp. (dead)	Quercus sp. (dead)			
Carya ovata (dead)	Carya ovata (dead)			
Fagus sp. (dead)	Fagus grandifolia (dead)			

Total No. of PRTs: >111 (>101 C. ovata)

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Shagbark (Carya ovata) Estimated Average Overstory dbh (in): 8

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing ROW

access road through woods

Comments (include access comments):

- landowners granted us permission to survey but do not want their woods cut down for the pipeline.
- more shagbark hickories than I could count.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATISH MORADO4NO Plot No.: 1

Date: 8/1-2/1 Start Time: 1450

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Ulmus americana (elm)	Ulmus americana (elm)	N/A	N/A

Total No. of PRTs: 2

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

swamp oak (Quercus palustris)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

in cow pasture
many existing electric fences

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BHI MORA005 NO Plot No.: 1

Date: 2-5-07 Start Time: 1542

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus americana (elm)	Quercus rubra (oak) Black locust (robinia pseudoacacia) (dying)	N/A	N/A	N/A

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Shingle Oak (Quercus imbricaria)

Black locust (Robinia pseudoacacia)

Bitternut Hickory (Carya cordiformis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing ROW

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMORA002(a)NO Plot No.: 1

Date: 2-7-07 Start Time: 0930

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Unknown (dead) - no bark - crooked Shagbark (alive)	N/A	Unknown (dead)	Unknown (dead) - no bark - crooked

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Shingle oak (Quercus imbricaria)

Shagbark hickory (Carya ovata)

American elm (Ulmus americana)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMORA0071NO Plot No.: 1

Date: 2-7-07 Start Time: 1310

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus Americana (alive)	N/A	Carya ovata (alive)	Quercus alba (mostly dead)	N/A
Ulmus americana (dead)				
Ulmus americana (dead)				
Ulmus americana (dead)				
[illegible]				
[illegible]				
[illegible]				

Total No. of PRTs: 6

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Honey locust (Gleditsia triacanthos)

American elm (Ulmus americana)

Shagbark hickory (Carya ovata)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

access existing ROW

1 to treeline

Comments (include access comments):

Scratched out last 4 PRT's above because we wandered away from pipeline without realizing it (GPS did not update because of cold + lack of satellites).

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATCH 2 NORTH WOODS NO Plot No.: ALL

Date: 8-4-07 Start Time: 7:35

Length of East/West Plot Edge (ft): 50

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus pallustris, Quercus imbricaria, Gleditsia triacanthos

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATHAM0A1007_NO Plot No.: ALL

Date: 8-3-07 Start Time: 4:45

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Quercus palustris, Quercus imbricaria, Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

Started at 918.94 due to access restrictions- impassable electric fencing

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1 MOAV 002 & NO Plot No.: ALL

Date: 8-3-07 Start Time: 4:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 6

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Quercus Palustris Quercus Imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NO

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHZMONO 003AV Plot No.: ALL

Date: 8-3-01 Start Time: 11:20

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba Estimated Average Overstory dbh (in): 10

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHMDMD004AV Plot No.: 1

Date: 8-3-07 Start Time: 10:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Carya ~~glabra~~ glabra; Juniperus virginiana Estimated Average Overstory dbh (in): 8

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MQWD004AV Plot No.: 2

Date: 8-3-07 Start Time: 11:00

Length of East/West Plot Edge (ft): 765

Length of North/South Plot Edge (ft): 665

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Quercus palustris, Quercus velutina

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W., ATV trail

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHMMWOOD1AU Plot No.: 3

Date: 8-3-07 Start Time: 11:05

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		2X Quercus alba - dead		

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Quercus alba, Carya ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W., pond

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHAMMOOSAV Plot No.: 1

Date: 8-3-07 Start Time: 9:10

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	2 Carya ovata -alive Quercus rubra -dead	Quercus alba -alive		

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

Quercus alba, Carya ovata, Quercus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BA1 MEADOWS AV Plot No.: 2

Date: 8-3-07 Start Time: 9:20

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	[illegible] dead		[illegible]	

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 4

Quercus rubra, Quercus stellata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOM0005AV Plot No.: 3

Date: 8-3-07 Start Time: 9:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Quercus alba - dead	Quercus alba - alive Carya ovata - alive	Quercus alba - alive	

Total No. of PRTs: 5

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Carya ovata Estimated Average Overstory dbh (in): 14

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOM0006AU Plot No.: A2

Date: _____ Start Time: 1:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Q Carya ovata, Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1 MMA DOT ROW Plot No.: A22

Date: 8-3-17 Start Time: 1:40

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Prunus serotina - dead		Quercus palustris dead

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Ulmus americana Quercus palustris Estimated Average Overstory dbh (in): 10

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAYBERRY WOODS AV Plot No.: AVC

Date: 8-3-07 Start Time: 2:10

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus imbricaria, Juniperus virginiana Estimated Average Overstory dbh (in): 6

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BHI MOMO 009 AV Plot No.: A-2c

Date: 8-3-07 Start Time: 2:15

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus imbricaria, ~~Quercus~~ Carya ovata Estimated Average Overstory dbh (in): 30

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH1 MAMO 010 AV Plot No.: ALL

Date: 6-3-07 Start Time: 2:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Carya ovata, Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH1 MOMO 08 11 AV Plot No.: ALL

Date: 8-3-07 Start Time: 7:50

Length of East/West Plot Edge (ft): 8

Length of North/South Plot Edge (ft): 8

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	2 Ulmus alberta (Dead)			

Total No. of PRTs: 2

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 7

Maclura Pomifera Acer Saccharinum Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

ROW

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHEMOW012AV Plot No.: ALL

Date: 8-2-07 Start Time: 2:40

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 9

Maclura pomifera, Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOM0013AV Plot No.: ALL

Date: 8-7-07 Start Time: 2:30

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): ____

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

Not a woodlot. No data recorded

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH1M0M0014AV Plot No.: A2L

Date: 8-2-07 Start Time: 12:10

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	4 Salix Nigra (Dead)	2 Carya Ovata (Alive) 1 Ulmus Americana (Dead) ~~4 Salix~~	2 Quercus alba (Alive)	

Total No. of PRTs: 9

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 13

Quercus alba Quercus Stellata Carya Ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Road in center, ROW

Comments (include access comments):

Did not survey west of 950.53 due to access-denied properties

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MAN0015AV Plot No.: ALL

Date: 8-2-07 Start Time: 1200pm

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	3x Ulmus americana - dead			

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Fraxinus americana, Quercus alba, Ulmus americana Estimated Average Overstory dbh (in): 8

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MM0016AV Plot No.: ALL

Date: 8-2-07 Start Time: 11:20

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	2x Quercus alba -dead	2x Quercus alba -dead Quercus alba- alive		Quercus alb. -alive

Total No. of PRTs: 6

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Fraxinus americana Estimated Average Overstory dbh (in): 12

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4MOM0017AU Plot No.: ALL

Date: 8-2-07 Start Time: 11:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus imbricaria, Quercus rubra, Celtis occidentalis Estimated Average Overstory dbh (in): 10

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1_MOMO018_AU Plot No.: ALL

Date: 8-2-07 Start Time: 10:10

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus americana - dead		Carya ovata - alive		Quercus robur - dead

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Juglans nigra, Ulmus americana Estimated Average Overstory dbh (in): 10"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W., stream, ATV trail

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1 MAPLOTAU Plot No.: ALL

Date: 8-2-07 Start Time: 9:45

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Carya ovata, Quercus imbricaria, Gladitsia triacan

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOM0020 Plot No.: 1

Date: 12-9-06 Start Time: 10:40

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 39° 3' 38.24SN
Long: 91° 19.45.050W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	NA	NA	NA	NA

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Juniperus virginiana

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

Stand of cedar

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOMD021 Plot No.: 1

Date: 12-9-06 Start Time: 11:15

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 39° 3' 29.1863" N

Long: 91° 19' 13.6294" W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	Carya ovata (alive)	NA	Standing dead	NA

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

Maclura pomifera Quercus imbricaria

Gleditsia triacanthos

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

open areas and stream

Comments (include access comments):

Brahmah Bull

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHZMOMO022 Plot No.: 1

Date: 12-9-06 Start Time: 12:00

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 39°3'22.687"N
Long: 91°18'45.0[illegible]"W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	5 Carya ovata alive +5	dead Gleditsia triacanthos 5 Carya Ovata alive	Gleditsia triacanthos alive	Acer saccharinum (alive)

Total No. of PRTs: 18

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Carya ovata
Celtis occidentalis
Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Stream Field edge

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH2 MOMO 023 Plot No.: 1

Date: 12-9-06 Start Time: 12:30

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	10 Carya ovata (alive)	15 Carya ovata (alive)	~~10~~ 5 (alive)	NA

Total No. of PRTs: 30

22 Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

Carya ovata

Juglans nigra

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

open areas near house park like.

Comments (include access comments):

park like areas with many shagbark

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOM0027AV Plot No.: 2

Date: 8-2-07 Start Time: 8:40

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
2x Carya ovata - alive	7x Carya ovata - alive	Ulmus americana - dead		

Total No. of PRTs: 10

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Carya ovata, Quercus imbricaria Estimated Average Overstory dbh (in): 8"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHMOMU2AV Plot No.: 2

Date: 8-2-07 Start Time: 8:50am

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		6 Carya ovata -alive. Ulmus americana -dead		

Total No. of PRTs: 7

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Carya ovata, Ulmus american, Celtis occidentalis Estimated Average Overstory dbh (in): 10

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MDL100704V Plot No.: 1

Date: 7-31-07 Start Time: 10:00AM

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Prunus serotina dead	Quercus alba dead Ulmus americana dead	Quercus alba dead		

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Ulmus americana, Fraxinus americana Estimated Average Overstory dbh (in): 9

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R. O. W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1WL1007AU Plot No.: 2

Date: 7-31-07 Start Time: 10:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Carya ovata - alive	Carya ovata - alive		

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Carya ovata

Estimated Average Overstory dbh (in): 10

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BHTMOD1 007AW Plot No.: 3

Date: 7-31-07 Start Time: 10:50

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Quercus alba - dead		

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba

Estimated Average Overstory dbh (in): 10

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHMDL008AV Plot No.: 2

Date: 7-31-07 Start Time: 11:15

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Quercus alba - dead 2* Quercus alba alive		

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Acer saccharum Estimated Average Overstory dbh (in): 12

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W., Access road

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1 MAL 008AV Plot No.: 2

Date: 7-31-07 Start Time: 11:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Quercus alba, Acer saccharum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

Steep ravine

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOILOOSAU Plot No.: 3

Date: 7-31-07 Start Time: 11:45

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Quercus alba - dead Acer saccharum dead	Quercus alba - dead			Quercus alba alive

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Acer saccharum Estimated Average Overstory dbh (in): 11

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MDL1008AU Plot No.: 4

Date: 7-31-07 Start Time: 12:15

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Quercus alba - dead		

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 11

Quercus alba, Carya ovata, Fraxinus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1WOL1009AU Plot No.: 1

Date: 7-31-07 Start Time: 1:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Juglans nigra, Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH1MOL1020AC Plot No.: 1

Date: 7-31-07 Start Time: 1:15

Length of East/West Plot Edge (ft): 8

Length of North/South Plot Edge (ft): 8

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Juglans nigra

Estimated Average Overstory dbh (in): 8

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

Took entrance point. Other points could not acquire satellites. No PRTs or mist net sites.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOL106AU Plot No.: 7

Date: 7-31-07 Start Time: 1:45

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		3X Fraxinus americanus		

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus Rubra, Acer Saccharum, Carya Ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

ROW

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOL0022AV Plot No.: 2

Date: 7-31-07 Start Time: 3:00

Length of East/West Plot Edge (ft): ~~165~~ 330

Length of North/South Plot Edge (ft): 605

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Carya ovata - dead 3 Quercus alba - alive 3 Carya ovata - alive Quercus alba - dead			

Total No. of PRTs: 8

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Carya ovata, Acer saccharum Estimated Average Overstory dbh (in): 11

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLI011AU Plot No.: 3

Date: 7-31-07 Start Time: 3:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Quercus alba, Acer saccharum Estimated Average Overstory dbh (in): 8

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHMOLI011AV Plot No.: 4

Date: 7-31-07 Start Time: 3:45

Length of East/West Plot Edge (ft): 105

Length of North/South Plot Edge (ft): 105

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		2 x Quercus rubra - dead Quercus alba alive		

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus alba, Acer saccharum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBM2MOL012AU Plot No.: 4 ~~5~~

Date: 7-31-07 Start Time: 4:15

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Quercus alba -dead	2x Quercus alba -alive			

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Acer saccharum Estimated Average Overstory dbh (in): 12

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W, ATV path

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH-MOL1002AV Plot No.: ALL

Date: 7-31-07 Start Time: 4:30

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 0

N/A

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

Not a Woodlot

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATSH2MOLI013AV Plot No.: A2C

Date: 6-3-07 Start Time: 4:40

Length of East/West Plot Edge (ft): 5

Length of North/South Plot Edge (ft): 5

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
2X Quercus alba -dead	Carya ovata -alive 5X Quercus rubra -dead	Quercus alba -alive 2X Quercus alba -dead		

Total No. of PRTs: 12

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba Acer saccharum Estimated Average Overstory dbh (in): 12

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLIOHAV Plot No.: 1

Date: 8-01-07 Start Time: 8:45

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	7x Ulmus americana - dead			

Total No. of PRTs: 7

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Quercus rubra, Carya ovata Estimated Average Overstory dbh (in): 60

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBMMOL2014AV Plot No.: 2

Date: 8-02-07 Start Time: 9:05

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Q x Quercus alba - alive Quercus alba - dead Carya ovata - alive			

Total No. of PRTs: 6

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Quercus rubra Estimated Average Overstory dbh (in): 11"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATRHIMOLI14AV Plot No.: 3

Date: 8-01-07 Start Time: 9:15

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	2 Quercus alba - alive			

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Quercus rubra

Estimated Average Overstory dbh (in): 10"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLI015 Plot No.: 1

Date: 12-8-06 Start Time: 11:50

Length of East/West Plot Edge (ft): 21

Length of North/South Plot Edge (ft): 21

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Carya ovata alive (11=2) Unknown dead (11=2)	Carya ovata alive (11=2) Unknown dead (1111=4) Ulmus americana alive	Carya ovata alive Unknown dead	n/a

Total No. of PRTs: 13

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22

Acer saccharum Quercus alba
Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Small streams, existing ROW

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOL1016AV Plot No.: D11

Date: 8-1-07 Start Time: 9:50

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus imbricaria, Acer saccharum Estimated Average Overstory dbh (in): 8"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

Lots of junk piles, few trees

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLI017 Plot No.: 1

Date: 12-8-06 Start Time: 11:15

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 7

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

tree line in pasture/grassy area

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLIØ18 Plot No.: 1

Date: 12-8-06 Start Time: 10:45

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Carya ovata alive	n/a	n/a	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Acer saccharum Quercus stellata

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

existing ROWs

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOLI019AV Plot No.: 1

Date: 8-1-07 Start Time: 10:05

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Carya ovata - alive		

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Carya cordiformis, Juglans nigra, Quercus imbricaria

Estimated Average Overstory dbh (in): 12"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHZMOLIC29AU Plot No.: 2

Date: 8-1-07 Start Time: 12:30

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10"

Acer saccharum, Quercus Muehlenbergii

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHMOLI020AU Plot No.: 1

Date: 8-1-07 Start Time: 10:45

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	2x Quercus alba - dead Quercus rubra - dead	3x Quercus rubra - dead	Quercus alba - dead	

Total No. of PRTs: 7

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Quercus rubra, Carya ovata Estimated Average Overstory dbh (in): 11"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLI020AV Plot No.: 2

Date: 8-1-07 Start Time: 11:15

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	4x Quercus alba - dead	2x Quercus alba - alive Ulmus americana - dead		

Total No. of PRTs: 7

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12"

Quercus alba, Carya ovata, Quercus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4MOWJ020AU Plot No.: 3

Date: 8-1-07 Start Time: 11:40

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 165

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Quercus rubra, Acer saccharum Estimated Average Overstory dbh (in): 12"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLI020AV Plot No.: 4

Date: 8-1-07 Start Time: 12:10

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Quercus alba - dead			

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Quercus rubra, Acer saccharum

Estimated Average Overstory dbh (in): 9"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI021 Plot No.: 1

Date: 12-8-06 Start Time: 10:30

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 39°59'54.740"N
Long: 91° 5'57.731"W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	NA	NA	NA	Acer saccharinum alive

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus imbricaria

Carya ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Stream at edge of plot

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI022 Plot No.: 1

Date: 12-8-06 Start Time: 10:45 11:25

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 38° 59 53, 206 N

Long: 91° 5' 41, 535 W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	NA	2 Carya ovata (alive)	2 Quercus alba (alive) 2 Quercus alba (dead) 2 Quercus rubra (dead)	Quercus alba (alive)

Total No. of PRTs: 9

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 19

Quercus alba Quercus rubra

Carya glabra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Streams in middle of plot ATV Road

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH2 MOLI023 Plot No.: 1

Date: 12-05-06 Start Time: 11:35

Length of East/West Plot Edge (ft): All Lat

Length of North/South Plot Edge (ft): All Long

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	NA	NA	1 Quercus alba (alive)	NA

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Quercus alba

Quercus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLT024AU Plot No.: 1

Date: 2 August 2007 Start Time: 0800

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 25?

Populus deltoides

Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photo: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI025AN Plot No.: 1

Date: 2 August 2007 Start Time: 0823

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22"

Quercus alba

Carya tomentosa

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

Photo 001 E
002 W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI025 Plot No.: 2

Date: 2 August 2007 Start Time: 0850

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Quercus alba (alive) (3) Carya ovata (alive)	n/a	n/a	n/a

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus alba

Quercus muehlenbergii

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MDLI025AV Plot No.: AW 3

Date: 2 August 2007 Start Time: 0915

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Carya ovata (alive) (7)	n/a	n/a	n/a

Total No. of PRTs: 7

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus alba

Quercus muehlenbergii

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Streams at base of hill where Platte Pipline Crosses

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI0825AM Plot No.: 4

Date: 2 August 2007 Start Time: 0935

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Quercus alba (dead) Quercus alba (alive)	n/a	n/a	n/a

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Quercus alba
Platanus occidentalis
Robinia pseudoacacia

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHOMOLT025AU Plot No.: 5

Date: 2 August 2007 Start Time: 1010

Length of East/West Plot Edge (ft): 165

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	Carya ovata (alive) (2)	n/a	n/a

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus rubra

Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MDLI026AU Plot No.: 1

Date: 2 August 2006 Start Time: 1045

Length of East/West Plot Edge (ft): ~~845~~ all

Length of North/South Plot Edge (ft): ~~845~~ all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Quercus sp. (dead) (4)	Quercus sp. (dead)	n/a	n/a

Total No. of PRTs: 5

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus alba

Quercus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

driveway off of AA goes to woodlot midpoint

PHOTO 001E 002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB12 NOTE027AN Plot No.: 1

Date: 2 August 2007 Start Time: 1125

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Quercus sp. (dead) 2	Carya ovata (alive) >10	Carya ovata (alive) >10	Quercus sp. (dead)	n/a

Total No. of PRTs: 20+ *70% of trees are Carya ovata, all PRTs

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Quercus alba
Carya ovata
Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001W
002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2M01L0028AN Plot No.: 1

Date: 2 August 2007 Start Time: 1100

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10"

Sassafrass albidum
Ulmus americana
Gleditsia triacanthos

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001W
002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI029AN Plot No.: 1

Date: 2 August 2007 Start Time: 1158

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Quercus macrocarpa

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB#2 MDLT 030AU Plot No.: 1

Date: 2 August 2007 Start Time: 1211

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Juglans nigra (dead)	n/a	n/a	n/a

Total No. of PRTs: ~~2~~ 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus macrocarpa

Platanus occidentalis

Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

Photos: 001E

002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB12MOLI0S1A(1) Plot No.: 1

Date: 1 August 2007 Start Time: 1905

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Carya ovata (dead) (2) Carya ovata (>10) (alive)	Carya ovata (alive) (5)	Quercus sp. (dead)	

Total No. of PRTs: ~20 * 80% of trees in woodlot are Carya ovata, all PRTs

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Carya ovata
Gleditsia triacanthos

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001W
002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI032AU Plot No.: 1

Date: August 2007 Start Time: 1111

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Carya ovata (alive)			

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Quercus rubra
Juglans nigra
Quercus alba

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBLKMOLI033AV Plot No.: 1

Date: 1 August 2007 Start Time: 1130

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12"

Sassafrass albidum

* Juniperus virginiana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOL1034AU Plot No.: 1

Date: August 2007 Start Time: 1144

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Carya ovata (alive) >5	Carya ovata (alive) >5 Carya ovata (dead)	Carya ovata (alive) >5	Quercus sp. (dead)	

Total No. of PRTs: 20+ * 60% of trees in woodlot are Carya ovata all PRTs

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 21"

Quercus alba
Quercus rubra
Carya ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

mob-001E
a2w

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB12MOCI0355AN Plot No.: 1

Date: 1 August 2007 Start Time: 1211

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus rubra, Robinia pseudoacacia, Juglans nigra

Estimated Average Overstory dbh (in): 12"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos
001 E
002 W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHRMOLI0230AV Plot No.: 1

Date: 1 August 2007 Start Time: 0953

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Carya >5 ovata (alive)	Carya >5 ovata (alive)	Carya >5 ovata (alive)		

Total No. of PRTs: 20+

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus alba

Carya ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

area surveyed from 970.85 to 971.24

access b/w 970.67 - 970.85 denied

photos: 001W

002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB1&2MDLT037AU Plot No.: 1

Date: 1 August 2007 Start Time: 0822

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: Ø

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16"

Acer saccharinum

Juglans nigra

Robinia pseudoacacia

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001S

002S

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI038AW Plot No.: 1

Date: 1 August 2007 Start Time: 0841

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Unknown dead trunk	Tilia americana (alive)		Quercus rubra (alive)	Quercus alba (alive)
Carya laciniosa (dead)	Carya laciniosa (alive) (4)			
Carya ovata (7) (alive)	Carya ovata (4) (alive)			

Total No. of PRTs: ~~18~~ 20 PRTs

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 21"

Quercus imbricaria
Quercus alba
Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

ditch running through middle of woodlot is not crossable with netting equipment

photo: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MIOLI039AW Plot No.: 1

Date: 31 July 2007 Start Time: 1557

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Quercus sp. (dead) (2) Prunus serotina (2) (dead)			

Total No. of PRTs: 4

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus alba, Fraxinus americana, Quercus rubra, ~~Carya tomentosa~~ SW

Estimated Average Overstory dbh (in): 21"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001 W
002 E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI040821 Plot No.: 1

Date: 8/July 2007 Start Time: 1449

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Juglans nigra
Quercus velutina
Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI041AU Plot No.: 1

Date: 5 July 2007 Start Time: 1500

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Quercus rubra
Quercus velutina
Carya tomentosa

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photo: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB12MOLI042AU Plot No.: 1

Date: 31 July 2007 Start Time: 1520

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Carya laciniosa (alive) Carya ovata (4) (alive	Carya ovata (alive) (2)		

Total No. of PRTs: 7

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22"

Quercus velutina
Quercus alba
Carya ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

Site surveyed from MP: 972.59 - 972.72 photo: 001E 002W
access b/w 972.72 - 972.78 denied

*Site is drivable

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI 043AV Plot No.: 1

Date: 31 July 2007 Start Time: 1419

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: Ø

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Acer saccharinum

Quercus imbricaria

Robinia pseudoacacia

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

area surveyed b/w mp: 973.14 - 973.29

access b/w mp: 973.09 - 973.13 denied

photo: 001W
002E

BHÉ/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI044AU Plot No.: 1

Date: 31 July 2007 Start Time: 1344

Length of East/West Plot Edge (ft): 80ft all

Length of North/South Plot Edge (ft): 80ft all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Ulmus americana (dead)		Acer saccharinum (dead) (2)	

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Robinia pseudoacacia
Acer saccharinum
Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

001E
002W.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB113MOL1051 Plot No.: 1

Date: 9 December 2004 Start Time: 1020

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12"

Platanus occidentalis

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

OC | W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3MOLI052 Plot No.: 1

Date: 8 December 2006 Start Time: 1055

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12"

Fraxinus pennsylvanica

Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

005

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHSMOLI053 Plot No.: 1

Date: 8 December 2006 Start Time: 1130

Length of East/West Plot Edge (ft): 66 ft

Length of North/South Plot Edge (ft): 66 ft

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10"

Fraxinus pennsylvanica

Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

COLS

Surveyors: Lisa Winkold
John Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4MOLI054 Plot No.: 1

Date: 7 Dec 2006 Start Time: 1015

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 5 (12cm)

Acer saccharinum

Acer negundo

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Access stream (6m net)
treeline
access farmlane at stream intersection

Comments (include access comments):

farmlane goes straight to site & crosses stream

Surveyors: Lisa Winhold
John Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT TRAN MOLI005 Plot No.: 1

Date: 6 Dec 2006 Start Time: 1120

Length of East/West Plot Edge (ft): n/a

Length of North/South Plot Edge (ft): n/a

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6 (15 cm)

Acer saccharinum

Acer negundo

Fraxinus nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across stream

+ to treeline

Comments (include access comments):

from line goes close to site (same line as MO-LI-54

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2MOLI056rev Plot No.: 1

Date: 31 July 2007 Start Time: 1300

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus rubra

Quercus imbricaria

Sassafrass albidum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

001W

002E.

Surveyors: Lisa Winhold
John Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4MOLI057 Plot No.: 1

Date: 8 Dec 2006 Start Time: 1250

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3):
Salix sp.
Acer saccharinum
Acer negundo

Estimated Average Overstory dbh (in): 4 (10cm)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
treeline

Comments (include access comments):
can park at road.
Site is trees along pond

old dog at house (not aggressive)

Surveyors: Lisa Winfield
John Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHHMOLI060 Plot No.: 1

Date: 6 Dec 2006 Start Time: 1200

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Ulmus americana

Estimated Average Overstory dbh (in): 6 (15cm)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

treeline

Comments (include access comments):

no easy access. barbed wire fence surrounds property
Cow pasture near stream.
Can park across street at pipeline station.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1@MOLI001NO Plot No.: 1

Date: 2-5-07 Start Time: 1110

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Silver maple (Acer saccharinum)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none (stream too wide + deep for mistnetting)

Comments (include access comments):

access by private drive to levee (on sod farm)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1MOLI003MA Plot No.: 1

Date: 19 Sept 2007 Start Time: 1430

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Ulmus ~~sp.~~ (dead) americana Ulmus americana (dead)	Ulmus ~~sp.~~ (dead) americana		

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

~~Acer saccharinum~~ Acer saccharinum } east of stream
Platan~~us~~ occidentalis

Ulmus rubra
Juglans nigra } west of stream
Prunus Serotina

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
Perpendicular to treeline

Comments (include access comments):
Barbed wire fence on either side of stream (N/S running).
Stream within project area doesn't have a canopy.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOLI004MA Plot No.: 1

Date: 20 Sept 2007 Start Time: 1030

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Ulmus americana (dead)	Prunus serotina (dead)	Unknown sp. (dead) - no bark - woodpecker holes	Unknown sp. (dead)	N/A

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus imbricaria
Quercus paulustrus
Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

perpendicular to treeline

Comments (include access comments):

4 barbed-wire fences to cross

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOSC001MA Plot No.: 1

Date: 22 Sept 2007 Start Time: 1200

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Salix nigra (dead)	N/A	Salix nigra (alive) -dead branch	N/A	Populus deltoides (alive) -dead branch

Total No. of PRTs: 3

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Salix nigra
Acer Saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

perpendicular to treeline

Comments (include access comments):

Rover: RD922BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOSC002MA Plot No.: 1

Date: 21 Sept 2007 Start Time: 1200

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Unknown sp. (dead) - no bark - crevices + holes	N/A	Quercus sp. (dead)	N/A

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Acer Saccharinum

Quercus palustris

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across levee

Comments (include access comments):

none

Rover: R00921BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOSC003MA Plot No.: 1

Date: 21 Sept 2007 Start Time: 1230

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	Acer Saccharinum (alive) - forks: 1/2 alive 1/2 dead with crevices	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Salix nigra
Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across levee

Comments (include access comments):

none

Rover: R000921BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOSC004MA Plot No.: 1

Date: 23 Sept 2007 Start Time: 0945

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Quercus rubra (dead)	N/A	N/A	Quercus rubra (dead) Quercus rubra (dead)

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Celtis occidentalis
Quercus rubra
Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

Rover: R0923BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOSC005MA Plot No.: 1

Date: 23 Sept 2007 Start Time: 1015

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Quercus rubra
Acer saccherinum
Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

perpendicular to treeline

Comments (include access comments):

Rover : R0923BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOSC006MA Plot No.: 1

Date: 24 Sept 2007 Start Time: 1030

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Unknown sp. (dead) Quercus rubra (dead) Quercus sp. (dead) Quercus rubra (dead) Quercus sp. (dead) Unknown sp. (dead)	Acer saccharinum (alive) - dead branches + top Ulmus americana (dead) Gleditsia triacanthos (alive) - dead top	Quercus sp. (dead) Unknown sp. (dead)	Unknown sp. (dead)	Quercus rubra (dead) Unknown sp. (dead) Unknown sp. (dead) Quercus sp. (dead) Acer saccharinum (alive) - dead branch

Total No. of PRTs: 17

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Quercus rubra
Celtis occidentalis
Quercus macrocarpa

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

Rover: RO924BHIB
Stream too wide + deep to net (~100')
center somewhat flagged in woods but not at entrance + exit

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIMOSC007MA Plot No.: 1

Date: 24 Sept 2007 Start Time: 1120

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus rubra Estimated Average Overstory dbh (in): 10

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
perpendicular to treeline

Comments (include access comments):
Rover: R0924BH1B
centerline somewhat flagged but not at enter + exit
canal on east edge of woodlot is ~50' wide + possibly de
(no canopy)

Appendix D. Field GPS Data and Site Photographs

The GPS-collected field data and site photographs are included on an attached CD-ROM.

B-2 – Illinois Bat Habitat Report

Prepared for:
Keystone Pipeline Project



Summer Habitat Assessment for the Indiana Bat (*Myotis sodalis)* Along the Keystone Mainline in Illinois

ENSR Corporation
November 2007
Document No.: 10623-004

ENSR | AECOM

PN: 0987.012-001 & 002 November 20, 2007

ASSESSMENT OF INDIANA BAT SUMMER HABITAT ALONG THE PROPOSED KEYSTONE PIPELINE IN ILLINOIS

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APPENDICES

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Appendix B. Wooded Areas Identified for Field Investigation within the Proposed Keystone Survey Corridor in Illinois.

Appendix C. Field Data Sheets

Appendix D. Field GPS Data and Site Photographs

EXECUTIVE SUMMARY

BHE Environmental, Inc. (BHE) was contracted by ENSR Corporation (ENSR) on behalf of the Keystone Pipeline Project (Keystone) to implement investigations described in the study plan developed for work to be conducted in Illinois. The study plan titled *Proposed Indiana Bat Investigations: Keystone Pipeline Project through Four Illinois Counties*, dated November 2006, describes methodology for assessment of Indiana bat summer habitat suitability on land parcels located in Illinois. BHE conducted the study in all of the Illinois counties traversed by the Keystone Project: Madison, Bond, Fayette, and Marion. Specifically, BHE sought to evaluate the quality of Indiana bat summer habitat at 124 wooded areas crossed by the Keystone Project. Of the 124 forest crossings initially identified for assessment, 101 sites have been assessed in the field to date. Access was denied at the 23 remaining woodlots. The quality of Indiana bat summer habitat was evaluated within the portion of the 101 forested tracts within the 200-ft wide survey corridor using a quantitative assessment method. Of the 101 sites assessed to date during the field investigations, there were 53 sites (52%) with no potential Indiana bat roost trees (PRTs). Based on the criteria established in the November 2006 study plan, the overall habitat suitability scores of the remaining sites were determined to be: eight "Low-Quality" sites (8%), 34 "Medium-Quality" sites (34%), and six "High-Quality" sites (6%).

1.0 INTRODUCTION

Keystone proposes to construct and operate an interstate crude oil transmission system from an oil supply hub near Hardisty, Alberta, in Canada to destinations in the U.S. In the U.S., the Keystone Mainline will consist of approximately 1,082 miles of new pipeline constructed from the U.S./Canadian border in Cavalier County, North Dakota, to existing terminals and refineries in Wood River (Madison County) and Patoka (Marion County), Illinois. The Cushing Extension will consist of approximately 296 miles of additional pipeline commencing in Jefferson County near the Nebraska-Kansas border and terminating at existing crude oil terminals in Cushing (Payne County), Oklahoma. Approximately 283 miles of the Keystone Mainline would parallel the proposed Rockies Express Pipeline - West (REX-West) Project in Kansas and Missouri.

This report addresses implementation of investigations described in the study plan developed for Indiana bat summer habitat suitability assessment to be conducted in Illinois. The study plan titled *Proposed Indiana Bat Investigations: Keystone Pipeline Project through Four Illinois Counties*, dated November 2006, describes methodology for assessment of parcels located in Illinois (BHE 2006). Specifically, BHE Environmental, Inc. (BHE) evaluated the quality of Indiana bat summer habitat at 124 areas where the Keystone Mainline route crosses forested parcels. Of the 124 forest crossings initially identified for assessment, 101 sites have been assessed in the field to date. Access permission was denied at the 23 remaining woodlots. The quality of Indiana bat summer habitat was evaluated within the portion of the 101 forested tracts within the 200-ft wide survey corridor using a quantitative assessment method. The area of wooded habitat surveyed at the 101 total sites ranged from approximately 0.2 acres to 22.5 acres.

Indiana bats are assumed present between April 1 and September 30 in the four Illinois counties crossed by the Keystone Mainline route. Known summer occurrences in the counties include captures of non-reproductive Indiana bats in Madison and Bond counties. In 1986, two adult lactating female and three juvenile Indiana bats were collected in Bond County, Illinois. Additionally, two adult lactating females were collected in the same area in 1987. These data support the likely presence of a maternity colony in Bond County. One or two maternity colonies of Indiana bats also are thought to occur in the Carlyle Lake Wildlife Management Area (WMA) (Joyce Collins, personal communication) (**Figure 1**). The nearest known winter occurrence, Brainerd Mine (Priority 3 hibernacula, 450 Indiana bats recorded in 2002), is more than 10 miles northeast of the Keystone Mainline route in Jersey County (Andy King, pers. comm.). Indiana bats are not known to occur in North Dakota, South Dakota, Nebraska, or Kansas (**Figure 1**); assessment of Indiana bat summer habitat quality was limited to Missouri and Illinois. Assessment of Indiana bat summer habitat quality in Missouri is described in a separate report.

2.0 METHODS

2.1 AGENCY COORDINATION

Russ Rommé of BHE contacted Joyce Collins of the Marion, Illinois Fish and Wildlife Service office on September 8, 2006, to discuss Endangered Species Act compliance issues specifically pertaining to the potential for the Keystone Pipeline Project to affect Indiana bats in Illinois. Several phone calls to Joyce Collins followed in the subsequent week. On September 14, 2006, Joyce Collins contacted Russ Rommé and provided recommendations regarding assessment of effects to Indiana bats and their habitat in Illinois. A teleconference was conducted on November 28, 2006, to discuss the content of the plan. On November 30, 2006, a revised study plan titled *Proposed Indiana Bat Investigations: Keystone Pipeline Project through Four Illinois Counties* was delivered to Joyce Collins by Russ Rommé. Signed concurrence with the field study and habitat assessment methods described in the study plan was received by BHE on December 2, 2006 (Appendix A).

2.2 SAMPLE AREA IDENTIFICATION

Investigations began with identification of wooded areas traversed by the route that may provide habitat for the Indiana bat. BHE identified from aerial photographs 124 instances where the pipeline route crossed areas with deciduous trees – these crossings range from wooded fencerows and tree lines to small woodlots and more extensive forests. Wooded areas crossed by pipe or contractor yards, and/or electric transmission corridors were not identified or assessed as part of this report.

Each of these 124 crossings (or woodlots) was assigned a unique alpha-numeric identifier (Appendix B-Table 1). Woodlot ID numbers adhered to the following protocol:

- FFFNNNSSCCXXXAA
    - FFF = Feature Type ("BAT" for bat habitat natural feature)
    - NNN= Team Number
        - December 2006 Field Effort
            - BH1 - Becky Braeutigam and Drew Carson (BHE)
            - BH2 – Samantha Williams and Dave Norcross (BHE)
            - BH3 - Chad Kinney (BHE) and Laura Vrabel (SCI)
            - BH4 – Lisa Winhold and John Alexander (BHE)
        - February 2007 Field Effort
            - BH1 – Chad Kinney and Lisa Winhold (BHE)
        - July 2007 Field Effort
            - BH1 – Chad Kinney and Brad Schroeder (BHE)
            - BH2 – Samantha Williams and Jennifer Wolff (BHE)
        - September 2007 Field Effort
            - BH1 – Lisa Winhold and Brad Schroeder (BHE)
    - SS = State
        - Illinois (IL)
    - CC = County Code
        - Madison (MA)
        - Bond (BO)
        - Fayette (FA)

        - Marion (MR)
    - XXX = Feature number (001-999 for the Keystone alignment)
    - AA = Alignment date of original alignment
        - August (AU)
        - November (NO)
        - March (MA)

Of the 124 forest crossings initially identified for assessment, 101 have been assessed in the field to date. Access was denied at 23 woodlots (Appendix B-Table 1).

2.3 FIELD METHODS

The density of potential Indiana bat roost trees (PRTs) was assessed quantitatively within the 124 wooded tracts during December 2006, and February, July, and September 2007. The woodlots were surveyed where access permission had been granted. The survey corridor along the Keystone Mainline was 200 feet wide centered on the proposed centerline (**Figure 2**). A single point within each woodlot was documented with GPS. Data regarding the presence of PRTs in each woodlot were recorded on hardcopy field forms (Appendix C) and were also recorded electronically utilizing a data dictionary developed by ENSR with support from BHE (Appendix D).

For purposes of this investigation, PRTs had the following characteristics:

- dead or live
- ≥3 m in height
- ≥25% of the tree covered by exfoliating bark, split tree trunks or branches, or cavities

Biologists recorded the dbh (diameter at breast height) size class of each PRT:

- <22 cm,
- 22 to <30 cm,
- 30 to <40 cm,
- 40 to <50 cm, or
- ≥50 cm.

Additionally, biologists made notes based on other attributes of the stands that may be useful in assessing summer habitat quality. These attributes included:

- whether each PRT was dead or live,
- PRT species (if possible),
- ocular estimates of average percent canopy cover,
- ocular estimates of average overstory tree dbh,
- dominant overstory tree species (up to three), and
- presence of apparently suitable mist net survey sites.

2.4 ANALYTICAL METHODS

2.4.1 PRT Density Calculation

Field data were analyzed to calculate a habitat suitability index (HSI) between 0.0 and 1.0 for each wooded tract. The HSI value is calculated from the density of PRTs in a woodlot as follows:

1. Determine the number of PRTs within the woodlot.
2. Determine the area of the woodlot, in hectares.
3. The density of PRTs, (D) in PRT/ha, is the value in step 1 divided by the value calculated in step 2.
4. The single-variable HSI is calculated by comparing the density to the ideal density of ≥14 PRT/ha:
   - If D ≥ 14, then HSI =1.0,
   - otherwise HSI = D/14.

2.4.2 Percent Forest Cover Calculation

Forest cover within 3.5 km of the 124 crossings was calculated using vegetative cover data (30-meter pixels) from the Illinois Department of Agriculture, Illinois Gap Analysis Project Land Cover 1999-2000. These data are based on circa 1999-2000 Landsat ETM+ satellite imagery. For purposes of this analysis, forest cover was compiled from the vegetation classifications: dry upland forest land, dry-mesic upland forested land, mesic upland forested land, potential canopy/savanna upland forested land, coniferous forested land, mesic floodplain forest wetland, wet-mesic floodplain forest wetland, and wet floodplain forest wetland.

2.5 HABITAT ASSESSMENT

This study combines site-specific and landscape level data to classify wooded areas crossed by the proposed Keystone Mainline as high-, medium-, or low-quality habitat. The three parameters considered were: density of PRTs, dbh of PRTs, and nearby forest cover (**Table 1**).

Table 1. Suitability scores for various habitat parameters.

Category	PRT HSI ([PRTs/ha]/14)	PRT dbh (PRTs/ha exceeding given dbh)	Forest cover within 3.5 km
High (score = 3)	≥0.60	8 PRT >30 cm or 5 PRT >40 cm or 3 PRT >50 cm	≥30 %
Medium (score = 2)	≥0.40 & <0.60	≥1 PRT ≥22 cm	≥13% & <30%
Low (score = 1)	<0.40	<1 PRT ≥22 cm	<13%

If all PRTs in a woodlot within the survey corridor measured less than 22 cm dbh, then the suitability was categorized as low for that parameter. If no PRTs were found the woodlot was automatically designated as "No PRTs" and was eliminated from further investigation.

After the scores for each parameter were calculated for all woodlots containing PRTs, the three scores were added together, and the overall habitat suitability determined from **Table 2**.

3.0 RESULTS

Of the 101 sites assessed to date during the field investigations, 53 sites (52%) were found to have no PRTs present and were eliminated from further evaluation herein (Appendix B-Table 1). Based on the criteria established in the November 2006 study plan, the overall habitat suitability scores of the remaining sites were determined to be: eight "Low-Quality" sites (8%), 34 "Medium-Quality" sites (34%), and six "High-Quality" sites (6%) (Appendix B-Table 1). Woodlot data for the 40 sites of medium- and high-quality are shown in **Table 3**.

Acreage estimates for all woodlots identified for field survey within the proposed Keystone survey corridor in Illinois were determined based on the 200-foot wide survey corridor (Appendix B-Table 1). More precise acreage estimates were determined for woodlots surveyed to date that had an overall habitat suitability score of "Medium" of "High" where they cross the Keystone Pipeline Project construction corridor (i.e., that portion of the 200-foot wide survey corridor that will be disturbed during construction) and associated extra temporary work spaces (EWSs) (Appendix B-Table 2).

Based on the 200-foot wide survey corridor, approximately 363.9 total acres have been surveyed to date at the 101 sites. Based on the 200-foot wide survey corridor, approximately 192.8 acres were found to have overall habitat suitability scores of "Medium" or "High." There are approximately 57.0 wooded acres within the 200-foot wide survey corridor at the 23 woodlots not yet surveyed (Appendix B-Table 1).

Based on the boundaries of the construction corridor associated with the Keystone Pipeline Project alignment and the boundaries of associated EWSs filed with the Department of State in September 2007, the total wooded acreage to be impacted within the 40 woodlots with an overall habitat suitability score of "Medium" or "High" is 61.5 acres (Appendix B-Table 2).

Table 2. Overall habitat suitability determination.

Sum of three scores from Table 1	Habitat Suitability
≥7	High
6 or 5	Medium
≤4	Low

Table 3. Characteristics of 40 wooded areas of "Medium-" and "High-Quality" Indiana bat habitat within the proposed Keystone survey corridor in Illinois.

Woodlot ID	Plot No.	Length of Plot (ft)*	Width of Plot (ft)*	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH1ILMA001MA	1	ALL	ALL	4	*Acer saccharinum* (2), *Acer negundo*, *Quercus macrocarpa*	75-100	12	*Acer saccharinum*
BATBH2ILMA020AU	1	ALL	ALL	4	*Quercus* sp. (4).	25-50	20	*Quercus alba*, *Acer saccharinum*, *Fraxinus americana*.
BATBH2ILMA021AU	1	ALL	ALL	1	*Quercus rubra*.	0-25	22	*Quercus rubra*, *Robinia pseudoacacia*.
BATBH2ILMA022AU	1	ALL	ALL	7	*Quercus* sp. (6), *Platanus occidentalis*.	50-75	24	*Acer saccharinum*, *Tilia americana*, *Ulmus americana*.
BATBH2ILMA024AU	1	ALL	ALL	3	*Quercus* sp. (2), *Populus deltoides*.	0-25	28	*Quercus alba*, *Platanus occidentalis*, *Quercus macrocarpa*.
BATBH2ILMA025AU	1	ALL	ALL	1	*Quercus* sp.	50-75	23	*Acer saccharinum*, *Platanus occidentalis*, *Robinia pseudoacacia*.
BATBH2ILMA031AU	1	ALL	ALL	1	*Ulmus americana*.	25-50	22	*Ulmus americana*, *Quercus alba*, *Juglans nigra*.

Table 3. Characteristics of 40 wooded areas of "Medium-" and "High-Quality" Indiana bat habitat within the proposed Keystone survey corridor in Illinois.

Woodlot ID	Plot No.	Length of Plot (ft)*	Width of Plot (ft)*	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH2ILMA034AU	1	ALL	ALL	9	*Juglans nigra* (4), *Quercus* sp. (2), *Acer negundo*, *Populus deltoides* (2).	50-75	20	*Platanus occidentalis, Quercus alba, Juglans nigra.*
BATBH1ILMA037	1	ALL	ALL	29	Unknown dead (19), *Gleditsia triacanthos* (6), *Carya ovata* (4).	75-100	20	*Gleditsia triacanthos, Quercus palustris, Quercus imbricaria.*
BATBH1ILMA038	1	ALL	ALL	1	Unknown Dead	0-25	12	*Quercus imbricaria, Celtis occidentalis.*
BATBH1ILMA042AU	1	ALL	ALL	5	*Ulmus americana* (2), *Acer saccharinum* (3).	0-25	12	*Celtis occidentalis, Acer saccharinum, Acer negundo*
BATBH1ILMA048AU	1	ALL	ALL	2	*Celtis occidentalis; Salix niger.*	0-25	4	*Celtis occidentalis, Salix niger.*
BATBH1ILMA051AU	1	ALL	ALL	1	*Quercus imbricaria.*	0-25	8	*Celtis occidentalis, Quercus imbricaria.*
BATBH1ILMA058	1	ALL	ALL	11	Unknown dead (2), *Carya ovata (*9).	75-100	14	*Quercus rubra, Quercus alba, Fraxinus pennsylvanica.*
BATBH1ILMA059	1	ALL	ALL	13	*Carya ovata* (13).	75-100	22	*Quercus alba, Quercus rubra, Carya ovata.*
BATBH1ILMA060	1	ALL	ALL	20	*Carya ovata* (18), Unknown dead (2).	75-100	16	*Fraxinus pennsylvanica, Quercus alba, Carya ovata.*

Table 3. Characteristics of 40 wooded areas of "Medium-" and "High-Quality" Indiana bat habitat within the proposed Keystone survey corridor in Illinois.

Woodlot ID	Plot No.	Length of Plot (ft)*	Width of Plot (ft)*	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH1ILMA061	1	ALL	ALL	22	*Carya ovata* (22).	50-75	20	*Carya ovata, Quercus alba.*
BATBH1ILMA062	1	ALL	ALL	2	Unknown dead (2).	75-100	18	*Quercus imbricaria, Platanus occidentalis.*
BATBH1ILMA063	1	ALL	ALL	2	*Ulmus americana, Quercus alba.*	50-75	10	*Gleditsia triacanthos, Quercus imbricaria.*
BATBH1ILMA003NO	1	ALL	ALL	8	*Carya ovata, Quercus rubra* (3), *Prunus serotina, Gleditsia triacanthos, Ulmus americana* (2).	50-75	16	*Gleditsia triacanthos, Celtis occidentalis, Quercus rubra.*
BATBH1ILBO004AU	1	ALL	ALL	14	*Carya ovata* (9); *Ulmus americana*; *Acer negundo* (2); *Quercus rubra*; *Quercus alba.*	50-75	12	*Quercus alba, Carya ovata, Acer negundo.*
BATBH1ILBO005AU	1	ALL	ALL	3	*Ulmus americana* (2); *Acer negundo.*	25-50	12	*Acer negundo*; *Platanus occidentalis*; *Celtis occidentalis.*
BATBH4ILBO011	1	ALL	ALL	2	*Carya ovata.*	0-25	16	*Quercus alba, Carya ovata.*
BATBH2ILBO012AU	1	ALL	ALL	1	*Carya ovata.*	50-75	24	*Quercus imbricaria, Quercus macrocarpa, Carya ovata.*

Table 3. Characteristics of 40 wooded areas of "Medium-" and "High-Quality" Indiana bat habitat within the proposed Keystone survey corridor in Illinois.

Woodlot ID	Plot No.	Length of Plot (ft)*	Width of Plot (ft)*	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH2ILBO014AU	1	ALL	ALL	21	*Celtis occidentalis* (2), Unknown dead (2), *Prunus serotina* (2), *Carya ovata* (10), *Robinia pseudoacacia* (2), *Carya laciniosa*, *Quercus* sp. (2).	25-50	26	*Celtis occidentalis*, *Quercus alba*, *Acer saccharinum*.
BATBH4ILBO016	1	ALL	ALL	1	*Quercus rubra*.	0-25	12	*Quercus rubra*, *Prunus serotina*, *Acer saccharinum*
BATBH4ILBO017	1	ALL	ALL	7	*Carya ovata* (2), *Ulmus americana* (2), *Quercus rubra* (3).	0-25	12	*Quercus rubra*, *Carya ovata*, *Ulmus americana*.
BATBH3ILBO018	1	164	65	13	*Carya ovata* (13).	50-75	16	*Carya ovata*.
BATBH3ILBO019	1	ALL	ALL	1	*Ulmus americana*.	50-75	14	*Carya cordiformes*, *Quercus palustris*.
BATBH3ILBO022	1	ALL	ALL	1	*Quercus velutina*.	25-50	12	*Salix nigra*, *Platanus occidentalis*.
BATBH3ILBO027	1	ALL	ALL	1	*Quercus* sp.	75-100	24	*Maclura pomifera*, *Quercus sp.*

Table 3. Characteristics of 40 wooded areas of "Medium-" and "High-Quality" Indiana bat habitat within the proposed Keystone survey corridor in Illinois.

Woodlot ID	Plot No.	Length of Plot (ft)*	Width of Plot (ft)*	No. of PRTs	PRT Species	Percent Canopy Cover	Average Overstory dbh (in)	Dominant Overstory Species
BATBH2ILBO004NO	1	ALL	ALL	1	*Quercus* sp.	25-50	20	*Platanus occidentalis, Acer saccharinum, Juglans nigra.*
BATBH2ILFA001	1	ALL	ALL	1	*Quercus imbricaria.*	0-25	18	*Quercus imbricaria.*
BATBH2ILFA002	1	ALL	ALL	5	*Acer negundo, Juglans nigra* (2), *Gleditsia triacanthos* (2).	50-75	16	*Quercus palustris, Acer negundo, Acer saccharinum.*
BATBH1ILFA012AU	1	ALL	ALL	1	*Salix nigra.*	50-75	10	*Salix nigra.*
BATBH1ILFA013AU	1	ALL	ALL	1	*Salix nigra.*	75-100	12	*Acer saccharinum, Salix nigra.*
BATBH1ILFA014AU	1	ALL	ALL	1	*Quercus palustris.*	75-100	10	*Quercus palustris, Acer saccharinum.*
BATBH1ILFA003NO	1	ALL	ALL	1	*Salix nigra.*	25-50	8	*Salix nigra, Acer saccharinum.*
BATBH1ILFA008NO	1	ALL	ALL	2	*Acer* sp., *Acer saccharinum.*	0-25	7	*Acer saccharinum, Acer negundo.*
BATBH2ILMR002	1	ALL	ALL	5	*Prunus serotina, Ulmus americana* (4).	50-75	15	*Maclura pomifera, Celtis occidentalis, Quercus imbricaria.*

*The entirety of each woodlot was surveyed.

4.0 LITERATURE CITED

BHE Environmental, Inc. (BHE). 2006. Proposed Indiana Bat Investigations: Keystone Pipeline Project Through Four Illinois Counties. Unpublished report submitted to U.S. Fish and Wildlife Service, Marion Field Office, Illinois. 6pp + attachments.

FIGURES

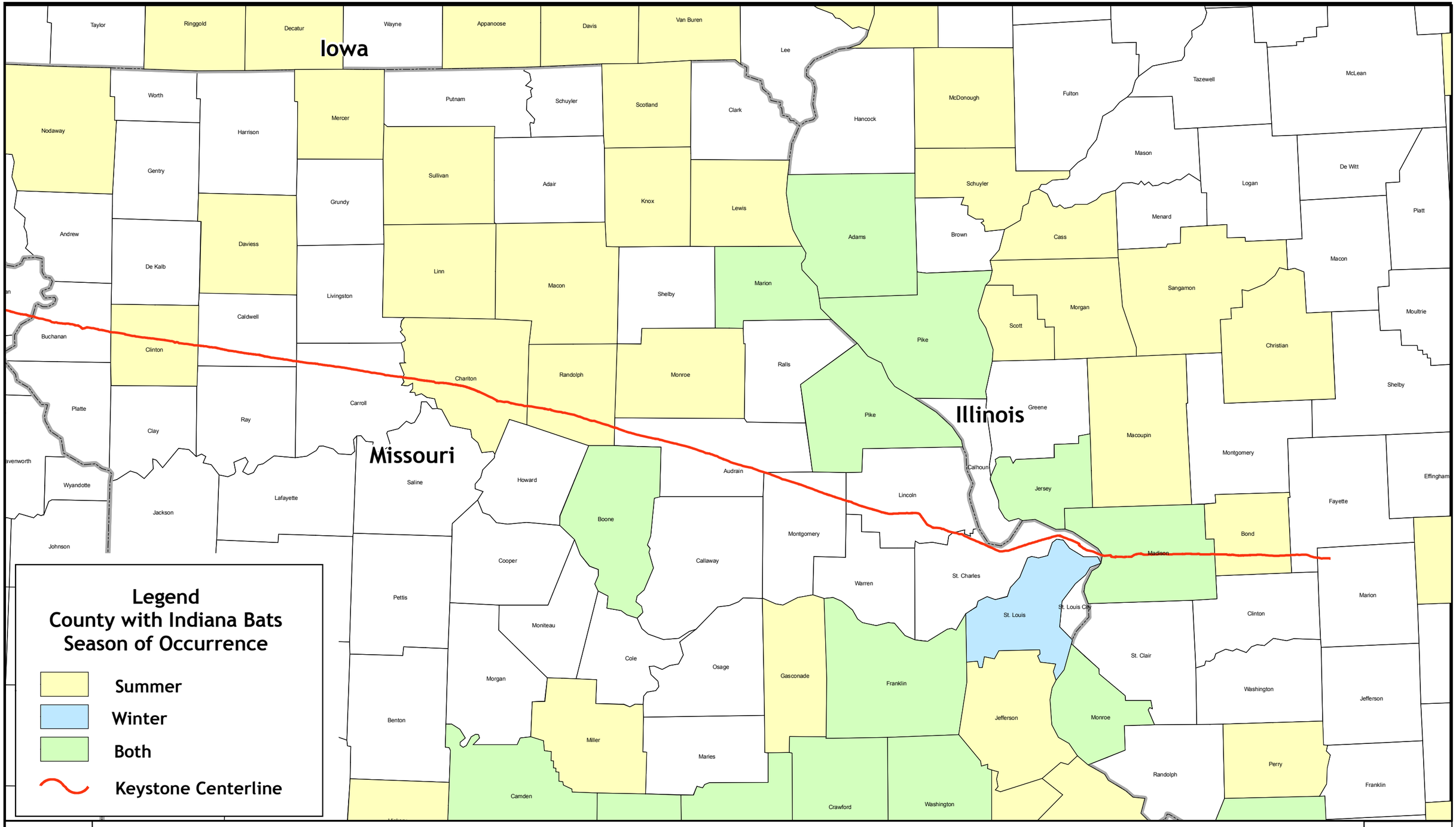


Figure 1: Location of the Keystone Pipeline Project in Missouri and Illinois

November 2007

Project No : 0987.012

Base Map: 2005 ESRI Data and Maps

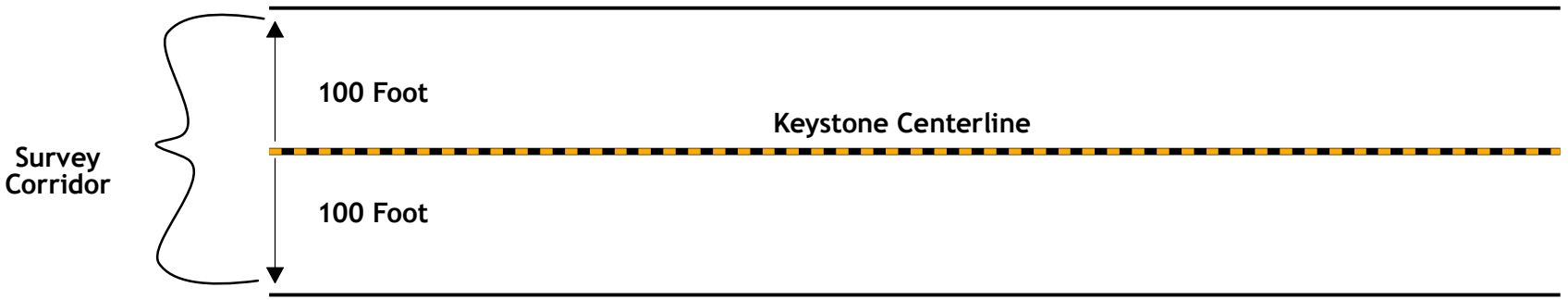


Figure 2. Diagram of Keystone Pipeline Project survey corridor in Illinois.

Project No. 0987.012	March 2007	Feet 100 50 0 100 200

BHE ENVIRONMENTAL

APPENDICES

Appendix A. USFWS Concurrence with Study Plan

U.S. FISH & WILDLIFE SERVICE

DEPARTMENT OF THE INTERIOR

U.S. Fish & Wildlife Service

Region 3 Great Lakes Big Rivers

United States Department of the Interior

Marion, Illinois SUBOFFICE (ES)
8588 ROUTE 148
MARION, ILLINOIS 62959

PHONE: (618)997-3344 FAX: (618)997-8961

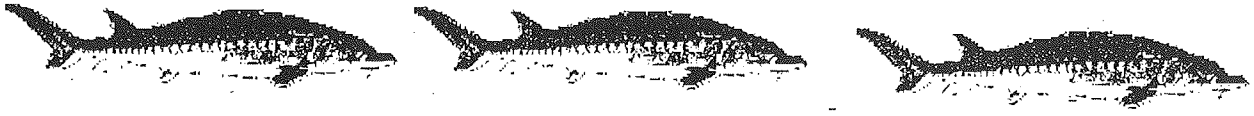
FACSIMILE TRANSMITTAL

TO: Russ Romme FAX: 513-326-1550

FROM: Joyce Collins DATE: 12/2/06

SUBJECT: Keystone Indiana bat Assessment PAGE 1 OF 8

NOTES



BHE ENVIRONMENTAL

11733 Chesterdale Road, Cincinnati, Ohio 45246 513.326.1500 / Fax 513.326.1550

November 30, 2006

0987.008.001

Joyce Collins
Assistant Field Supervisor
U.S. Fish & Wildlife Service
Marion Ecological Services Office
8588 Route 148
Marion, IL 62959-4565

Subject: Requesting concurrence with proposed Indiana bat investigations on Keystone Pipeline Project through four Illinois counties

Dear Joyce,

May we have your concurrence with the attached study plan dated November 2006 for "Indiana bat investigations on Keystone pipeline through four Illinois counties"? We expect to initiate field work beginning in early December. This version of the plan addresses your comments on the October version, and incorporates results of our telephone conversation earlier this week.

Sincerely,
BHE ENVIRONMENTAL, INC.

Russ Rommé
Director

c: Charles Johnson (ENSR)
Sara Stribley (ENSR)
Vince Hand (BHE)

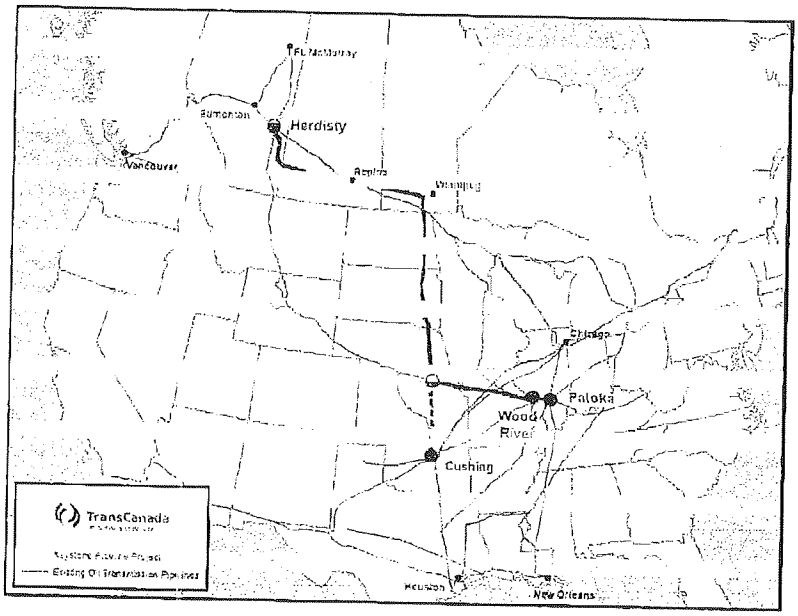
X **CONCUR** with edits on Pages 3 & 4	Signature Joyce A Collins
	Name (print) Joyce A. Collins
DO NOT CONCUR	Title Assistant Field Supervisor
	Date 12/2/03

PROPOSED INDIANA BAT INVESTIGATIONS
KEYSTONE PIPELINE PROJECT THROUGH FOUR ILLINOIS COUNTIES
NOVEMBER 2006

1.0 INTRODUCTION

1.1 BACKGROUND

Keystone proposes to construct and operate an interstate crude oil transmission system from an oil supply hub near Hardisty, Alberta, in Canada to destinations in the U.S. (Figure 1). In the U.S., the Keystone Mainline will consist of 1,078 miles of new pipeline constructed from the U.S./Canadian border in Cavalier County, North Dakota, to existing terminals and refineries in Wood River (Madison County) and Patoka (Marion County), Illinois. The Keystone Mainline will consist of 1,023 miles of 30-inch pipe between the Canadian border and Wood River, Illinois and a 55-mile segment of 24-inch pipeline between Wood River and Patoka, Illinois. The Cushing Extension will consist of approximately 292 miles of 36-inch pipeline commencing in Platte County near the Nebraska-Kansas border and terminating at existing crude oil terminals in Cushing (Payne County), Oklahoma.



In Illinois, the majority of the Keystone Pipeline will be a 24-inch pipeline, and the project will be constructed within a 95-foot-wide corridor, consisting of both a temporary 45-foot-wide construction ROW and a 50-foot permanent ROW. A small segment of pipe from the Mississippi River to the Wood River terminal (less than 2 miles) will consist of 30-inch pipe and will be constructed within a 110-foot-wide corridor (temporary 60-foot-wide construction ROW and a 50-foot permanent ROW). The pipeline typically will be buried with a minimum depth of cover of four feet. The pipeline will be constructed primarily in rural Illinois areas, with more populated areas occurring around Wood River and Edwardsville. Construction is scheduled to begin in early 2008 with an in-service date for the Keystone Mainline of no later than November 2009.

The construction of the Keystone Pipeline Project is subject to environmental review pursuant to the National Environmental Policy Act (NEPA). Because the project crosses the U.S.-Canadian border, the Department of State has been designated as the lead federal agency for the NEPA process.

Occurrences of the Indiana bat have been documented in two of the four counties traversed by the route in Illinois, Madison and Bond counties (Attachment 1). This study plan outlines

an approach to investigate the potential effects of the Keystone Pipeline Project on the Indiana bat in Illinois, including a field survey and a habitat assessment.

1.2 COMMUNICATION WITH US FISH AND WILDLIFE SERVICE

Russ Rommé of BHE Environmental, Inc. contacted Joyce Collins of the Marion, Illinois FWS office on September 8, 2006 to discuss Endangered Species Act compliance issues specifically pertaining to the potential for the Keystone Pipeline Project to affect Indiana bats in Illinois. Several phone calls to Joyce Collins followed in the subsequent week. On September 14, 2006 Joyce Collins contacted Russ Rommé (BHE) and provided recommendations regarding assessment of effects to Indiana bats and their habitat in Illinois. A teleconference was conducted on November 28, 2006 to discuss the content of this plan.

2.0 APPROACH

2.1 TECHNICAL BACKGROUND

Rommé et al. (1995) showed how number of potential Indiana bat roost trees (PRTs) per unit area affected habitat quality. Optimal habitat includes at least fourteen PRTs per hectare, and the quality of habitat declines linearly as the number of PRTs declines. The ratio of actual trees per hectare (T) to the optimal value of at least fourteen PRTs per hectare, gives a measure of habitat quality on a zero to one scale. If T>14, the ratio is still one. Farmer et al. (2002) go so far as to recommend evaluation of a single variable, density of suitable roost trees, as appropriate for landscape scale assessments. Based on previous literature, those two studies define PRTs as having dbh ≥9 inches (≥ 22 cm).

Recent published literature indicates that linear distances between roosts and foraging areas for females range from approximately 0.5 to 8.4 km (0.8 to 5.2 miles), and average approximately 3.5 km (2.2 miles) (Murray and Kurta 2004, Sparks et al. 2005, Butchkoski and Hassinger 2002). Rommé et al. (1995) indicate that even with all other summer habitat attributes being ideal, sufficient nearby wooded area is a critical factor for suitable habitat. Wooded areas with 13 percent forest cover in the analysis area can rate no higher than 0.32 on a scale of 0.0 (no habitat value) to 1.0 (ideal habitat). For a suitability rating of 1.0 for this habitat parameter, there must be a minimum of 30% forested cover within 3.5 km.

Given this background, the study plan below combines site-specific and landscape-level data to classify wooded areas crossed by the pipeline ROW as high-, medium-, or low-quality habitat.

2.2 FIELD SURVEY

Biologists will assess the portion of all forested/wooded stands (woodlot) within a 200-foot wide survey corridor (100 feet either side of the pipeline centerline) crossed by the proposed pipeline right-of-way for the presence of PRTs. For purposes of this evaluation, PRTs will be dead or live trees, at least three meters tall, with at least 25% peeling or exfoliating bark, split tree trunks or branches, or cavities.

The biologists will record whether the tree is dead or living, the tree species (if possible), and dbh size class (<22 cm, 22 to <30 cm, 30 to <40 cm, 40 to <50 cm, ≥50 cm), if practical.

2.3 HABITAT ASSESSMENT

Upon completion of the field survey effort, Keystone will derive an assessment of habitat quality based on field parameters and a review of aerial photographs to determine forested cover within 3.5 kilometers of each site.

In addition to density, PRTs must meet minimum size criteria for the area represented by the sample site to qualify as high quality habitat, namely:

- at least eight PRTs per hectare greater than 30 cm dbh, or
- at least five PRTs per hectare greater than 40 cm dbh, or
- at least three PRTs per hectare greater than 50 cm dbh.

If all PRTs in a woodlot measure less than 20 cm dbh, then the suitability will be categorized as low for that parameter. Thus there will be three parameters considered: density of PRTs, dbh of PRTs, and nearby forest cover (Table 1).

Table 1. Suitability scores for various habitat parameters.

Category	PRT density (number/ha)/14	PRT dbh (trees/ha exceeding given dbh)	Forest cover within 3.5 km
High (score = 3)	≥ 0.60	8 PRT > 30 cm or 5 PRT > 40 cm or 3 PRT > 50 cm	≥ 30 %
Medium (score = 2)	≥ 0.40 & < 0.60	≥ 1 PRT ≥ 20 cm	≥ 13% & < 30%
Low (score = 1)	< 0.40	< 1 PRT ≥ 20 cm	< 13%

If no PRTs are found within the 200 -foot wide survey corridor within a woodlot, we will conclude that project activities at that location may affect but are not likely to adversely affect Indiana bats. Otherwise, the three scores will be added together, and the overall habitat suitability determined from Table 2.

Table 2. Overall habitat suitability determination.

Sum of three scores from Table 1.	Habitat Suitability
≥ 7	High
6 or 5	Medium
≤ 4	Low

3.0 SCHEDULE

We expect to begin field work to assess habitat quality in early December, 2006.

4.0 FOLLOW-UP ACTIONS

Keystone will provide the Service with a summary of the field data collected and the overall habitat suitability evaluation for each woodlot (High, Medium, Low, no PRTs). We propose follow on field investigations (e.g., mist net surveys) only at sites with medium or high quality habitat scores as defined in Section 2.3 (Table 2), above. ~~If mist net survey results are negative at any site, we will conclude that proposed construction activities at the site that~~

Based on the data collected in the field survey, and the classification in the habitat assessment, Keystone will work with the FWS to determine appropriate subsequent activities. Joint call 12/2/06

~~remove suitable Indiana bat habitat may affect, but are not likely to adversely affect Indiana bats.~~ We understand the Section 7 finding needs to be made for the project as a whole rather than for each particular crossing of wooded habitat.

In our telephone conversation on November 28, 2006, we agreed there was limited value in the collection of additional data describing habitat quality (beyond that described in Section 2.3, above) at sites with low quality habitat or at sites with no PRTs.

We further agreed that for those sites with no PRTs or sites with low quality roosting habitat, we would conduct a semi-quantitative, desktop assessment of Indiana bat habitat quality near each site. This analysis would quantify the percent forest cover within 3.5 km of each site, and would verify the absence of any Indiana bat occurrence records in the area. These data will be sufficient to characterize the effects to Indiana bats at the site.

We also agreed that at sites with no PRTs, or at sites with low habitat quality, project activities are not likely to adversely affect Indiana bats because effects would be insignificant or discountable (in the absence of any unusual circumstances such as proximity to a known occurrence).

5.0 LITERATURE CITED

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Farmer A.H., B.S. Cade, and D.F. Stauffer. 2002. Evaluation of a habitat suitability index model. Pp. 172-181 *in* A. Kurta and J. Kennedy (eds.), The Indiana Bat: Biology and Management of an Endangered Species. Bat Conservation International, Austin, Texas.

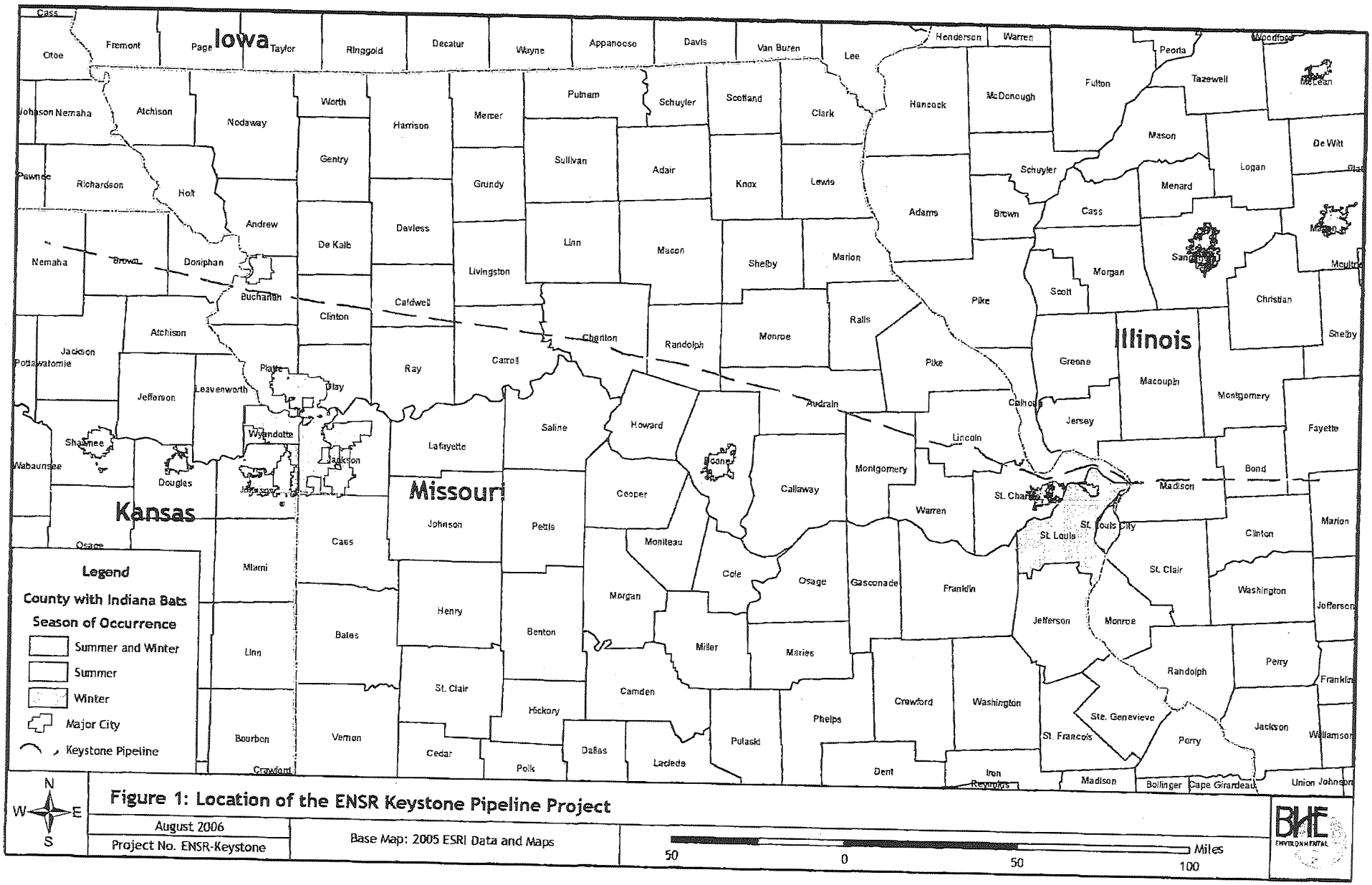
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Attachment 1. Indiana Bat Seasonal Occurrence near the Proposed Keystone Pipeline Project Corridor in Illinois

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Appendix B. Wooded Areas Identified for Field Investigation
within the Proposed Keystone Survey Corridor in Illinois.

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Illinois. Rows in gray represent woodlots that have not been assessed in the field (see Comments column for details).

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Number of Plots	Total Number of PRTs	PRT/ha	Woodlot HSI	PRT Density Score	Number of PRTs with dbh <22 cm	Number of PRTs with dbh 22-30 cm	Number of PRTs with dbh 30-40 cm	Number of PRTs with dbh 40-50 cm	Number of PRTs with dbh >50 cm	PRTs/ha with dbh <22 cm	PRTs/ha with dbh 22-30 cm	PRTs/ha with dbh 30-40 cm	PRTs/ha with dbh 40-50 cm	PRTs/ha with dbh >50 cm	PRT dbh Score	Percent Forest Cover Within 3.5 km	Percent Forest Cover Score	Sum of Scores	Overall Habitat Suitability	Comments
BATBH1ILMA001MA	Madison	1025.10	1025.25	1025.40	1742	8.0	Census	4	1.24	0.09	1	0	1	0	1	2	0.0	0.3	0.0	0.3	0.6	2	14	2	5	Medium	Already surveyed
BATBH1ILMA002MA	Madison	1025.44	1025.46	1025.48	317	1.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	14	2	N/A	No PRTs	Already surveyed
BATBH1ILMA003MA	Madison	1025.54	1025.57	1025.59	317	1.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	13	2	N/A	No PRTs	Already surveyed
BATBH1ILMA004MA	Madison	1025.63	1025.69	1025.75	686	3.2	Census	1	0.78	0.06	1	0	0	0	1	0	0.0	0.0	0.0	0.8	0.0	2	11	1	4	Low	Already surveyed
BATBH1ILMA005MA	Madison	1026.83	1026.89	1026.93	581	2.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	7	1	N/A	No PRTs	Already surveyed
BATBH1ILMA006MA	Madison	1027.03	1027.09	1027.16	792	3.6	Census	1	0.68	0.05	1	0	0	0	0	1	0.0	0.0	0.0	0.0	0.7	2	7	1	4	Low	Already surveyed
BATBH_ILMA006AU	Madison	1028.24	1028.32	1028.39	845	3.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7	1	N/A	N/A	Access Denied
BATBH_ILMA007AU	Madison	1028.42	1028.48	1028.55	686	3.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7	1	N/A	N/A	Access Denied
BATBH2ILMA008AU	Madison	1029.41	1029.42	1029.42	211	1.0	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	10	1	N/A	No PRTs	Already surveyed
BATBH2ILMA009AU	Madison	1029.44	1029.45	1029.45	53	0.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	10	1	N/A	No PRTs	Already surveyed
BATBH_ILMA010AU	Madison	1029.66	1029.67	1029.67	106	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11	1	N/A	N/A	Access Denied
BATBH_ILMA011AU	Madison	1029.67	1029.74	1029.79	581	2.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11	1	N/A	N/A	Access Denied
BATBH_ILMA012AU	Madison	1030.01	1030.07	1030.14	634	2.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11	1	N/A	N/A	Access Denied
BATBH_ILMA013AU	Madison	1030.50	1030.60	1030.70	106	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	1	N/A	N/A	Access Denied
BATBH_ILMA014AU	Madison	1030.85	1030.96	1031.06	1214	5.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9	1	N/A	N/A	Access Denied
BATBH_ILMA015AU	Madison	1031.09	1031.18	1031.26	950	4.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9	1	N/A	N/A	Access Denied
BATBH_ILMA016AU	Madison	1031.82	1031.83	1031.84	106	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31	3	N/A	N/A	Access Denied
BATBH_ILMA017AU	Madison	1031.89	1031.89	1031.90	158	0.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31	3	N/A	N/A	Access Denied
BATBH_ILMA018AU	Madison	1031.94	1031.95	1031.96	317	1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	32	3	N/A	N/A	Access Denied
BATBH_ILMA019AU	Madison	1032.07	1032.14	1032.21	845	3.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	32	3	N/A	N/A	Access Denied
BATBH2ILMA020AU	Madison	1032.25	1032.44	1032.64	2059	9.5	Census	4	1.05	0.07	1	0	2	2	0	0	0.0	0.5	0.5	0.0	0.0	2	32	3	6	Medium	Already surveyed
BATBH2ILMA021AU	Madison	1032.76	1032.90	1033.04	1478	6.8	Census	1	0.36	0.03	1	0	0	0	1	0	0.0	0.0	0.0	0.4	0.0	2	35	3	6	Medium	Already surveyed
BATBH2ILMA022AU	Madison	1033.06	1033.20	1033.33	1637	7.5	Census	7	2.30	0.16	1	1	3	2	1	0	0.3	1.0	0.7	0.3	0.0	2	35	3	6	Medium	Already surveyed
BATBH2ILMA023AU	Madison	1033.72	1033.73	1033.74	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	36	3	N/A	No PRTs	Already surveyed
BATBH2ILMA024AU	Madison	1033.80	1033.85	1033.89	581	2.7	Census	3	2.78	0.20	1	0	0	0	1	2	0.0	0.0	0.0	0.9	1.9	2	36	3	6	Medium	Already surveyed
BATBH2ILMA025AU	Madison	1033.93	1034.00	1034.09	950	4.4	Census	1	0.57	0.04	1	1	0	0	0	0	0.6	0.0	0.0	0.0	0.0	2	37	3	6	Medium	Already surveyed
BATBH_ILMA026AU	Madison	1034.35	1034.38	1034.42	422	1.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37	3	N/A	N/A	Access Denied
BATBH_ILMA027AU	Madison	1034.43	1034.44	1034.45	106	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37	3	N/A	N/A	Access Denied
BATBH_ILMA028AU	Madison	1034.54	1034.55	1034.58	211	1.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37	3	N/A	N/A	Access Denied
BATBH_ILMA029AU	Madison	1034.62	1034.74	1034.86	1267	5.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	36	3	N/A	N/A	Access Denied
BATBH2ILMA030AU	Madison	1034.91	1034.98	1035.03	792	3.6	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	35	3	N/A	No PRTs	Already surveyed
BATBH2ILMA031AU	Madison	1035.07	1035.13	1035.18	581	2.7	Census	1	0.93	0.07	1	0	0	1	0	0	0.0	0.0	0.9	0.0	0.0	2	34	3	6	Medium	Already surveyed
BATBH2ILMA032AU	Madison	1035.21	1035.23	1035.24	264	1.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	33	3	N/A	No PRTs	Already surveyed
BATBH2ILMA033AU	Madison	1035.34	1035.35	1035.36	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	32	3	N/A	No PRTs	Already surveyed
BATBH2ILMA034AU	Madison	1035.38	1035.85	1036.31	4910	22.5	Census	9	0.99	0.07	1	5	2	0	1	1	0.5	0.2	0.0	0.1	0.1	2	30	3	6	Medium	Already surveyed
BATBH_ILMA035AU	Madison	1036.33	1036.40	1036.48	898	4.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	25	2	N/A	N/A	Access Denied
BATBH_ILMA036AU	Madison	1036.53	1036.60	1036.67	792	3.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	24	2	N/A	N/A	Access Denied
BATBH1ILMA037	Madison	1036.73	1036.88	1037.08	2112	9.7	Census	29	7.39	0.53	2	15	10	2	2	0	3.8	2.5	0.5	0.5	0.0	2	22	2	6	Medium	Already surveyed
BATBH1ILMA038	Madison	1037.45	1037.51	1037.58	686	3.2	Census	1	0.78	0.06	1	0	0	1	0	0	0.0	0.0	0.8	0.0	0.0	2	17	2	5	Medium	Already surveyed
BATBH_ILMA039AU	Madison	1038.11	1038.13	1038.15	370	1.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11	1	N/A	N/A	Access Denied
BATBH_ILMA040AU	Madison	1038.51	1038.52	1038.52	53	0.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	1	N/A	N/A	Access Denied
BATBH_ILMA041AU	Madison	1038.54	1038.55	1038.57	264	1.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	1	N/A	N/A	Access Denied
BATBH1ILMA042AU	Madison	1040.38	1040.60	1040.82	2323	10.7	Census	5	1.16	0.08	1	0	0	2	2	1	0.0	0.0	0.5	0.5	0.2	2	15	2	5	Medium	Already surveyed
BATBH1ILMA043AU	Madison	1040.88	1040.89	1040.91	264	1.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	14	2	N/A	No PRTs	Already surveyed
BATBH3ILMA044	Madison	1041.18	1041.34	1041.50	1690	7.8	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	13	2	N/A	No PRTs	Already surveyed
BATBH3ILMA045	Madison	1041.50	1041.51	1041.52	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	11	1	N/A	No PRTs	Already surveyed
BATBH3ILMA046	Madison	1041.62	1041.69	1041.77	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	12	1	N/A	No PRTs	Already surveyed
BATBH3ILMA047	Madison	1042.29	1042.29	1042.30	845	3.9	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	12	1	N/A	No PRTs	Already surveyed
BATBH1ILMA048AU	Madison	1044.10	1044.11	1044.12	158	0.7	Census	2	6.80	0.49	2	1	1	0	0	0	3.4	3.4	0.0	0.0	0.0	2	8	1	5	Medium	Already surveyed
BATBH1ILMA049AU	Madison	1044.47	1044.53	1044.60	686	3.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	12	1	N/A	No PRTs	Already surveyed
BATBH1ILMA050AU	Madison	1044.65	1044.69	1044.74	1320	6.1	Census	3	1.22	0.09	1	0	0	0	3	0	0.0	0.0	0.0	1.2	0.0	2	12	1	4	Low	Already surveyed

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Illinois. Rows in gray represent woodlots that have not been assessed in the field (see Comments column for details).

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Number of Plots	Total Number of PRTs	PRT/ha	Woodlot HSI	PRT Density Score	Number of PRTs with dbh <22 cm	Number of PRTs with dbh 22-30 cm	Number of PRTs with dbh 30-40 cm	Number of PRTs with dbh 40-50 cm	Number of PRTs with dbh >50 cm	PRTs/ha with dbh <22 cm	PRTs/ha with dbh 22-30 cm	PRTs/ha with dbh 30-40 cm	PRTs/ha with dbh 40-50 cm	PRTs/ha with dbh >50 cm	PRT dbh Score	Percent Forest Cover Within 3.5 km	Percent Forest Cover Score	Sum of Scores	Overall Habitat Suitability	Comments
BATBH1ILMA051AU	Madison	1044.90	1044.91	1044.93	158	0.7	Census	1	3.40	0.24	1	0	0	0	1	0	0.0	0.0	0.0	3.4	0.0	2	13	2	5	Medium	Already surveyed
BATBH1ILMA052AU	Madison	1045.09	1045.09	1045.11	634	2.9	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	13	2	N/A	No PRTs	Already surveyed
BATBH1ILMA053AU	Madison	1046.43	1046.71	1046.99	2957	13.6	Census	8	1.46	0.10	1	0	5	0	3	0	0.0	0.9	0.0	0.5	0.0	2	14	1	4	Low	Already surveyed
BATBH1ILMA054AU	Madison	1047.02	1047.10	1047.17	950	4.4	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	12	1	N/A	No PRTs	Already surveyed
BATBH1ILMA055AU	Madison	1047.21	1047.25	1047.28	370	1.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	12	1	N/A	No PRTs	Already surveyed
BATBH_ILMA003NO	Madison	1049.33	1049.35	1049.37	211	1.0	Census	8	20.41	1.00	3	0	1	5	1	1	0.0	2.6	12.8	2.6	2.6	3	15	2	8	High	Already surveyed
BATBH1ILMA057	Madison	1049.50	1049.55	1049.61	581	2.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	16	2	N/A	No PRTs	Already surveyed
BATBH1ILMA058	Madison	1049.71	1049.80	1049.90	1162	5.3	Census	11	5.10	0.36	1	0	6	4	1	0	0.0	2.8	1.9	0.5	0.0	2	17	2	5	Medium	Already surveyed
BATBH1ILMA059	Madison	1049.96	1050.01	1050.06	1399	6.4	Census	13	5.00	0.36	1	0	2	6	5	5	0.0	0.8	2.3	1.9	1.9	2	17	2	5	Medium	Already surveyed
BATBH1ILMA060	Madison	1050.08	1050.15	1050.22	792	3.6	Census	20	13.59	0.97	3	0	5	9	6	0	0.0	3.4	6.1	4.1	0.0	3	17	2	8	High	Already surveyed
BATBH1ILMA061	Madison	1050.49	1050.55	1050.60	634	2.9	Census	22	18.69	1.00	3	0	0	14	8	0	0.0	0.0	11.9	6.8	0.0	3	17	2	8	High	Already surveyed
BATBH1ILMA062	Madison	1050.86	1050.99	1051.12	1320	6.1	Census	2	0.82	0.06	1	0	0	0	0	2	0.0	0.0	0.0	0.0	0.8	2	15	2	5	Medium	Already surveyed
BATBH1ILMA063	Madison	1052.87	1052.88	1052.90	158	0.7	Census	2	6.80	0.49	2	0	0	2	0	0	0.0	0.0	6.8	0.0	0.0	2	3	1	5	Medium	Already surveyed
BATBH2ILBO001AU	Bond	1054.77	1054.78	1054.79	158	0.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	4	1	N/A	No PRTs	Already surveyed
BATBH4ILBO002	Bond	1056.13	1056.15	1056.16	3854	17.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	15	2	N/A	No PRTs	Already surveyed
BATBH4ILBO003	Bond	1056.17	1056.19	1056.20	158	0.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	15	2	N/A	No PRTs	Already surveyed
BATBH1ILBO004AU	Bond	1057.06	1057.23	1057.38	1742	8.0	Census	14	4.32	0.31	1	5	4	4	1	0	1.5	1.2	1.2	0.3	0.0	2	22	2	5	Medium	Already surveyed
BATBH1ILBO005AU	Bond	1057.78	1057.84	1057.87	475	2.2	Census	3	3.40	0.24	1	0	1	0	1	1	0.0	1.1	0.0	1.1	1.1	2	25	2	5	Medium	Already surveyed
BATBH4ILBO006	Bond	1058.06	1058.09	1058.12	317	1.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	25	2	N/A	No PRTs	Already surveyed
BATBH1ILBO001NO	Bond	1059.11	1059.18	1059.25	739	3.4	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	26	2	N/A	No PRTs	Already surveyed
BATBH1ILBO002NO	Bond	1059.32	1059.35	1059.38	317	1.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	24	2	N/A	No PRTs	Already surveyed
BATBH2ILBO003NO	Bond	1059.90	1059.92	1059.94	211	1.0	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	17	2	N/A	No PRTs	Already surveyed
BATBH2ILBO004NO	Bond	1060.04	1060.06	1060.08	211	1.0	Census	1	2.55	0.18	1	0	0	1	0	0	0.0	0.0	2.6	0.0	0.0	2	16	2	5	Medium	Already surveyed
BATBH2ILBO005NO	Bond	1060.16	1060.17	1060.18	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	14	2	N/A	No PRTs	Already surveyed
BATBH4ILBO009	Bond	1060.42	1060.47	1060.52	634	2.9	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	12	1	N/A	No PRTs	Already surveyed
BATBH4ILBO010	Bond	1060.60	1060.70	1060.80	1003	4.6	Census	2	1.07	0.08	1	0	1	1	0	0	0.0	0.5	0.5	0.0	0.0	2	11	1	4	Low	Already surveyed
BATBH4ILBO011	Bond	1062.46	1062.53	1062.60	739	3.4	Census	2	1.46	0.10	1	0	0	2	0	0	0.0	0.0	1.5	0.0	0.0	2	14	2	5	Medium	Already surveyed
BATBH2ILBO012AU	Bond	1062.65	1062.67	1062.68	158	0.7	Census	1	3.40	0.24	1	0	1	0	0	0	0.0	3.4	0.0	0.0	0.0	2	15	2	5	Medium	Already surveyed
BATBH2ILBO013AU	Bond	1062.78	1062.78	1062.79	53	0.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	15	2	N/A	No PRTs	Already surveyed
BATBH2ILBO014AU	Bond	1062.97	1063.23	1063.50	2746	12.6	Census	21	4.12	0.29	1	3	8	5	2	3	0.6	1.6	1.0	0.4	0.6	2	17	2	5	Medium	Already surveyed
BATBH4ILBO015	Bond	1063.76	1063.76	1063.77	53	0.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	19	2	N/A	No PRTs	Already surveyed
BATBH4ILBO016	Bond	1063.82	1063.92	1064.01	950	4.4	Census	1	0.57	0.04	1	0	0	1	0	0	0.0	0.0	0.6	0.0	0.0	2	19	2	5	Medium	Already surveyed
BATBH4ILBO017	Bond	1064.01	1064.15	1064.28	1373	6.3	Census	7	2.74	0.20	1	1	3	0	1	2	0.4	1.2	0.0	0.4	0.8	2	19	2	5	Medium	Already surveyed
BATBH3ILBO018	Bond	1064.53	1064.66	1064.78	1373	6.3	1	13	131.27	1.00	3	5	8	0	0	0	2.0	3.1	0.0	0.0	0.0	2	18	2	7	High	Already surveyed
BATBH3ILBO019	Bond	1064.82	1064.85	1064.88	581	2.7	Census	1	0.93	0.07	1	0	0	0	1	0	0.0	0.0	0.0	0.9	0.0	2	17	2	5	Medium	Already surveyed
BATBH3ILBO020	Bond	1064.90	1064.91	1064.92	211	1.0	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	16	2	N/A	No PRTs	Already surveyed
BATBH3ILBO021	Bond	1065.23	1064.27	1065.31	422	1.9	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	14	2	N/A	No PRTs	Already surveyed
BATBH3ILBO022	Bond	1065.40	1065.41	1065.43	185	0.8	Census	1	2.91	0.21	1	0	1	0	0	0	0.0	2.9	0.0	0.0	0.0	2	13	2	5	Medium	Already surveyed
BATBH3ILBO023	Bond	1065.80	1065.89	1066.05	950	4.4	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	9	1	N/A	No PRTs	Already surveyed
BATBH3ILBO024	Bond	1066.07	1066.17	1066.27	1056	4.8	Census	1	0.51	0.04	1	0	0	0	1	0	0.0	0.0	0.0	0.5	0.0	2	7	1	4	Low	Already surveyed
BATBH3ILBO025	Bond	1068.06	1068.07	1068.08	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	2	1	N/A	No PRTs	Already surveyed
BATBH_ILBO026AU	Bond	1068.32	1068.45	1068.58	1373	6.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	N/A	N/A	Access Denied
BATBH3ILBO027	Bond	1069.83	1069.84	1069.84	53	0.2	Census	1	10.19	0.73	3	0	0	0	0	1	0.0	0.0	0.0	0.0	10.2	3	3	1	7	High	Already surveyed
BATBH3ILBO028	Bond	1070.31	1070.33	1070.36	1320	6.1	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	4	1	N/A	No PRTs	Already surveyed
BATBH3ILBO029	Bond	1070.59	1070.71	1070.85	1373	6.3	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	5	1	N/A	No PRTs	Already surveyed
BATBH3ILBO030	Bond	1071.18	1071.28	1071.37	792	3.6	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	8	1	N/A	No PRTs	Already surveyed
BATBH2ILFA001	Fayette	1072.55	1072.56	1072.57	79	0.4	Census	1	6.80	0.49	2	0	0	0	1	0	0.0	0.0	0.0	6.8	0.0	3	16	2	7	High	Already surveyed
BATBH2ILFA002	Fayette	1073.19	1073.37	1073.55	1901	8.7	Census	5	1.42	0.10	1	0	0	1	4	0	0.0	0.0	0.3	1.1	0.0	2	19	2	5	Medium	Already surveyed
BATBH1ILFA001NO	Fayette	1073.80	1073.82	1073.85	317	1.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	21	2	N/A	No PRTs	Already surveyed
BATBH1ILFA002NO	Fayette	1073.90	1073.91	1073.92	158	0.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	21	2	N/A	No PRTs	Already surveyed

Table 1. Wooded areas identified for field investigation within the proposed Keystone survey corridor in Illinois. Rows in gray represent woodlots that have not been assessed in the field (see Comments column for details).

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Number of Plots	Total Number of PRTs	PRT/ha	Woodlot HSI	PRT Density Score	Number of PRTs with dbh <22 cm	Number of PRTs with dbh 22-30 cm	Number of PRTs with dbh 30-40 cm	Number of PRTs with dbh 40-50 cm	Number of PRTs with dbh >50 cm	PRTs/ha with dbh <22 cm	PRTs/ha with dbh 22-30 cm	PRTs/ha with dbh 30-40 cm	PRTs/ha with dbh 40-50 cm	PRTs/ha with dbh >50 cm	PRT dbh Score	Percent Forest Cover Within 3.5 km	Percent Forest Cover Score	Sum of Scores	Overall Habitat Suitability	Comments
BATBH1ILFA003NO	Fayette	1073.96	1074.04	1074.12	845	3.9	Census	1	3.40	0.24	1	0	0	1	0	0	1.7	0.0	0.0	0.0	1.7	2	22	2	5	Medium	Already surveyed
BATBH1ILFA004NO	Fayette	1074.13	1074.20	1074.27	739	3.4	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	22	2	N/A	No PRTs	Already surveyed
BATBH1ILFA005NO	Fayette	1074.34	1074.36	1074.37	211	1.0	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	22	2	N/A	No PRTs	Already surveyed
BATBH1ILFA006NO	Fayette	1074.50	1074.58	1074.66	845	3.9	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	22	2	N/A	No PRTs	Already surveyed
BATBH1ILFA009AU	Fayette	1074.71	1074.73	1074.74	158	0.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	22	2	N/A	No PRTs	Already surveyed
BATBH1ILFA010AU	Fayette	1074.80	1074.84	1074.88	422	1.9	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	23	2	N/A	No PRTs	Already surveyed
BATBH1ILFA011AU	Fayette	1074.90	1074.91	1074.92	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	23	2	N/A	No PRTs	Already surveyed
BATBH1ILFA012AU	Fayette	1074.97	1075.09	1075.19	1003	4.6	Census	1	0.54	0.04	1	0	1	0	0	0	0.0	0.5	0.0	0.0	0.0	2	24	2	5	Medium	Already surveyed
BATBH1ILFA013AU	Fayette	1075.38	1075.41	1075.44	317	1.5	Census	1	1.70	0.12	1	0	0	1	0	0	0.0	0.0	1.7	0.0	0.0	2	25	2	5	Medium	Already surveyed
BATBH1ILFA014AU	Fayette	1075.56	1075.62	1075.69	739	3.4	Census	1	0.73	0.05	1	0	0	1	0	0	0.0	0.0	0.7	0.0	0.0	2	25	2	5	Medium	Already surveyed
BATBH1ILFA007NO	Fayette	1075.78	1075.79	1075.80	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	24	2	N/A	No PRTs	Already surveyed
BATBH1ILFA008NO	Fayette	1075.86	1075.89	1075.92	317	1.5	Census	2	3.40	0.24	1	1	0	0	0	1	1.7	0.0	0.0	0.0	1.7	2	24	2	5	Medium	Already surveyed
BATBH1ILFA009NO	Fayette	1075.93	1075.96	1076.00	3168	14.5	Census	2	0.34	0.02	1	0	0	1	1	0	0.0	0.0	0.2	0.2	0.0	1	23	2	4	Low	Already surveyed
BATBH1ILFA010NO	Fayette	1076.06	1076.07	1076.08	53	0.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	22	2	N/A	No PRTs	Already surveyed
BATBH1ILFA011NO	Fayette	1076.19	1076.31	1076.43	1320	6.1	Census	1	0.41	0.03	1	0	1	0	0	0	0.0	0.4	0.0	0.0	0.0	1	21	2	4	Low	Already surveyed
BATBH_ILFA020AU	Fayette	1077.28	1077.29	1077.30	106	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15	2	N/A	N/A	Access Denied
BATBH1ILFA021AU	Fayette	1077.54	1077.55	1077.57	158	0.7	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	12	1	N/A	No PRTs	Already surveyed
BATBH2ILFA022	Fayette	1078.56	1078.58	1078.60	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	7	1	N/A	No PRTs	Already surveyed
BATBH2ILMR001	Marion	1079.08	1079.10	1079.11	106	0.5	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	8	1	N/A	No PRTs	Already surveyed
BATBH2ILMR002	Marion	1080.78	1080.89	1081.00	1162	5.3	Census	5	2.32	0.17	1	0	1	1	2	1	0.0	0.5	0.5	0.9	0.5	2	14	2	5	Medium	Already surveyed
BATBH2ILMR003	Marion	1081.16	1081.21	1081.25	475	2.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	15	2	N/A	No PRTs	Already surveyed
BATBH2ILMR004	Marion	1081.56	1081.58	1081.61	185	0.8	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	17	2	N/A	No PRTs	Already surveyed
BATBH2ILMR005	Marion	1081.60	1081.61	1081.61	53	0.2	Census	0	0.00	0.00	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	N/A	17	2	N/A	No PRTs	Already surveyed

Table 2. Wooded areas within the proposed Keystone survey corridor in Illinois with overall habitat suitability scores of "Medium" or "High."

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Center Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Woodlot Area Based on July 2007 Construction Corridor & EWSs (acres)	Number of Plots	Number of PRTs in 200 ft Survey Corridor	Number PRTs in 200 ft Survey Corridor >22 cm	PRT/ha	Woodlot HSI	PRT Density Score	Number of PRTs with dbh <22 cm	Number of PRTs with dbh 22-30 cm	Number of PRTs with dbh 30-40 cm	Number of PRTs with dbh 40-50 cm	Number of PRTs with dbh >50 cm	PRTs/ha with dbh <22 cm	PRTs/ha with dbh 22-30 cm	PRTs/ha with dbh 30-40 cm	PRTs/ha with dbh 40-50 cm	PRTs/ha with dbh >50 cm	PRT dbh Score	Percent Forest Cover Within 3.5 km	Percent Forest Cover Score	Sum of Scores	Overall Habitat Suitability	Comments
BATBH1ILMA001MA	Madison	1025.10	1025.25	1025.40	1742	8.0	4.1	Census	4	4	1.24	0.09	1	0	1	0	1	2	0.0	0.3	0.0	0.3	0.6	2	14	2	5	Medium	Already surveyed
BATBH2ILMA020AU	Madison	1032.25	1032.44	1032.64	2059	9.5	3.5	Census	4	4	1.05	0.07	1	0	2	2	0	0	0.0	0.5	0.5	0.0	0.0	2	32	3	6	Medium	Already surveyed
BATBH2ILMA021AU	Madison	1032.76	1032.90	1033.04	1478	6.8	2.2	Census	1	1	0.36	0.03	1	0	0	0	1	0	0.0	0.0	0.0	0.4	0.0	2	35	3	6	Medium	Already surveyed
BATBH2ILMA022AU	Madison	1033.06	1033.20	1033.33	1637	7.5	3.0	Census	7	6	2.30	0.16	1	1	3	2	1	0	0.3	1.0	0.7	0.3	0.0	2	35	3	6	Medium	Already surveyed
BATBH2ILMA024AU	Madison	1033.80	1033.85	1033.89	581	2.7	n/a*	Census	3	3	2.78	0.20	1	0	0	0	1	2	0.0	0.0	0.0	0.9	1.9	2	36	3	6	Medium	Already surveyed
BATBH2ILMA025AU	Madison	1033.93	1034.00	1034.09	950	4.4	1.8	Census	1	0	0.57	0.04	1	1	0	0	0	0	0.6	0.0	0.0	0.0	0.0	2	37	3	6	Medium	Already surveyed
BATBH2ILMA031AU	Madison	1035.07	1035.13	1035.18	581	2.7	0.7	Census	1	1	0.93	0.07	1	0	0	1	0	0	0.0	0.0	0.9	0.0	0.0	2	34	3	6	Medium	Already surveyed
BATBH2ILMA034AU	Madison	1035.38	1035.85	1036.31	4910	22.5	8.9	Census	9	4	0.99	0.07	1	5	2	0	1	1	0.5	0.2	0.0	0.1	0.1	2	30	3	6	Medium	Already surveyed
BATBH1ILMA037	Madison	1036.73	1036.88	1037.08	2112	9.7	3.1	Census	29	14	7.39	0.53	2	15	10	2	2	0	3.8	2.5	0.5	0.5	0.0	2	22	2	6	Medium	Already surveyed
BATBH1ILMA038	Madison	1037.45	1037.51	1037.58	686	3.2	0.2	Census	1	1	0.78	0.06	1	0	0	1	0	0	0.0	0.0	0.8	0.0	0.0	2	17	2	5	Medium	Already surveyed
BATBH1ILMA042AU	Madison	1040.38	1040.60	1040.82	2323	10.7	2.7	Census	5	5	1.16	0.08	1	0	0	2	2	1	0.0	0.0	0.5	0.5	0.2	2	15	2	5	Medium	Already surveyed
BATBH1ILMA048AU	Madison	1044.10	1044.11	1044.12	158	0.7	0.3	Census	2	1	6.80	0.49	2	1	1	0	0	0	3.4	3.4	0.0	0.0	0.0	2	8	1	5	Medium	Already surveyed
BATBH1ILMA051AU	Madison	1044.90	1044.91	1044.93	158	0.7	0.2	Census	1	1	3.40	0.24	1	0	0	0	1	0	0.0	0.0	0.0	3.4	0.0	2	13	2	5	Medium	Already surveyed
BATBH_ILMA003NO	Madison	1049.33	1049.35	1049.37	211	1.0	0.2	Census	8	8	20.41	1.00	3	0	1	5	1	1	0.0	2.6	12.8	2.6	2.6	3	15	2	8	High	Already surveyed
BATBH1ILMA058	Madison	1049.71	1049.80	1049.90	1162	5.3	1.8	Census	11	11	5.10	0.36	1	0	6	4	1	0	0.0	2.8	1.9	0.5	0.0	2	17	2	5	Medium	Already surveyed
BATBH1ILMA059	Madison	1049.96	1050.01	1050.06	1399	6.4	1.2	Census	13	18	5.00	0.36	1	0	2	6	5	5	0.0	0.8	2.3	1.9	1.9	2	17	2	5	Medium	Already surveyed
BATBH1ILMA060	Madison	1050.08	1050.15	1050.22	792	3.6	1.7	Census	20	20	13.59	0.97	3	0	5	9	6	0	0.0	3.4	6.1	4.1	0.0	3	17	2	8	High	Already surveyed
BATBH1ILMA061	Madison	1050.49	1050.55	1050.60	634	2.9	1.3	Census	22	22	18.69	1.00	3	0	0	14	8	0	0.0	0.0	11.9	6.8	0.0	3	17	2	8	High	Already surveyed
BATBH1ILMA062	Madison	1050.86	1050.99	1051.12	1320	6.1	1.9	Census	2	2	0.82	0.06	1	0	0	0	0	2	0.0	0.0	0.0	0.0	0.8	2	15	2	5	Medium	Already surveyed
BATBH1ILMA063	Madison	1052.87	1052.88	1052.90	158	0.7	0.2	Census	2	2	6.80	0.49	2	0	0	2	0	0	0.0	0.0	6.8	0.0	0.0	2	3	1	5	Medium	Already surveyed
BATBH1ILBO004AU	Bond	1057.06	1057.23	1057.38	1742	8.0	2.3	Census	14	9	4.32	0.31	1	5	4	4	1	0	1.5	1.2	1.2	0.3	0.0	2	22	2	5	Medium	Already surveyed
BATBH1ILBO005AU	Bond	1057.78	1057.84	1057.87	475	2.2	0.7	Census	3	3	3.40	0.24	1	0	1	0	1	1	0.0	1.1	0.0	1.1	1.1	2	25	2	5	Medium	Already surveyed
BATBH2ILBO004NO	Bond	1060.04	1060.06	1060.08	211	1.0	0.4	Census	1	1	2.55	0.18	1	0	0	1	0	0	0.0	0.0	2.6	0.0	0.0	2	16	2	5	Medium	Already surveyed
BATBH4ILBO011	Bond	1062.46	1062.53	1062.60	739	3.4	0.4	Census	2	2	1.46	0.10	1	0	0	2	0	0	0.0	0.0	1.5	0.0	0.0	2	14	2	5	Medium	Already surveyed
BATBH2ILBO012AU	Bond	1062.65	1062.67	1062.68	158	0.7	n/a*	Census	1	1	3.40	0.24	1	0	1	0	0	0	0.0	3.4	0.0	0.0	0.0	2	15	2	5	Medium	Already surveyed
BATBH2ILBO014AU	Bond	1062.97	1063.23	1063.50	2746	12.6	3.5	Census	21	18	4.12	0.29	1	3	8	5	2	3	0.6	1.6	1.0	0.4	0.6	2	17	2	5	Medium	Already surveyed
BATBH4ILBO016	Bond	1063.82	1063.92	1064.01	950	4.4	n/a*	Census	1	1	0.57	0.04	1	0	0	1	0	0	0.0	0.0	0.6	0.0	0.0	2	19	2	5	Medium	Already surveyed
BATBH4ILBO017	Bond	1064.01	1064.15	1064.28	1373	6.3	1.5	Census	7	6	2.74	0.20	1	1	3	0	1	2	0.4	1.2	0.0	0.4	0.8	2	19	2	5	Medium	Already surveyed
BATBH3ILBO018	Bond	1064.53	1064.66	1064.78	1373	6.3	2.4	1	13	8	131.27	1.00	3	5	8	0	0	0	2.0	3.1	0.0	0.0	0.0	2	18	2	7	High	Already surveyed
BATBH3ILBO019	Bond	1064.82	1064.85	1064.88	581	2.7	0.6	Census	1	1	0.93	0.07	1	0	0	0	1	0	0.0	0.0	0.0	0.9	0.0	2	17	2	5	Medium	Already surveyed
BATBH3ILBO022	Bond	1065.40	1065.41	1065.43	185	0.8	0.2	Census	1	1	2.91	0.21	1	0	1	0	0	0	0.0	2.9	0.0	0.0	0.0	2	13	2	5	Medium	Already surveyed
BATBH3ILBO027	Bond	1069.83	1069.84	1069.84	53	0.2	0.1	Census	1	1	10.19	0.73	3	0	0	0	0	1	0.0	0.0	0.0	0.0	10.2	3	3	1	7	High	Already surveyed
BATBH2ILFA001	Fayette	1072.55	1072.56	1072.57	79	0.4	0.1	Census	1	1	6.80	0.49	2	0	0	0	1	0	0.0	0.0	0.0	6.8	0.0	3	16	2	7	High	Already surveyed
BATBH2ILFA002	Fayette	1073.19	1073.37	1073.55	1901	8.7	2.9	Census	5	5	1.42	0.10	1	0	0	1	4	0	0.0	0.0	0.3	1.1	0.0	2	19	2	5	Medium	Already surveyed
BATBH1ILFA003NO	Fayette	1073.96	1074.04	1074.12	845	3.9	1.5	Census	1	1	3.40	0.24	1	0	0	1	0	0	1.7	0.0	0.0	0.0	1.7	2	22	2	5	Medium	Already surveyed
BATBH1ILFA012AU	Fayette	1074.97	1075.09	1075.19	1003	4.6	2.2	Census	1	1	0.54	0.04	1	0	1	0	0	0	0.0	0.5	0.0	0.0	0.0	2	24	2	5	Medium	Already surveyed
BATBH1ILFA013AU	Fayette	1075.38	1075.41	1075.44	317	1.5	0.4	Census	1	1	1.70	0.12	1	0	0	1	0	0	0.0	0.0	1.7	0.0	0.0	2	25	2	5	Medium	Already surveyed
BATBH1ILFA014AU	Fayette	1075.56	1075.62	1075.69	739	3.4	1.1	Census	1	1	0.73	0.05	1	0	0	1	0	0	0.0	0.0	0.7	0.0	0.0	2	25	2	5	Medium	Already surveyed
BATBH1ILFA008NO	Fayette	1075.86	1075.89	1075.92	317	1.5	0.5	Census	2	1	3.40	0.24	1	1	0	0	0	1	1.7	0.0	0.0	0.0	1.7	2	24	2	5	Medium	Already surveyed
BATBH2ILMR002	Marion	1080.78	1080.89	1081.00	1162	5.3	1.9	Census	5	5	2.32	0.17	1	0	1	1	2	1	0.0	0.5	0.5	0.9	0.5	2	14	2	5	Medium	Already surveyed
						192.8	**61.5**																						

*The entirety of this woodlot falls outside of the July 2007 alignment construction corridor and EWSs, so it has an effective area of zero acres.

Appendix C. Field Data Sheets

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMAØØ1 Plot No.: 1

Date: 12-6-06 Start Time: 9:10

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	Salix alba alive (x4)	Salix alba alive (x2)	Salix alba alive (x3)

Total No. of PRTs: 9

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22

Salix alba
Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

tree line in agricultural field

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILHA002 Plot No.: 1

Date: 12-6-06 Start Time: 9:30

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Salix alba
Morus alba

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

Feature is the edge of a larger woodlot & 2 small patches of trees

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA004AU Plot No.: 1

Date: 2-4-07 Start Time: 1240

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Hackberry (Celtis occidentalis)
Black willow (Salix nigra)
Cottonwood (Populus deltoides)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

near private drive to ~~tank~~ tank farm (Robbins Rd)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA005AU Plot No.: 1

Date: 2-4-07 Start Time: 1200

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: Ø

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 1

Staghorn Sumac (Rhus typhina)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

no trees! just shrubs

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMA000BAU Plot No.: 1

Date: 28 July 2007 Start Time: 0815

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: Ø

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): n/a

no trees in area

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMA009AU Plot No.: 1

Date: 28 July 2007 Start Time: 0820

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): n/a

no trees in area

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: GATEWAY MADRONA Plot No.: 1

Date: 28 July 2007 Start Time: 1255

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Quercus sp. (dead) (2)	Quercus sp. (dead) (2)		

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Quercus alba
Acer saccharum
Fraxinus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):
site only surveyed b/w MP 1032.12 – 1032.41 b/c access was denied b/w 1032.02 – 1032.12

photos: 001W
002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2 ILMAD2 (AW) Plot No.: 1

Date: 28 July 2007 Start Time: 1011

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
			Quercus rubra (alive)	~~Juglans nigra~~ ~~(alive)~~

Total No. of PRTs: ~~2~~ 2W

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22"

Quercus rubra

Robinia pseudoacacia

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

nearby Cahokia Creek not in survey area

Comments (include access comments):

Site only surveyed b/w MP 1032.75 - 1032.82 b/c access was denied 1032.53 - 1032.75

photos: 001W

002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2 IL MA022 4W Plot No.: 1

Date: 28 July 2007 Start Time: 1038

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Quercus sp. (dead)	Quercus sp. (dead) (3)	Quercus sp. (dead) 2	Platanus occidentalis (alive)	

Total No. of PRTs: 7

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 24"

Acer saccharinum
Tilia americana
Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

Note: WE ROW

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2IL_MA023AU Plot No.: 1

Date: 29 July 2007 Start Time: 0931

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 25"

Salix nigra

Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMA024AV Plot No.: 1

Date: 29 July 2007 Start Time: 0949

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	Quercus sp. (dead)	Quercus sp. (dead) Populus deltoides (alive)

Total No. of PRTs: 3

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 28"

Quercus alba
Platanus occidentalis
Quercus macrocarpa

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

Photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMA025AV Plot No.: 1

Date: 29 July 2007 Start Time: 1005

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Quercus sp. (dead)	n/a	n/a	n/a	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 23"

Acer saccharum

Platanus occidentalis

Robinia pseudoacacia

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

area surveyed from MP 1033.69 - 1033.81 b/c from MP 1033.82 - 1033.87 access denied

photos: 01E
02W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2TCMA030AW Plot No.: 1

Date: 29 July 2007 Start Time: 1130

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22"

Quercus rubra

Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

area surveyed from MP 1034.75 - 1034.83 b/c

area b/w MP 1034.68 - 1034.75 denied access

photos: 0016

0017W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHDILMA031AU Plot No.: 1

Date: 29 July 2007 Start Time: 1150

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Ulmus americana (dead)		

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22"

Ulmus americana
Quercus alba
Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

photos: 001E
002W

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ICMA032AU Plot No.: 1

Date: 29 July 2007 Start Time: 1207

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 30"

Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMA033AV Plot No.: 1

Date: 29 July 2007 Start Time: 1257

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): n/a

no trees in area, entirely a corn field

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

all GPS points taken along edge of cornfield ~150' from centerline

photo: 0015

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMA034AU Plot No.: 1

Date: 29 July 2007 Start Time: 1500

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Juglans (3) nigra (dead) Quercus sp. (2) (dead)	Acer negundo (dead) Juglans nigra (dead)		Populus deltoides (dead)	Populus deltoides (dead)

Total No. of PRTs: 9

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Platanus occidentalis
Quercus alba
Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Comments (include access comments):

site is driveable, gravel road off of IL 157

photos: 001E site surveyed from MP: 1035.16 - 1035.75 b/c 002W access denied b/w 1035.75 - 1036.09

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA037 Plot No.: 1

Date: 12-6-06 Start Time: 11:50

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Unknown dead (IIII IIII II = 12)	Gleditsia triacanthos dead (IIII = 4)	Carya ovata alive (II = 2)	Unknown dead (II = 2)	n/a
Gleditsia triacanthos dead (II = 2)	Unknown dead (IIII = 5)			
Carya ovata	Carya ovata alive			

Total No. of PRTs: 29

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20

Gleditsia triacanthos
Quercus palustris
Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

small streams

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA038 Plot No.: 1

Date: 12-6-06 Start Time: 12:30

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	Unknown dead	n/a	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus imbricaria

Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

tree line along agricultural field

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHTICMAC42AV Plot No.: ALL ~~1244~~

Date: 7-29-07 Start Time: 11:00

Length of East/West Plot Edge (ft): 8

Length of North/South Plot Edge (ft): 8

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		2x Ulmus americana - dead	2x Acer saccharinum - dead	Acer saccharinum - dead

Total No. of PRTs: 5

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Celtis occidentalis, Acer saccharinum, Acer negundo

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

No trees West of MP 10C/0.4 - Habitat not surveyed beyond this point.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH21LM0043AV Plot No.: ALL

Date: 7-29-07 Start Time: 1040

Length of East/West Plot Edge (ft): 3

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
				~~Acer Saccharinum~~ dead

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Acer saccharinum, Acer negundo

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Across Stream

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHSICMA044 Plot No.: 1

Date: 6 December 2006 Start Time: 1020

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14" +

Quercus palustrus

Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

001W
002E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATB13ILMA045 Plot No.: 1

Date: 6 December 2006 Start Time: 1000

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10"

Celtis occidentalis

Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3ILMA0416 Plot No.: 1

Date: 6 December 2006 Start Time: 0920

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18"

Quercus imbricaria
Acer saccharum
Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

001 NYMM

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3ILMA047 Plot No.: 1

Date: 2 December 2000 Start Time: 0830

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14"

Platanus occidentalis

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

001E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILLMA043AU Plot No.: 1

Date: 8-4-07 Start Time: 1500

Length of East/West Plot Edge (ft): 41

Length of North/South Plot Edge (ft): 41

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Celtis occidentalis (alive)	Salix nigra (alive) - broken top	N/A	N/A	N/A

Total No. of PRTs: 2

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 4

Hackberry (Celtis occidentalis)

black willow (Salix nigra)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

- ROW grade + treeline south of site are cleared + level
- trees, concrete, dirt etc piled in middle of ROW at site

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA049AU Plot No.: 1

Date: 2-4-07 Start Time: 930

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 4

Shingle oak (Quercus imbricaria)
Pin oak (Quercus palustris)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

north border of yard (huge, new, brick house)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA050AU Plot No.: 1

Date: 2-4-07 Start Time: 1000

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	Populus deltoides (alive) "dead branch Unidentified hardwood snag Ulmus americana (dead)	N/A

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Populus deltoides (Cottonwood)
Celtis occidentalis (Hackberry)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing road
across creek (6-9 m wide)

Comments (include access comments):

all good PRTs have been bulldozed + piled at south edge of stand.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA051AU Plot No.: 1

Date: 8-4-07 Start Time: 1240

Length of East/West Plot Edge (ft): adj

Length of North/South Plot Edge (ft): adj

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	Quercus imbricaria (alive)	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Hackberry (Celtis occidentalis)

Shingle oak (Quercus imbricaria)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIILMA052AW Plot No.: 1

Date: 9-3-07 Start Time: 1550

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Honey locust (Gleditsia triacanthos)
Shingle oak (Quercus imbricaria)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing ROW

Comments (include access comments):

dense honeysuckle throughout. (Lonicera maackii)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHL IL MA053 AV Plot No.: ALL

Date: 7-28-07 Start Time: 11:40

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	5x Gladitsia triacanthos - dead		2x Gladitsia triacanthos - alive Gladitsia triacanthos - dead	

Total No. of PRTs: 8

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 15

Prunus serotina, Maclura pomifera, Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA054AU Plot No.: 2

Date: 7-25-07 Start Time: 1120

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Celtis occidentalis, Acer negundo

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATRH1MA055AV Plot No.: ALL

Date: 1-28-07 Start Time: 11:00AM

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Maclura pomifera, Celtis occidentalis, Tilia americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA0506 Plot No.: 1

Date: 12-5-06 Start Time: 1:30 pm

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Carya ovata alive (x2)	Carya laciniosa alive	n/a	Ulmus rubra alive

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Quercus rubra
Ulmus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Ravine

Comments (include access comments):

friendly dogs (2)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH1 IL MA 057 Plot No.: 1

Date: 12-5-06 Start Time: 1:15 pm

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: Ø

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus alba

Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

- Woodlot is actually 2 smaller woodlots separated by a small corn field
- Friendly dogs (2)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA058 Plot No.: 1

Date: 12-5-06 Start Time: 12:50

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Unknown dead Carya ovata alive (x5)	Carya ovata alive (x4)	Unknown dead	n/a

Total No. of PRTs: 11

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

Quercus rubra
Quercus alba
Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

small trail through woodlot

Comments (include access comments):

friendly dogs (2)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA059 Plot No.: 1

Date: 12-5-06 Start Time: 11:40

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Carya ovata alive (x2)	Carya ovata alive (x6)	Carya ovata alive (x5)	n/a

Total No. of PRTs: 13

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22

Quercus alba Carya Ovata

Quercus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Ravine

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA060 Plot No.: 1

Date: 12-5-06 Start Time: 11:10

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Carya ovata alive (x4) Unknown dead	Carya ovata alive (x8) Unknown dead	Carya ovata alive (x6)	n/a

Total No. of PRTs: 20

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Fraxinus pennsylvanica

Quercus alba

Carya ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

small streams

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA061 Plot No.: 1

Date: 12-5-06 Start Time: 10:30

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	Carya ovata alive (x14)	Carya ovata alive (x8)	n/a

Total No. of PRTs: 22

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20

Carya ovata

Quercus alba

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Open understory

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA062 Plot No.: 1

Date: 12-5-06 Start Time: 10:00

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	unknown dead (x2)

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 18

Quercus imbricaria

Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

woodlot is tree line in agricultural field

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMA063 Plot No.: 1

Date: 12-5-06 Start Time: 8:30

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	Ulmus americana alive Quercus alba dead	n/a	n/a

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Gleditsia triacanthos

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

small stream

Comments (include access comments):

none

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA001NO Plot No.: 1

Date: 2-4-07 Start Time: 1330

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Cotton-wood (Populus deltoides)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NO

Comments (include access comments):

site accessed by "Company Vehicles Only" road at barge dock.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH11LMA003NO Plot No.: ALL

Date: 7-28-07 Start Time: 10:20

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Carya ovata - alive	3 Quercus rubra - dead Prunus serotina - dead Gladitsia triacanthos - dead	Ulmus americana - dead	Ulmus americana - dead

Total No. of PRTs: 8

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Gladitsia triacanthos, Celtis occidentalis, Quercus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Edge of field, R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA001MA Plot No.: 1

Date: 26 Sept 2007 Start Time: 1045

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Acer negundo (alive) -dead top	N/A	Acer saccharinum (alive) -dead branch	Quercus macrocarpa (dead) Acer saccharinum (alive) -dead branch

Total No. of PRTs: 4

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across gaps in woods perpendicular to treeline

Comments (include access comments):

Rover : R0926BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA002MA Plot No.: 1

Date: 26 Sept 2007 Start Time: 1020

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Acer saccharinum

Ulmus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

Rover: R0926BH1B

area is grassy field w/ thin line of vine-covered trees to north

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA003MA Plot No.: 1

Date: 25 Sept 2007 Start Time: 1400

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Celtis occidentalis

~~Acer saccharinum~~ RW

Populus deltoides

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

none

Rover: R0925BH1B

1

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA0041MA Plot No.: 1

Date: 25 Sept 2007 Start Time: 1415

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	Acer saccharum (alive) - dead branch	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Acer saccharinum
Liquidambar styraciflua

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

Rover: RD925BH1B
none of the trees are within proposed ROW

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA005MA Plot No.: 1

Date: 27 Sept 2007 Start Time: 1007

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

well flagged centerline with path cleared

Rover: R0927BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILMA006MA Plot No.: 1

Date: 27 Sept 2007 Start Time: 1030

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	Salix nigra (alive) -dead branch

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Salix nigra
Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

centerline well flagged & trail cut
Rover: R0927BH1B

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH IILB0202AU Plot No.: 1

Date: 2-3-21 Start Time: 1345

Length of East/West Plot Edge (ft): 66

Length of North/South Plot Edge (ft): 66

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Black cherry (Prunus serotina)
Osage orange (Maclura pomifera)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

only 3 trees in plot

Surveyors: Lisa Winhold
John Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4ILB0002 Plot No.: 1

Date: 6 Dec. 2006 Start Time: 0845

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 5 (12cm)

Pinus serotina

Populus deltoides

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

tree line

Comments (include access comments):

area overgrown by vines

no easy access; farmlane along treeline to north that extends to State Ave.

Surveyors: Lisa Winhold
John Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4IL00003 Plot No.: 1

Date: 6 Dec 2006 Start Time: 0915

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12 (30 cm)

Prunus serotina

Celtis occidentalis

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

treeline

Comments (include access comments):

area overgrown by vines

no easy access; farmlane along treeline to north that extends to State Ave.

Can cross drain at ROW (higher ground)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1 ILBO004AU Plot No.: 1

Date: 8-3-07 Start Time: 1102

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Carya ovata (alive)	Carya ovata (alive)	Carya ovata (alive)	Acer negundo (alive)	
Carya ovata (alive)	Carya ovata (alive)	Quercus rubra (alive)	-dead branches	
Carya ovata (alive)	Ulmus americana (dead)	Quercus rubra (alive)		N/A
Carya ovata (alive)	Acer negundo (alive)	-dead branches		
Carya ovata (alive)		Carya ovata (alive)		

Total No. of PRTs: 14

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

White oak (Quercus alba)
Beech
Shagbark (Carya ovata)
Acer negundo (Box elder)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across existing corridor
across stream (<6 m)

Comments (include access comments):

driveway comes close to west end
bridge crosses stream - has big steel supports (could probably support vehicle)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILB0005AU Plot No.: 1

Date: 8-3-07 Start Time: 12:00

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Ulmus americana (dead)	N/A	Acer negundo (alive) with dead branches	Ulmus americana (dead)

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Box elder (Acer negundo)
Sycamore (Platanus occidentalis)
Hackberry (Celtis occidentalis)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across field
across existing pipeline R.O.W.

Comments (include access comments):

road/drive at junction of 3 fields

surveyors: Lisa Winhold
John Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH14ILBO006 Plot No.: 1

Date: 6 Dec 2006 Start Time: 1000

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16 (40 cm)

Quercus alba

Quercus macrocarpa

Quercus rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

treeline

Comments (include access comments):

Can park at road at southern end of treeline & walk along treeline

no road leading to site

deep drain along north point of treeline

exit pt. recorded ~10 m south of centerline due to ditch

Surveyors: Winhold + Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH 4 IL BO 007 Plot No.: 1

Date: 6 Dec 2006 Start Time: 1330

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	J. nigra (dead) J. nigra (dying)	N/A	A. saccharinum (dead)

Total No. of PRTs: 3

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

Platanus occidentalis
Populus deltoides
Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
river ~ 60-75' wide + deep (boat needed) → Shoal Creek
trails by river netable + ~ 9 m wide
treelines

Comments (include access comments):
PRT's = low quality (little loose bark, shaded)
drive = dirt but covers most of site (little walking distance)

Surveyors: Winhold & Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4ILB0009 Plot No.: 1

Date: 5 Dec 2006 Start Time: 1230

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Carya ovata
Celtis occidentalis
Sassafras albidum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

treeline

Comments (include access comments):

woodlot is fenced off

Surveyors: Winhold + Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4ILBO910 Plot No.: 1

Date: 5 Dec 2006 Start Time: 1210

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	U. americana (dead)	U. americana (dead)	N/A	N/A

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Celtis occidentalis
Fraxinus pennsylvanica
Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

stream wide enough for 6 m ~~net~~ or 9 m net, but may be over grown in places
treeline

Comments (include access comments):

med quality PRT's - 1 has low % bark remaining + 1 has grape vine up side that may create too much clutter.
old farm lane leads right up to east end of pipeline
steep bank on stream

Surveyors: Winhold + Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH4ILBOØ11 Plot No.: 1

Date: 5 Dec 2006 Start Time: 1115

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	C. cavata (live) C. cavata (live)	N/A	N/A

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Quercus alba

Carya Ovata

~~Acer rubrum~~

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

open stand in mowed area, new pond edge.

needs across street from house

no ditch, so can park in pipeline area (at corner)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2TLB0012AU Plot No.: 1

Date: 26 July 2007 Start Time: 1336

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Carya ovata (alive)	n/a	n/a	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 24"

Quercus imbricaria
Quercus macrocarpa
Carya ovata

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

ditch w/ water present

Comments (include access comments):

photos: 001 W
002 E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILBOØ13AV Plot No.: 1

Date: 26 July 2007 Start Time: 1319

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8"

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

photos: 001 W
002 E

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILBØØ14AU Plot No.: 1

Date: 26 July 2007 Start Time: 11:05

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
celtis occidentalis (dead) (2) Unknown dead trunk sp.	Prunus serotina (dead) Unknown dead trunk sp. Carya ovata (alive) (1)	Robinia pseudoacacia (alive) (2) Carya (2) ovata (alive) Carya laciniosa (alive)	Prunus serotina (alive) Carya ovata (alive)	Carya ovata (dead) Quercus sp. (dead) (2)

Total No. of PRTs: ~~28~~ 21

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 26"

Celtis occidentalis Quercus alba

~~Prunus serotina~~ Acer saccharum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

stream through woodlot

Comments (include access comments):

photos: 001E, 002W

Surveyors: Winhold + Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH 4 IL BOØ15 Plot No.: 1

Date: 5 Dec 2006 Start Time: 1020

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3):
Celtis occidentalis
Pinus sylvestris
Ailanthus altissima

Estimated Average Overstory dbh (in): 20

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
none

Comments (include access comments):
1 large hackberry (C. occidentalis) surrounded by many saplings of P. sylvestris + ailanthus
Farm lane across street for parking

surveyors: Winhold + Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH4 IL BO 0186 Plot No.: 1

Date: 5 Dec 2006 Start Time: 0940

Length of East/West Plot Edge (ft): nil

Length of North/South Plot Edge (ft): nil

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	Quercus rubra (dead)	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 120

Quercus rubra
Pinus strobus
[illegible]
Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

~~None~~ treeline at [illegible] west end where treeline goes south

Comments (include access comments):

PRT = low quality

parking across street w/ BO #17

Surveyors: Winbold + Alexander

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH41LB0017 Plot No.: 1

Date: 5 Dec 2006 Start Time: 0753

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

< 22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
C. ovata (live)	C. ovata (live) U. americana (dead) U. americana (dead)	N/A	Q. rubra (dead)	Q. rubra (dying) Q. rubra (dying)

Total No. of PRTs: 7

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus rubra
Carya ovata
Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

treeline - run net ⊥ to trees

Comments (include access comments):

Q. rubra = low quality PRT

Farm Field entrance at west end for parking

at west end = 3 white wood sign says

campground cumberland presbyterian church established 1820 sunday school 9:30 church 10:30

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3ILBØØ18 Plot No.: 1

Date: 5 December 2006 Start Time: 1630

Length of East/West Plot Edge (ft): 169

Length of North/South Plot Edge (ft): 65

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
5 Carya ovata (alive)	8 Carya ovata (alive)	3 n/a	n/a	n/a

Total No. of PRTs: 13

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Carya ovata

Estimated Average Overstory dbh (in): 16"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.): No openings to forest or streams, existing ROW present could be netted

Comments (include access comments):

001W
PRT (2)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHSILB0019 Plot No.: 1

Date: 5 December 2006 Start Time: 1615

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	Ulmus americana (dead)	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14"

Carya cordiformes

Quercus palustrus

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

~~n/a~~ large pond if necessary

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATSH3ILRD020 Plot No.: 1

Date: 5 December 2006 Start Time: 1345

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10"

Fraxinus pennsylvanica

Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

Very small wooded area along pond

COW

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHSIRBD021 Plot No.: 1

Date: 5 December 2006 Start Time: 1500

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14"

fraxinus pennsylvanica

Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

OOIS

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: EATBH3ILBD023 Plot No.: 1

Date: 5 December 2006 Start Time: 1400

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	Quercus velutina dead	n/a	n/a	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12"

Salix nigra

Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

~~AMC~~ stream margin "woodlot"

Comments (include access comments):

very small wooded area

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3ILBDC123 Plot No.: 1

Date: 5 December 2006 Start Time: 1530

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8"

Ulmus americana

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

mainly wetland, forested area outside of survey corridor

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3ILB0024 Plot No.: 1

Date: 5 December 2016 Start Time: 1300

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	unknown dead trunk	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16"

Ulmus americana

Celtis occidentalis

Quercus velutina

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3IL60025 Plot No.: 1

Date: 5 December 2006 Start Time: 1300

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14"

Salix nigra

Fraxinus pennsylvanica

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3IL80627 Plot No.: 1

Date: 5 December 2006 Start Time: 1120

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	Quercus sp. alive

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 24"

Maclura pomifera

* Quercus sp.

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

center point taken @ PRT

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3ILRD028 Plot No.: 1

Date: 5 December 2006 Start Time: 0945

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10"

Celtis occidentalis

Ulmus americana

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH3ILBO029 Plot No.: 1

Date: December 2006 Start Time: 1015

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus palustris, Acer saccharum, Ulmus rubra

Estimated Average Overstory dbh (in): 14"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHSIL0030 Plot No.: 1

Date: 5 December 2006 Start Time: 1050

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Celtis occidentalis, Carya sp., Juglans nigra

Estimated Average Overstory dbh (in): 14"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

n/a

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BARH1K BOOINO Plot No.: ALL

Date: 7-27-07 Start Time: 9:45

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

LAT: 38° 48' 38.152" N

LONG: 89° 29' ~~44.361~~ 49.613" W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus imbricaria, Platanus occidentalis, Juglans nigra Estimated Average Overstory dbh (in): 12

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Road

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BABHZILB0002NO Plot No.: ALL

Date: 7-27-07 Start Time: 9:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

LAT: 38°48'37.971" N

LONG: 89°39'41.361" W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Juglans nigra, Celtis occidentalis, Platanus occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILB0003NO Plot No.: 1

Date: 27 July 2007 Start Time: 1053

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 22"

Juglans nigra
Quercus alba
Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Stream in middle,

Comments (include access comments):

photos
001 NW
002 S

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2I2B0004NO Plot No.: 1

Date: 27 July 2007 Start Time: 1033

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	Quercus sp. (dead) ~~n/a~~ SW	n/a	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 20"

Platanus occidentalis
Acer saccharum
Juglans nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

Photos:
001 N
002 S

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILB0005NO Plot No.: 1

Date: 27 July 2007 Start Time: 1020

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14"

Quercus imbricaria
Ulmus americana
Quercus macrocarpa

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

photos: 001S
002N

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH2 ILFA001 Plot No.: 1

Date: 12-5-06 Start Time: 4:00

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Lat: 38°46'15.763N

Long: 89°15'5.058W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	Quercus Imbricaria (dead)	n/a

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Quercus imbricaria Estimated Average Overstory dbh (in): 18

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

none

Comments (include access comments):

large
lots Trees in wood lot it is 10 ft wide

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILFA002 Plot No.: 1

Date: 12-05-06 Start Time: 3:00pm

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	Acer negundo	2 Juglans nigra 2 Gleditsia triacanthos	n/a

Total No. of PRTs: 5

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Quercus Palustris
Acer negundo
Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Stream in middle of plot

Boat access road

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILFA003 Plot No.: 1

Date: 12-06-06 Start Time: 9:00am 9:25

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 38° 48' 16.660" N

Long: 89° 13' 42.484" W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
None	None	None	None	None

Total No. of PRTs: 0

understory clear

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Wetland None

Comments (include access comments):

Wetland with small willows

Nearly all open

Centerline offset 150ft 180° off Levee

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

check in Pathfinder

Woodlot (Feature) ID: BATBHZILFA004 Plot No.: 1

Date: 12-06-06 Start Time: 9:25

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 38° 48' 15.459" N
Long: 89° 13' 29.091" W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	NA	1 Salix nigra alive	5 Salix nigra alive	NA

Total No. of PRTs: 6

understory very dense

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Salix Nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Wetland in middle of plot/ along Levee

Comments (include access comments):

very dense Button Bush

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILFA005 Plot No.: 1

Date: 12-06-06 Start Time: 10:45

Lat: 38°48'15.740"N
Long: 89°B' 17.749"W

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
			Saliv Nigra 3 branches alive	

Total No. of PRTs: 1

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

Saliv Nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

along river

Comments (include access comments):

Saliv is only large tree 3

Wood lot very small

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILFA006 Plot No.: 1

Date: 12-06-06 Start Time: 11:45

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat: 38°48'15.205"N

Long: 89°13'13.263"W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	NA	NA	NA	NA

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

understory dense

Dominant Overstory Tree Species (list up to 3): Salix nigra Estimated Average Overstory dbh (in): 8

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

small Salix next to river

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH2ILFA007 Plot No.: 1

Date: 12-06-06 Start Time: 12:05

Length of East/West Plot Edge (ft): All

Length of North/South Plot Edge (ft): All

Lat 38° 48' 15.039 N
Long 89° 13' 5.659 W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
			Salix nigra alive	

Total No. of PRTs: 1

Understory - Mid.

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 14

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

On Levee

Comments (include access comments):

Flooded and could not travers offset points in gps

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BABH1LFA009AV Plot No.: ALL

Date: 7-26-07 Start Time: 10:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

Only two trees in site

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BHZ IL FA 0 10 AV Plot No.: ALL

Date: 7/25/07 Start Time: 6:20

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILFAGILAU Plot No.: ALL

Date: 7/25/07 Start Time: 0915

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Sx1X nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH12ILFA012AV Plot No.: ALL

Date: 7-25-07 Start Time: 6:00

Length of East/West Plot Edge (ft): 50

Length of North/South Plot Edge (ft): 50

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
	Salix nigra Dead			

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILFA013AV Plot No.: ALL

Date: 7-25-07 Start Time: 5:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Salix nigra Dead		

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Acer Saccharinum, Salix nigra Estimated Average Overstory dbh (in): 12"

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BABH2ILFA014AV Plot No.: AKL

Date: 7-25-07 Start Time: 4:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Quercus palustris - Dead		

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Quercus palustris, Acer saccharinum,

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Gap between sections of forest, right-of-way

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BHTIBHILFA015A1 Plot No.: 1

Date: 8-2-07 Start Time: 1630

Length of East/West Plot Edge (ft): 33

Length of North/South Plot Edge (ft): 33

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Black willow (Salix nigra) Estimated Average Overstory dbh (in): 5

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

flagged
center pt ≈ 40' east of GPS pt
[illegible] ≈ 5' east & west of center
can drive on levee to site

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILF2016AU Plot No.: 1

Date: 8-2-07 Start Time: 1550

Length of East/West Plot Edge (ft): 66

Length of North/South Plot Edge (ft): 66

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
Maple (Acer sp.)	N/A	N/A	N/A	Silver Maple (alive) (Acer Saccharinum)

Total No. of PRTs: 2 (same as BATBHILF2016NO)

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 7

Silver Maple (Acer Saccharinum)
Box elder (Acer negundo)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NO

Comments (include access comments):

Can drive on levee to site

* photo label in image (whiteboard) says "NO" not "AU"

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHIILFA0187AO Plot No.: 1

Date: 2-2-07 Start Time: 1140

Length of East/West Plot Edge (ft): 66

Length of North/South Plot Edge (ft): NA

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	Silver maple (alive);	Silver maple (alive)	N/A

Total No. of PRTs: 2 (same as BATBHIILFA229NO)

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Silver maple (Acer saccharinum)
cottonwood (Populus deltoides)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

access stream

Comments (include access comments):

farmlane near BATBHIILFA010NO + BATBHIILFA018A is closest access if permission is granted to drive on it.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHTLF001BAU Plot No.: 1

Date: 8-2-21 Start Time: 1200

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 7

Silver Maple (Acer Saccharinum)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

1 to treeline

Comments (include access comments):

farmlane parallels treeline to the west

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BaTBH2IL FA019 Plot No.: 1

Date: 12-05-06 Start Time: 12:25 1:45 out

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Lat: 38° 48' 5.297" N
Long: 89° 11' 0.667 W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	Betula nigra Betula nigra Salix nigra Salix nigra Betula nigra	n/a

Total No. of PRTs: 5

Understory mod

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Betula nigra
Salix nigra
Acer rubra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):
Edge of wetland in the ~~East~~ western portion

Comments (include access comments):

Wood lot seperated by scrubby area
Large trees next to wetland in the western portion of the plot
Many small trees in the East

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BAT BH1 ILFA021AU Plot No.: ALL

Date: 7-25-07 Start Time: 12:30

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% (75-100%)

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 9

Quercus palustris, Fraxinus americana, Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILFA022 Plot No.: 1

Date: 12-05-06 Start Time: 11:50 12:15

Length of East/West Plot Edge (ft): 911

Length of North/South Plot Edge (ft): 911

Lat 38° 17' 28.076" N
Long 89° 6' 34.047 W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
None	None	None	None	None

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

understory moderate

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16

Quercus Palustris
Fraxinus Pennsylvanica
Celtis Occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

Narrow strip of trees between Ag fields

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH7 IL FA001NO Plot No.: ALC

Date: 7-26-07 Start Time: 1:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1LFA002NO Plot No.: ALL

Date: 7-26-07 Start Time: 1215

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 6

Salix nigra,

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2WLFA003NO Plot No.: ALL

Date: 7-26-07 Start Time: 12:00

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
		Salix nigra - dead		

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Salix nigra, Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILFA004ND Plot No.: ALL

Date: 7-26-07 Start Time: 10:45

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 8

Salix nigra, Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

R.O.W.

Comments (include access comments):

Very overgrown

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BABHILFA005NO Plot No.: ALL

Date: 7-26-07 Start Time: 10:15

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 9

Salix nigra, Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

NONE

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILFA00%NO Plot No.: ALL

Date: 7-26-07 Start Time: 9:30

Length of East/West Plot Edge (ft): 0

Length of North/South Plot Edge (ft): 0

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 10

Salix nigra

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Across wetland

Comments (include access comments):

Exit is 300' west of exit point taken

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1LFR007.10 Plot No.: 1

Date: 8-2-07 Start Time: 1500

Length of East/West Plot Edge (ft): 66

Length of North/South Plot Edge (ft): 21

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 5

Black willow (Salix nigra)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

No

Comments (include access comments):

open field

center ~40' west east of GPS pt

edge is approx ~ 5' from center (east + west)

need DNR to open gate to levees + can drive on levee to site)

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: SATOH1ILFA203NO Plot No.: 1

Date: 2-8-07 Start Time: 1520

Length of East/West Plot Edge (ft): adj

Length of North/South Plot Edge (ft): adj

Within each DBH size class list PRT species and indicate dead/alive

≥22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
maple (Acer sp) - living - dead	N/A	N/A	N/A	Silver Maple (Acer) - main trunk is split in multiples

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 7

Silver maple (Acer saccharinum)

Box elder (Acer negundo)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no

Comments (include access comments):

low quality PRT's

need DNR to open gate to levees, can drive on levee to site

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILFA024NO Plot No.: 1

Date: 5-25-07 Start Time: 11:15am

Length of East/West Plot Edge (ft): n/a

Length of North/South Plot Edge (ft): n/a

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	Silver maple (alive) -Hollow -Some [illegible] -not [illegible]	Silver maple (alive) -Cottonwood	N/A

Total No. of PRTs: 2

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 16 (40 cm)

Silver maple (Acer saccharinum)
Cottonwood (Populus deltoides)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

across stream (12-13m wide), wadable (chest waders)

Comments (include access comments):

N/S farmlane near is closest access BATBH1ILFA010NO & BATBH1ILFA018AU if permission is granted to drive on it.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILLFAB1001O Plot No.: 1

Date: 8-2-07 Start Time: 1100

Length of East/West Plot Edge (ft): 66

Length of North/South Plot Edge (ft): 66

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	N/A	N/A	N/A	N/A

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Silver Maple (Acer saccharinum) Estimated Average Overstory dbh (in): 7 (18cm)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

1 to treeline

Comments (include access comments):

1 to treeline

Farmlane parallels treeline to the west

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBHILSAR1109 Plot No.: 1

Date: 8-2-07 Start Time: 11:30 a.m.

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Black willow crumbly w/ some branch	N/A	N/A	N/A

Total No. of PRTs: 1

Percent Canopy Cover (circle one): 0-25% 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 5 (12 cm)

Silver Maple (Acer saccharinum)
Black willow (Salix nigra)
River birch (Betula nigra)
Pin Oak (Quercus ~~palustris~~ palustris)

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

no - ROW existing pipeline corridor

Comments (include access comments):

part of woods + existing pipeline ROW is flooded.

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMR001 Plot No.: 1

Date: 12-5-06 Start Time: 11:15

Length of East/West Plot Edge (ft): all 11:45

Length of North/South Plot Edge (ft): all

Lat/ 38° 47' 23.5036
Long/ 89° 8' 0.611 W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
NA	NA	NA	NA	NA

Total No. of PRTs: 0

understory

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

None

Comments (include access comments):

strip of trees 20ft wide

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH2ILMR002 Plot No.: 1

Date: 12-5-06 Start Time: 9:15 10:30 out

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Lat +38°47'15.537"N
Long 89°6'9.679"W

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
N/A	Prunis serotina (dead)	Ulmus americana (dead)	Ulmus americana (dead) Ulmus americana (dead)	Ulmus americana (dead)

Total No. of PRTs: 5

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 15

Maclura pomifera
Celtis occidentalis
Quercus imbricaria

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

Stream in center of plot
pastured portion of plot has open areas

Comments (include access comments):

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMR003 Plot No.: 1

Date: 12-4-04 Start Time: 11:00

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% 25-50% (50-75%) 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 15

Pinus rigida

Acer saccharinum

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

open understory

Comments (include access comments):

Residential back yard

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMR004 Plot No.: 1

Date: 12-4-06 Start Time: 10:45

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): (0-25%) 25-50% 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 5

Tilia americana

Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

small stream

Comments (include access comments):

few trees along ditch/stream

BHE/ENSR Bat Habitat Survey Field Form
Potential Roost Tree Identification

Woodlot (Feature) ID: BATBH1ILMRDOS Plot No.: 1

Date: 12-4-06 Start Time: 10:30

Length of East/West Plot Edge (ft): all

Length of North/South Plot Edge (ft): all

Within each DBH size class list PRT species and indicate dead/alive

>22 cm	22-30 cm	30-40 cm	40-50 cm	≥50 cm
n/a	n/a	n/a	n/a	n/a

Total No. of PRTs: 0

Percent Canopy Cover (circle one): 0-25% (25-50%) 50-75% 75-100%

Dominant Overstory Tree Species (list up to 3): Estimated Average Overstory dbh (in): 12

Quercus imbricaria

Celtis occidentalis

Presence of Apparently Suitable Mist Net Sites (streams, trails, etc.):

small stream

Comments (include access comments):

none

Appendix D. Field GPS Data and Site Photographs

The GPS-collected field data and site photographs are included on an attached CD-ROM.

B-3 – Missouri Woodlots Worksheet

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
NAT9ABC001	Buchanan	754.96	755.13	898	4.1	0.9	29	2756	0.03%	Census	0	0	N/A			
NAT9ABC002	Buchanan	755.14	755.22	422	1.9	0.4	30	2852	0.02%	Census	0	0	N/A			
NAT9ABC003	Buchanan	755.28	755.33	317	1.5	0.3	32	3042	0.01%	Census	1.1	0.5	N/A			
NAT9ABC004	Buchanan	755.39	755.90	2693	12.4	2.8	37	3517	0.08%	3	1.1	0.5	N/A			
NATBH1BC005	Buchanan	756.38	756.44	370	1.7	0.4	43	4087	0.01%	Census	0.55	0.1	No Indiana bats captured			
BATBH1MOBC001NO	Buchanan	756.87	757.44	2957	13.6	7.5	41	3897	0.19%	Census	1.65	0.0	N/A			
BATBH1MOBC002NO	Buchanan	757.55	757.65	528	2.4	1.3	40	3802	0.04%	Census	0.55	0.1	N/A			
BATBH1MOBC003NO	Buchanan	757.67	758.36	3590	16.5	9.1	38	3612	0.25%	Census	6.05	0.1	N/A			
NAT8ABC011	Buchanan	758.68	758.74	370	1.7	0.4	38	3612	0.01%	Census	0	0	N/A			
NAT8ABC012	Buchanan	758.80	758.87	370	1.7	0.4	38	3612	0.01%	Census	0.55	0.2	N/A			
NAT8ABC013	Buchanan	759.04	759.22	950	4.4	1.0	38	3612	0.03%	Census	0.55	0.1	N/A			
NAT8ABC014	Buchanan	759.37	759.55	1003	4.6	1.0	36	3422	0.03%	1	0	0	N/A	Linear distance is less than 0.7 miles between woodlots with 30 to 40% forest cover within 3.5 km. HSI values ranged from 0 to 0.5. Approximately 0.01 to 0.25% forest cover will be removed during construction. Three narrow wooded, riparian corridors (Contrary Creek, Pigeon Creek, and unnamed tributary of Pigeon Creek) cross the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at a site within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	A
NAT8ABC015	Buchanan	759.99	760.08	475	2.2	0.5	32	3042	0.02%	Census	0	0	N/A			
NAT8ABC016	Buchanan	760.10	760.15	211	1.0	0.2	31	2947	0.01%	Census	0.55	0.3	N/A			
NAT8ABC017	Buchanan	760.20	760.37	950	4.4	1.0	31	2947	0.03%	Census	1.1	0.1	N/A			
NAT8ABC018/019	Buchanan	760.41	760.86	2376	10.9	2.5	31	2947	0.08%	4	2.2	0.7	No Indiana bats captured			
BATBH1MOBC001AU	Buchanan	760.89	761.35	2429	11.2	6.1	29	2763	0.22%	Census	13.2	0.4	N/A			
BATBH1MOBC002AU	Buchanan	761.46	761.56	581	2.7	1.5	29	2756	0.05%	Census	6.05	0.7	N/A			
NAT8ABC020	Buchanan	761.76	761.80	581	2.7	0.6	28	2661	0.02%	Census	0	0	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
NAT8ABC021	Buchanan	761.93	761.99	264	1.2	0.3	27	2566	0.01%	Census	0	0	N/A			
NAT8ABC022	Buchanan	762.07	762.14	370	1.7	0.4	27	2566	0.01%	1	0	0	N/A			
NAT8ABC023	Buchanan	762.60	762.76	422	1.9	0.4	24	2281	0.02%	1	0	0	N/A			
NAT8ABC024	Buchanan	762.92	763.15	792	3.6	0.8	22	2091	0.04%	1	0.55	0.7	No Indiana bats captured			
NAT8ABC025	Buchanan	763.33	763.37	1214	5.6	1.3	19	1806	0.07%	1	0	0	N/A			
NAT__BC026	Buchanan	763.44	763.54	211	1.0	0.2	18	1711	0.01%	N/A	N/A	N/A	N/A			
NAT8ABC027	Buchanan	765.44	765.57	528	2.4	0.5	14	1331	0.04%	Census	0	0	N/A			
NAT8ABC028	Buchanan	766.07	766.20	739	3.4	0.8	14	1331	0.06%	Census	0	0	N/A			
NAT8ABC029	Buchanan	766.95	767.04	686	3.2	0.7	16	1521	0.05%	Census	0	0	N/A			
NAT8ABC030	Buchanan	767.16	767.22	475	2.2	0.5	16	1521	0.03%	Census	1.1	0.5	N/A			
BATBH2MOBC004NO	Buchanan	767.30	767.40	528	2.4	1.3	17	1616	0.08%	Census	0	0.2	N/A	Linear distance is less than 1.1 miles between woodlots with 13 to 19% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.02 to 0.11% forest cover will be removed during construction. Three narrow wooded riparian corridors (unnamed tributary of Platte River, Malden Creek and unnamed tributary of Malden Creek) cross the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at a site within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	B
BATBH2MOBC005NO	Buchanan	767.49	767.53	264	1.2	0.7	18	1711	0.04%	Census	2.2	0.2	N/A			
BATBH1MOBC006NO	Buchanan	767.90	767.95	317	1.5	0.8	19	1806	0.04%	Census	0.55	0.1	N/A			
BATBH1MOBC007NO	Buchanan	768.31	768.44	739	3.4	1.9	18	1711	0.11%	Census	0.55	0.1	N/A			
NAT8ABC033	Buchanan	769.14	769.27	634	2.9	0.7	15	1426	0.05%	2	3.85	1	No Indiana bats captured			
BATBH1MOBC008NO	Buchanan	770.28	770.33	211	1.0	0.5	13	1236	0.04%	Census	0	0.0	N/A			
BATBH1MOCL001NO	Clinton	774.50	774.57	317	1.5	0.8	19	1806	0.04%	Census	0	0.0	N/A			
NAT9ACL036	Clinton	774.90	774.98	422	1.9	0.4	15	1426	0.03%	Census	0	0	N/A			
NAT9ACL037	Clinton	775.01	775.14	739	3.4	0.8	15	1426	0.05%	1	0	0	N/A	Linear distance is less than 0.5 miles between woodlots with 14 to 19% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.03 to 0.11% forest cover will be removed during construction. One narrow wooded riparian corridor (Castle Creek) crosses the proposed pipeline. Due to the low HSI values and the fact that Indiana bats were captured at a site within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	C

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
NAT9ACL038	Clinton	775.32	775.39	370	1.7	0.4	15	1426	0.03%	Census	3.3	1	N/A	grouping, we are assuming that no primary roost trees will be affected by construction.		
NAT9ACL039	Clinton	775.70	775.98	1478	6.8	1.5	14	1331	0.11%	2	1.65	1	No Indiana bats captured			
BATBH2MOCL002NO	Clinton	784.10	784.15	845	3.9	2.1	17	1616	0.13%	Census	8.8	0.7	N/A	Linear distance is 0.2 between woodlots with 17% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.04 to 0.20% forest cover will be removed during construction. One narrow wooded riparian corridor (unnamed tributary of Little Platte River) crosses the proposed pipeline. Due to the high number of PRTs and the high HSI score, we are assuming that one primary roost tree will be affected by construction.	1	D
BATBH2MOCL003NO	Clinton	784.22	784.46	1320	6.1	3.3	17	1616	0.21%	Census	0	0	N/A			
BATBH1MOCL004NO	Clinton	788.07	788.56	2640	12.1	6.7	19	1806	0.37%	Census	23.1	0.6	N/A			
BATBH1MOCL005NO	Clinton	788.91	788.94	634	2.9	1.6	20	1901	0.08%	Census	2.75	0.3	N/A			
BATBH1MOCL006NO	Clinton	789.07	789.33	1373	6.3	3.5	19	1806	0.19%	Census	7.7	0.4	N/A			
NAT9ACL046	Clinton	789.39	789.51	581	2.7	0.6	16	1521	0.04%	1	1.1	1	No Indiana bats captured			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
NAT9ACL047	Clinton	789.61	789.71	475	2.2	0.5	16	1521	0.03%	Census	1.1	0.6	No Indiana bats captured	Linear distance is less than 1.0 miles between woodlots with 15 to 20% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.02 to 0.36% forest cover will be removed during construction. Several narrow wooded riparian corridors cross the proposed pipeline. Due to the low HSI values and the fact that Indiana bats were not captured at one of the sites within the grouping, we assume that no primary roost trees will be affected by construction.	0	E
NAT9ACL048	Clinton	790.66	790.71	317	1.5	0.3	15	1426	0.02%	Census	0	0	N/A			
NAT9ACL049	Clinton	790.81	790.89	422	1.9	0.4	16	1521	0.03%	1	1.65	1	No Indiana bats captured			
BATBH_MOCL007NO	Clinton	791.18	791.32	792	3.6	2.0	20	1901	0.11%	N/A	N/A	N/A	N/A			
BATBH2MOCL008NO	Clinton	792.08	792.16	422	1.9	1.1	18	1711	0.06%	Census	1.1	0.2	N/A			
BATBH2MOCL009NO	Clinton	792.19	792.23	264	1.2	0.7	18	1711	0.04%	Census	0.55	0.1	N/A			
BATBH2MOCL010NO	Clinton	792.45	792.61	1003	4.6	2.5	19	1806	0.14%	Census	1.1	0.1	N/A			
NAT10ACA051	Caldwell	793.86	793.91	211	1.0	0.2	18	1711	0.01%	1	1.1	1	No Indiana bats captured	Linear distance is less than 1.1 miles between woodlots with 18 to 21% forest cover within 3.5 km. HSI values ranged from 0.1 to 1. Approximately 0.01 to 0.10% forest cover will be removed during construction. Three narrow wooded riparian corridors (Goose Creek, and 2 unnamed tributaries of Goose Creek) cross the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at a site within the grouping, we are assuming that no primary roost trees will be affected.	0	F
BATBH_MOCA001NO	Caldwell	794.86	795.00	845	3.9	2.1	20	1901	0.11%	N/A	N/A	N/A	N/A			
BATBH1MOCA002NO	Caldwell	795.07	795.17	634	2.9	1.6	21	1996	0.08%	Census	0.55	0.1	N/A			
NAT10ACA052	Caldwell	796.88	797.08	1056	4.8	1.1	21	1996	0.05%	2	1.1	0.7	No Indiana bats captured	Linear distance is less than 0.8 miles between woodlots with 14 to 21% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.01 to 0.08% forest cover will be removed during construction. Several narrow wooded riparian corridors cross the proposed pipeline. While there are high HSI values, because of the fact that no Indiana bats were captured at several sites within the grouping we are assuming that no primary roost trees will be affected by construction.	0	G
NAT10ACA053	Caldwell	797.62	797.71	475	2.2	0.5	21	1996	0.02%	1	0	0	N/A			
NAT10ACA054	Caldwell	798.06	798.18	528	2.4	0.5	21	1996	0.03%	1	0	0	N/A			
NAT__CA055	Caldwell	798.18	798.28	634	2.9	0.7	21	1996	0.03%	N/A	N/A	N/A	No Indiana bats captured			
NAT__CA056	Caldwell	798.66	798.84	950	4.4	1.0	21	1996	0.05%	N/A	N/A	N/A	N/A			
NAT__CA057	Caldwell	798.87	798.93	317	1.5	0.3	21	1996	0.02%	N/A	N/A	N/A	N/A			
NAT10ACA058	Caldwell	799.09	799.15	317	1.5	0.3	22	2091	0.02%	1	0.55	0.7	N/A			
NAT10ACA059	Caldwell	799.15	799.29	686	3.2	0.7	22	2091	0.03%	1	0.55	0.7	No Indiana bats captured			
BATBH1MOCA003NO	Caldwell	800.01	800.03	211	1.0	0.5	24	2281	0.02%	Census	0.55	0.2	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

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NAT10ACA060	Caldwell	800.85	800.89	211	1.0	0.2	18	1711	0.01%	1	1.1	1	No Indiana bats captured			
NAT10ACA061	Caldwell	801.46	801.65	1003	4.6	1.0	14	1331	0.08%	2	1.1	0.7	No Indiana bats captured			
NAT10ACA062	Caldwell	801.74	801.79	317	1.5	0.3	15	1426	0.02%	1	0.55	0.7	No Indiana bats captured			
NAT10ACA063	Caldwell	803.86	803.93	370	1.7	0.4	15	1426	0.03%	Census	0	0	N/A	Linear distance is less than 0.6 miles between woodlots with 15% forest cover within 3.5 km. HSI values ranged from 0 to 0.2. Approximately 0.03% forest cover will be removed during construction. Two narrow wooded riparian corridors (Brush Creek and an unnamed tributary of Brush Creek) cross the proposed pipeline. Due to the low HSI values we are assuming that no primary roost trees will be affected by construction.	0	H
NAT10ACA064	Caldwell	804.22	804.29	370	1.7	0.4	15	1426	0.03%	Census	0.55	0.2	N/A			
NAT10ACA065	Caldwell	804.30	804.38	422	1.9	0.4	15	1426	0.03%	1	0	0	N/A			
NAT10ACA066	Caldwell	804.93	805.01	422	1.9	0.4	15	1426	0.03%	1	0	0	N/A			
NAT10ACA067	Caldwell	810.33	810.52	1003	4.6	1.0	19	1806	0.06%	2	1.65	1	No Indiana bats captured			
NAT10ACA068	Caldwell	810.55	810.67	634	2.9	0.7	20	1901	0.03%	2	1.1	0.7	No Indiana bats captured			
NAT10ACA069	Caldwell	810.82	811.08	1373	6.3	1.4	21	1996	0.07%	2	1.1	0.7	No Indiana bats captured			
NAT10ACA070	Caldwell	811.19	811.46	1426	6.5	1.5	22	2091	0.07%	3	1.1	0.5	N/A	Linear distance is less than 0.9 miles between woodlots with 19 to 21% forest cover within 3.5 km. HSI values ranged from 0 to 0.7. Approximately 0.01 to 0.07% forest cover will be removed during construction. Four narrow wooded riparian corridors (4 unnamed tributaries of North Mud Creek) cross the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at several sites within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	I
NAT10ACA071	Caldwell	811.49	811.58	475	2.2	0.5	22	2091	0.02%	Census	0	0	N/A			
NAT10ACA072	Caldwell	812.39	812.44	370	1.7	0.4	21	1996	0.02%	1	0	0	N/A			
NAT10ACA073	Caldwell	812.58	812.69	528	2.4	0.5	20	1901	0.03%	1	0	0	N/A			
NAT10ACA074	Caldwell	812.70	812.78	422	1.9	0.4	20	1901	0.02%	1	0	0	N/A			
NAT10ACA075	Caldwell	812.83	812.97	686	3.2	0.7	19	1806	0.04%	2	0	0	N/A			
NAT10ACA076	Caldwell	814.81	814.94	739	3.4	0.8	16	1521	0.05%	1	0	0	N/A	Linear distance is less than is less than 1.3 miles between woodlots with 15 to 16% forest cover within 3.5 km. HSI values ranged from 0 to 0.1. Approximately 0.05 to 0.07% forest cover will be removed during construction. Three narrow wooded riparian corridors (Mud Creek, Willow Creek, and an unnamed tributary of Willow Creek) cross the proposed pipeline. Due to the low HSI values we are assuming that no primary roost trees will be affected by construction.	0	J
BATBH_MOCA004NO	Caldwell	816.14	816.22	422	1.9	1.1	15	1426	0.07%	N/A	N/A	N/A	N/A			
BATBH2MOCA005NO	Caldwell	816.23	816.28	317	1.5	0.8	15	1426	0.06%	Census	0.55	0.1	N/A			

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
NAT9ACR077	Carroll	818.07	818.22	792	3.6	0.8	23	2186	0.04%	1	0.55	0.7	No Indiana bats captured	Linear distance is less than 0.5 miles between woodlots with 18 to 23% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.02 to 0.08% forest cover will be removed during construction. Three narrow wooded riparian corridors (Turkey Creek, and 2 unnamed tributaries of Turkey Creek) cross the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at several sites within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	K
NAT9ACR078	Carroll	818.48	818.79	1531	7.0	1.6	21	1996	0.08%	2	1.65	1	No Indiana bats captured			
NAT9ACR079	Carroll	818.98	819.19	1109	5.1	1.1	19	1806	0.06%	1	0	0	N/A			
NAT__CR080	Carroll	819.30	819.36	370	1.7	0.4	18	1711	0.02%	N/A	N/A	N/A	No Indiana bats captured			
NAT9ACR081	Carroll	823.18	823.23	317	1.5	0.3	27	2566	0.01%	Census	2.2	1	No Indiana bats captured	Linear distance is less than 0.8 miles between woodlots with 27 to 41% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.02 to 0.11% forest cover will be removed during construction. Four narrow wooded riparian corridors (4 unnamed tributaries of Big Creek) cross the proposed pipeline. While there are high HSI values, because of the fact that no Indiana bats were captured at several sites within the grouping we are assuming that no primary roost trees will be affected by construction.	0	L
BATBH1MOCR001NO	Carroll	823.84	823.88	370	1.7	0.9	35	3327	0.03%	Census	0	0.0	N/A			
NAT9ACR082	Carroll	824.29	824.60	1584	7.3	1.6	40	3802	0.04%	3	7.7	1	No Indiana bats captured			
NAT9ACR083	Carroll	824.75	824.93	950	4.4	1.0	41	3897	0.03%	2	4.95	1	No Indiana bats captured			
NAT9ACR084	Carroll	825.37	825.66	1584	7.3	1.6	41	3897	0.04%	3	8.25	1	No Indiana bats captured			
NAT9ACR085	Carroll	825.80	825.89	475	2.2	0.5	40	3802	0.01%	1	1.65	1	No Indiana bats captured			
NAT9ACR086	Carroll	825.97	826.33	1901	8.7	2.0	40	3802	0.05%	3	8.25	1	No Indiana bats captured			
NAT9ACR087	Carroll	827.44	827.61	739	3.4	0.8	33	3137	0.02%	1	3.3	1	No Indiana bats captured	Linear distance is less than 0.5 miles between woodlots with 14 to 28% forest cover within 3.5 km. HSI values ranged from 0 to 0.9. Approximately 0.02 to 0.11% forest cover will be removed during construction. Two narrow wooded riparian corridors (Grand River and unnamed tributary of Grand River) cross the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at several sites within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	M
NAT9ACR088	Carroll	827.99	828.15	845	3.9	0.9	28	2661	0.03%	1	0	0	N/A			
NAT9ACR089	Carroll	828.20	828.25	264	1.2	0.3	27	2566	0.01%	1	0	0	N/A			
NAT9ACR090	Carroll	828.64	828.77	686	3.2	0.7	25	2376	0.03%	1	0.55	0.7	No Indiana bats captured			
NAT9ACR091	Carroll	828.77	828.83	370	1.7	0.4	24	2281	0.02%	Census	2.2	0.9	No Indiana bats captured			
NAT9ACR092	Carroll	828.95	829.12	845	3.9	0.9	23	2186	0.04%	1	0	0	N/A			
NAT9ACR093	Carroll	829.77	829.85	475	2.2	0.5	22	2091	0.02%	1	0	0	N/A			
BATBH1MOCR002NO	Carroll	830.41	830.54	634	2.9	1.6	20	1901	0.08%	Census	0.55	0.1	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
BATBH1MOCR003NO	Carroll	830.65	830.68	211	1.0	0.5	19	1806	0.03%	Census	0	0.0	N/A			
NAT9ACR095	Carroll	831.17	831.31	686	3.2	0.7	14	1331	0.05%	1	0	0	N/A			
NAT9ACR096	Carroll	843.06	843.25	1003	4.6	1.0	14	1331	0.08%	2	1.65	1	No Indiana bats captured	Linear distance is less than 0.6 miles between woodlots with 14% forest cover within 3.5 km. HSI values ranged from N/A to 1. Approximately 0.07 to 0.08% forest cover will be removed during construction. Three narrow wooded riparian corridors (Brush Creek, unnamed tributary of Brush Creek, and unnamed tributary of Lake Creek) cross the proposed pipeline. Due to the fact that no Indiana bats were captured at both sites in the grouping, we are assuming that no primary roost trees will be affected by construction.	0	N
NAT__CI097	Chariton	843.45	843.62	898	4.1	0.9	14	1331	0.07%	N/A	N/A	N/A	No Indiana bats captured			
BATBH1MOCI001NO	Chariton	851.10	851.15	211	1.0	0.5	20	1901	0.03%	Census	0	0.0	N/A	Linear distance is less than 0.9 miles between woodlots with 20 to 23% forest cover within 3.5 km. HSI values ranged from 0 to 0.3. Approximately 0.03 to 0.35% forest cover will be removed during construction. One narrow wooded riparian corridor (unnamed tributary of Lake Creek) crosses the proposed pipeline. Due to the low HSI values, we are assuming that no primary roost trees will be affected by construction.	0	O
BATBH1MOCI002NO	Chariton	851.38	851.48	317	1.5	0.8	20	1901	0.04%	Census	0	0.0	N/A			
BATBH_MOCI003NO	Chariton	851.80	852.17	2218	10.2	5.6	20	1901	0.29%	N/A	N/A	N/A	N/A			
BATBH1MOCI004NO	Chariton	852.36	852.86	2693	12.4	6.8	20	1901	0.36%	Census	4.4	0.1	N/A			
BATBH1MOCI005NO	Chariton	852.95	852.99	422	1.9	1.1	20	1901	0.06%	Census	0	0.0	N/A			
NAT9ACI101	Chariton	854.96	855.13	845	3.9	0.9	23	2186	0.04%	Census	1.65	0.3	N/A			
BATBH1MOCI006NO	Chariton	855.88	855.93	211	1.0	0.5	23	2186	0.02%	Census	0	0.0	N/A			
BATBH1MOCI007NO	Chariton	856.12	856.19	422	1.9	1.1	22	2091	0.05%	Census	0	0.0	N/A			
BATBH1MOCI008NO	Chariton	869.46	869.52	317	1.5	0.8	14	1331	0.06%	Census	0	0.0	N/A	Linear distance is less than 0.3 miles between woodlots with 14 to 19% forest cover within 3.5 km. HSI values are 0 for all sites.. Approximately 0.07 to 0.42% forest cover will be removed during construction. Due to the low HSI values, we are assuming that no primary roost trees will be affected by construction.	0	P
BATBH1MOCI009NO	Chariton	869.57	869.65	422	1.9	1.1	15	1426	0.07%	Census	0	0.0	N/A			
BATBH1MOCI010NO	Chariton	869.66	870.23	2851	13.1	7.2	19	1806	0.40%	Census	0	0.0	N/A			
BATBH1MOCI011NO	Chariton	874.15	874.18	211	1.0	0.5	17	1616	0.03%	Census	0	0.0	N/A			
BATBH1MOCI012NO	Chariton	874.33	874.83	2640	12.1	6.7	18	1711	0.39%	Census	0	0.0	N/A			
NAT8ARA104	Randolph	877.38	877.45	422	1.9	0.4	14	1331	0.03%	Census	0	0	N/A			
NAT8ARA105	Randolph	877.59	877.76	950	4.4	1.0	14	1331	0.07%	Census	1.65	0.4	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
NAT8ARA106	Randolph	877.88	878.11	1320	6.1	1.4	15	1426	0.10%	Census	0.55	0	N/A	Linear distance is less than 2.8 miles between woodlots with 13 to 39% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.01 to 0.39% forest cover will be removed during construction. Numerous narrow wooded riparian corridors cross the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at several sites within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	Q
NAT8ARA107	Randolph	879.17	879.20	264	1.2	0.3	22	2091	0.01%	Census	0.55	0.3	N/A			
BATBH1MORA001NO	Randolph	879.29	879.53	1267	5.8	3.2	23	2186	0.15%	Census	3.85	0.2	N/A			
BATBH1MORA002NO	Randolph	879.61	879.66	211	1.0	0.5	24	2281	0.02%	Census	0	0.0	N/A			
BATBH1MORA003NO	Randolph	879.84	880.12	1373	6.3	3.5	25	2376	0.15%	Census	61.05	1.0	N/A			
BATBH1MORA004NO	Randolph	880.18	880.36	845	3.9	2.1	26	2471	0.09%	Census	1.1	0.1	N/A			
BATBH1MORA005NO	Randolph	880.53	880.79	1320	6.1	3.3	27	2566	0.13%	Census	1.65	0.1	N/A			
NAT9ARA112	Randolph	882.52	882.63	475	2.2	0.5	37	3517	0.01%	1	0.55	0.7	No Indiana bats captured			
NAT9ARA113	Randolph	882.66	882.85	739	3.4	0.8	37	3517	0.02%	1	3.85	1	No Indiana bats captured			
NAT9ARA114	Randolph	883.21	883.35	792	3.6	0.8	37	3517	0.02%	1	1.65	1	No Indiana bats captured			
NAT9ARA115	Randolph	883.49	883.58	370	1.7	0.4	38	3612	0.01%	Census	2.2	0.8	No Indiana bats captured			
BATBH1MORA006NO	Randolph	883.88	884.02	634	2.9	1.6	39	3707	0.04%	Census	2.2	0.2	N/A			
BATBH1MORA007NO	Randolph	884.12	884.54	2112	9.7	5.3	38	3612	0.15%	Census	3.3	0.1	N/A			
NAT10ARA117/118	Randolph	885.56	886.01	2429	11.2	2.5	30	2852	0.09%	5	0.55	0.1	N/A			
NAT10ARA119	Randolph	886.13	886.46	1690	7.8	1.7	24	2281	0.08%	4	1.65	0.5	N/A			
BATBH1MORA008NO	Randolph	896.95	897.05	528	2.4	1.3	13	1236	0.11%	Census	0	0	N/A			
NAT10AAU120	Audrain	917.86	917.92	370	1.7	0.4	14	1331	0.03%	Census	0	0	N/A	Linear distance is less than 2.2 miles between woodlots with 14 to 17% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.03 to 0.12% forest cover will be removed during construction. One narrow wooded riparian corridor (Skull Lick Creek) crosses the proposed pipeline. Due to the low HSI values and the fact that no Indiana bats were captured at one site within the grouping, we are assuming that no primary roost trees will be affected by construction.	0	R
NAT10AAU121	Audrain	918.22	918.35	581	2.7	0.6	14	1331	0.05%	1	1.1	1	No Indiana bats captured			
BATBH1MOAU001NO	Audrain	919.06	919.21	792	3.6	2.0	17	1616	0.12%	Census	0	0	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
BATBH_1MOAU002NO	Audrain	921.37	921.42	211	1.0	0.5	17	1616	0.03%	Census	0	0	N/A			
BATBH_MOMO001AU	Montgomery	943.88	943.93	211	1.0	0.5	13	1258	0.04%	N/A	N/A	N/A	N/A			
BATBH_MOMO002AU	Montgomery	944.04	944.07	264	1.2	0.7	14	1309	0.05%	N/A	N/A	N/A	N/A			
BATBH1MOMO003AU	Montgomery	945.18	945.27	475	2.2	1.2	18	1713	0.07%	Census	0	0	N/A			
BATBH1MOMO004AU	Montgomery	945.33	945.91	3010	13.8	7.6	19	1810	0.42%	3	1.1	0.5	N/A			
BATBH1MOMO005AU	Montgomery	945.96	946.78	4171	19.2	10.5	19	1835	0.57%	3	4.95	1	N/A			
BATBH1MOMO006AU	Montgomery	946.86	947.00	739	3.4	1.9	18	1725	0.11%	Census	0	0	N/A			
BATBH1MOMO007AU	Montgomery	947.10	947.18	634	2.9	1.6	18	1736	0.09%	Census	1.1	0.1	N/A			
BATBH1MOMO008AU	Montgomery	947.20	947.33	686	3.2	1.7	18	1724	0.10%	Census	0	0	N/A			
BATBH1MOMO009AU	Montgomery	947.41	947.47	422	1.9	1.1	17	1662	0.06%	Census	0	0	N/A			
BATBH1MOMO010AU	Montgomery	947.50	947.52	211	1.0	0.5	17	1653	0.03%	Census	0	0	N/A			
BATBH1MOMO011AU	Montgomery	948.94	949.13	1003	4.6	2.5	20	1906	0.13%	Census	1.1	0.1	N/A			
BATBH1MOMO012AU	Montgomery	949.74	949.78	528	2.4	1.3	23	2216	0.06%	Census	0	0	N/A			
BATBH1MOMO013AU	Montgomery	950.09	950.16	290	1.3	0.7	24	2299	0.03%	Census	0	0	N/A			
BATBH1MOMO014AU	Montgomery	950.17	950.98	4198	19.3	10.6	25	2371	0.45%	Census	4.95	0.1	N/A			
BATBH1MOMO015AU	Montgomery	951.03	951.08	290	1.3	0.7	25	2386	0.03%	Census	1.65	0.4	N/A			
BATBH1MOMO016AU	Montgomery	951.13	951.48	1927	8.8	4.9	25	2390	0.20%	Census	3.3	0.1	N/A			
BATBH1MOMO017AU	Montgomery	951.55	951.58	264	1.2	0.7	26	2434	0.03%	Census	0	0	N/A			
BATBH1MOMO018AU	Montgomery	951.72	951.99	1373	6.3	3.5	27	2522	0.14%	Census	1.65	0.1	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
BATBH1MOMO019AU	Montgomery	952.45	952.61	845	3.9	2.1	27	2537	0.08%	Census	0	0	N/A			
BATBH2MOMO020	Montgomery	953.15	953.36	1135	5.2	2.9	25	2398	0.12%	Census	0	0	N/A			
BATBH2MOMO021	Montgomery	953.69	953.80	686	3.2	1.7	23	2230	0.08%	Census	1.1	0.1	N/A			
BATBH2MOMO022	Montgomery	954.06	954.25	1056	4.8	2.7	22	2113	0.13%	Census	9.9	0.7	N/A			
BATBH2MOMO023	Montgomery	954.41	954.56	792	3.6	2.0	22	2113	0.09%	Census	16.5	1	N/A			
BATBH_MOMO024AU	Montgomery	954.64	954.79	607	2.8	1.5	24	2239	0.07%	N/A	N/A	N/A	N/A			
BATBH_MOMO025AU	Montgomery	954.78	954.98	1109	5.1	2.8	25	2363	0.12%	N/A	N/A	N/A	N/A			
BATBH_MOMO026AU	Montgomery	955.05	955.11	317	1.5	0.8	27	2574	0.03%	N/A	N/A	N/A	N/A			
BATBH1MOMO027AU	Montgomery	955.46	955.95	2640	12.1	6.7	34	3186	0.21%	2	9.35	1	N/A			
BATBH_MOMO028AU	Montgomery	956.29	956.95	3538	16.2	8.9	43	4123	0.22%	N/A	N/A	N/A	N/A			
BATBH_MOMO029AU	Montgomery	956.98	957.01	211	1.0	0.5	45	4281	0.01%	N/A	N/A	N/A	N/A			
BATBH_MOLI001AU	Lincoln	957.16	958.51	7234	33.2	18.3	51	4874	0.37%	N/A	N/A	N/A	N/A			
BATBH_MOLI002AU	Lincoln	958.56	959.24	3485	16.0	8.8	55	5206	0.17%	N/A	N/A	N/A	N/A			
BATBH_MOLI003AU	Lincoln	959.26	959.30	211	1.0	0.5	54	5117	0.01%	N/A	N/A	N/A	N/A			
BATBH_MOLI004AU	Lincoln	959.34	959.46	634	2.9	1.6	53	5078	0.03%	N/A	N/A	N/A	N/A			
BATBH_MOLI005AU	Lincoln	959.60	959.94	1690	7.8	4.3	54	5135	0.08%	N/A	N/A	N/A	N/A			
BATBH_MOLI006AU	Lincoln	959.99	960.10	581	2.7	1.5	54	5086	0.03%	N/A	N/A	N/A	N/A			
BATBH1MOLI007AU	Lincoln	960.16	960.81	3379	15.5	8.5	54	5179	0.16%	3	3.85	1	N/A			
BATBH1MOLI008AU	Lincoln	961.05	961.71	3485	16.0	8.8	57	5439	0.16%	4	4.4	1	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
BATBH1MOLI009AU	Lincoln	961.72	961.92	1056	4.8	2.7	56	5325	0.05%	Census	0	0	N/A	Linear distance is less than 1.5 miles between woodlots with 15 to 55% forest cover within 3.5 km. HSI values ranged from 0 to 1. Approximately 0.01 to 0.42% forest cover will be removed during construction. Numerous narrow wooded riparian corridors cross the proposed pipeline. Due to the fact that several woodlots have a HSI value of 1, and that the grouping spans greater than 40 miles, we are assuming that 10 primary roost trees will be affected by construction.	10	S
BATBH1MOLI010AU	Lincoln	961.92	962.04	634	2.9	1.6	56	5321	0.03%	Census	0	0	N/A			
BATBH1MOLI011AU	Lincoln	962.05	963.17	5914	27.2	14.9	54	5110	0.29%	5	9.35	1	N/A			
BATBH1MOLI012AU	Lincoln	963.18	963.22	211	1.0	0.5	55	5256	0.01%	Census	0	0	N/A			
BATBH1MOLI013AU	Lincoln	963.25	963.61	1901	8.7	4.8	55	5216	0.09%	Census	6.05	0.2	N/A			
BATBH1MOLI014AU	Lincoln	963.66	964.02	1901	8.7	4.8	55	5183	0.09%	3	5.5	1	N/A			
BATBH1MOLI015	Lincoln	964.05	964.26	1214	5.6	3.1	54	5121	0.06%	Census	7.15	0.4	N/A			
BATBH1MOLI016AU	Lincoln	964.47	964.50	211	1.0	0.5	53	5072	0.01%	Census	0	0	N/A			
BATBH1MOLI017	Lincoln	964.51	964.53	211	1.0	0.5	53	5058	0.01%	Census	0	0	N/A			
BATBH1MOLI018	Lincoln	964.61	964.74	634	2.9	1.6	52	4988	0.03%	Census	0.55	0.1	N/A			
BATBH1MOLI019AU	Lincoln	964.74	965.02	1531	7.0	3.9	50	4796	0.08%	2	0.55	0.4	N/A			
BATBH1MOLI020AU	Lincoln	965.04	966.29	6653	30.5	16.8	45	4312	0.39%	4	8.25	1	N/A			
BATBH2MOLI021	Lincoln	966.30	966.40	475	2.2	1.2	41	3887	0.03%	Census	0.55	0.1	N/A			
BATBH2MOLI022	Lincoln	966.44	966.70	1373	6.3	3.5	40	3769	0.09%	Census	4.95	0.3	N/A			
BATBH2MOLI023	Lincoln	966.81	966.89	581	2.7	1.5	38	3617	0.04%	Census	0.55	0.1	N/A			
BATBH2MOLI024AU	Lincoln	966.92	967.00	475	2.2	1.2	37	3501	0.03%	Census	0	0	N/A			
BATBH1MOLI025AU	Lincoln	967.15	967.91	4039	18.5	10.2	33	3110	0.33%	5	8.25	1	N/A			
BATBH2MOLI026AU	Lincoln	967.97	968.18	1373	6.3	3.5	31	2985	0.12%	Census	2.75	0.1	N/A			
BATBH2MOLI027AU	Lincoln	968.64	968.78	713	3.3	1.8	33	3120	0.06%	Census	11	1.0	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
BATBH2MOLI028AU	Lincoln	968.84	969.09	1320	6.1	3.3	34	3208	0.10%	Census	0	0	N/A			
BATBH2MOLI029AU	Lincoln	969.14	969.17	211	1.0	0.5	34	3232	0.02%	Census	0	0	N/A			
BATBH2MOLI030AU	Lincoln	969.25	969.29	211	1.0	0.5	34	3219	0.02%	Census	0.55	0.2	N/A			
BATBH2MOLI031AU	Lincoln	969.46	969.61	792	3.6	2.0	33	3175	0.06%	Census	11	1.0	N/A			
BATBH2MOLI032AU	Lincoln	969.83	969.95	634	2.9	1.6	33	3116	0.05%	Census	0.55	0.1	N/A			
BATBH2MOLI033AU	Lincoln	970.07	970.11	211	1.0	0.5	32	3048	0.02%	Census	0	0	N/A			
BATBH2MOLI034AU	Lincoln	970.14	970.44	1637	7.5	4.1	32	3005	0.14%	Census	11	0.5	N/A			
BATBH2MOLI035AU	Lincoln	970.47	970.80	1795	8.2	4.5	29	2777	0.16%	Census	0	0	N/A			
BATBH2MOLI036AU	Lincoln	970.82	971.40	3010	13.8	7.6	26	2475	0.31%	Census	11	0.3	N/A			
BATBH2MOLI037AU	Lincoln	971.47	971.54	475	2.2	1.2	25	2388	0.05%	Census	0	0	N/A			
BATBH2MOLI038AU	Lincoln	971.68	972.05	1954	9.0	4.9	24	2288	0.22%	Census	11	0.4	N/A			
BATBH2MOLI039AU	Lincoln	972.19	972.40	1162	5.3	2.9	22	2072	0.14%	Census	2.2	0.1	N/A			
BATBH2MOLI040AU	Lincoln	972.40	972.53	739	3.4	1.9	21	1985	0.09%	Census	0	0	N/A			
BATBH2MOLI041AU	Lincoln	972.58	972.70	634	2.9	1.6	20	1856	0.09%	Census	0	0	N/A			
BATBH2MOLI042AU	Lincoln	972.79	972.90	1003	4.6	2.5	18	1727	0.15%	Census	3.85	0.3	N/A			
BATBH2MOLI043AU	Lincoln	973.24	973.44	1056	4.8	2.7	19	1774	0.15%	Census	0	0	N/A			
BATBH2MOLI044AU	Lincoln	973.57	973.73	1056	4.8	2.7	21	1951	0.14%	Census	1.65	0.1	N/A			
BATBH1MOLI001NO	Lincoln	974.24	974.27	211	1.0	0.5	27	2566	0.02%	Census	0	0	N/A			
BATBH_MOLI002NO	Lincoln	974.29	974.35	422	1.9	1.1	28	2661	0.04%	N/A	N/A	N/A	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN MISSOURI.

Woodlot ID	County (Missouri)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 110 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km Removed	Number of Plots	Number of PRTs Based on 110 ft Construction Corridor	Woodlot HSI*	Proximate Mist Netting Results (2007)	Comments	Potential Primary Roost Trees Affected	Group ID
BATBH_MOLI003NO	Lincoln	975.15	975.22	264	1.2	0.7	32	3042	0.02%	N/A	N/A	N/A	N/A			
BATBH_MOLI004NO	Lincoln	975.23	975.30	317	1.5	0.8	33	3137	0.03%	N/A	N/A	N/A	N/A			
BATBH3MOLI051	Lincoln	975.91	975.95	264	1.2	0.7	26	2477	0.03%	Census	0	0	N/A			
BATBH3MOLI052	Lincoln	976.07	976.11	264	1.2	0.7	25	2404	0.03%	Census	0	0	N/A			
BATBH3MOLI053	Lincoln	976.83	976.96	686	3.2	1.7	22	2048	0.08%	Census	0	0	N/A			
BATBH4MOLI054	Lincoln	977.36	977.48	686	3.2	1.7	19	1812	0.10%	Census	0	0	N/A			
BATBH4MOLI055	Lincoln	977.59	977.63	211	1.0	0.5	18	1744	0.03%	Census	0	0	N/A			
BATBH2MOLI056AU	Lincoln	979.90	979.96	370	1.7	0.9	15	1470	0.06%	Census	0	0	N/A			
BATBH_MOLI001MA	Lincoln	980.16	980.26	2640	12.1	6.7	19	1850	0.36%	N/A	N/A	N/A	N/A			
BATBH_MOLI002MA	Lincoln	980.59	980.65	1690	7.8	4.3	20	1868	0.23%	N/A	N/A	N/A	N/A			
BATBH1MOLI003MA	Lincoln	981.04	981.28	1320	6.1	3.3	18	1702	0.20%	Census	1.65	0.1	N/A			
BATBH1MOLI004MA	Lincoln	981.42	981.68	2772	12.7	7.0	16	1561	0.45%	Census	2.2	0.1	N/A			
BATBH1MOSC001MA	St. Charles	988.82	989.02	1346	6.2	3.4	14	1321	0.26%	Census	1.65	0.1	N/A	Linear distance is less than 0.4 miles between woodlots with 14 to 21% forest cover within 3.5 km. HSI values ranged from 0 to 0.4. Approximately 0.02 to 0.20% forest cover will be removed during construction. Two narrow wooded riparian corridors (unnamed tributaries of the Cuivre River) cross the proposed pipeline. Due to the low HSI values we are assuming that no primary roost will be affected by construction.	0	T
BATBH1MOSC002MA	St. Charles	989.20	989.40	1109	5.1	2.8	16	1504	0.19%	Census	1.1	0.1	N/A			
BATBH1MOSC003MA	St. Charles	989.45	989.57	634	2.9	1.6	16	1557	0.10%	Census	0.55	0.1	N/A			
BATBH1MOSC004MA	St. Charles	989.78	989.91	792	3.6	2.0	17	1613	0.12%	Census	1.65	0.1	N/A			
BATBH1MOSC005MA	St. Charles	989.95	989.98	370	1.7	0.9	17	1632	0.06%	Census	0	0	N/A			
BATBH1MOSC006MA	St. Charles	990.04	990.39	1874	8.6	4.7	18	1676	0.28%	Census	9.35	0.3	N/A			
BATBH1MOSC007MA	St. Charles	990.58	990.76	950	4.4	2.4	21	1951	0.12%	Census	0	0	N/A			
														TOTAL	**11**	

*Based on 200 ft survey corridor, not 110 ft construction corridor

B-4 – Illinois Woodlots Worksheet

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH1ILMA001MA	Madison	1025.10	1025.40	1584	7.3	3.5	14	1358	0.25%	2	Medium	Linear distance is less than 1.1 miles between woodlots with 7 to 14% forest cover in surrounding area. Of the eight woodlots, one provides medium habitat quality, two low habitat quality, three do not have PRTs, and two woodlots were not assessed. Small amount of forest within 3.5 km, unlikely to support a colony. Approximately 0.05 to 0.30% forest cover within 3.5 km will be removed during construction. There is a narrow, wooded riparian corridor (Cahokia Diversion Channel) approximately 1 mile south of the proposed pipeline. Due to the fact that some woodlots do not contain PRTs, we are assuming that no primary roost trees will be affected by construction.	0	AA
BATBH1ILMA002MA	Madison	1025.44	1025.48	211	1.0	0.5	14	1298	0.04%	0	No PRTs			
BATBH1ILMA003MA	Madison	1025.54	1025.59	264	1.2	0.6	13	1216	0.05%	0	No PRTs			
BATBH1ILMA004MA	Madison	1025.63	1025.75	634	2.9	1.4	11	1084	0.13%	0	Low			
BATBH1ILMA005MA	Madison	1026.83	1026.93	528	2.4	1.2	7	659	0.17%	0	No PRTs			
BATBH1ILMA006MA	Madison	1027.03	1027.16	686	3.2	1.5	7	671	0.22%	0	Low			
BATBH_ILMA006AU	Madison	1028.24	1028.39	792	3.6	1.7	7	624	0.28%	N/A	N/A			
BATBH_ILMA007AU	Madison	1028.42	1028.55	686	3.2	1.5	7	653	0.23%	N/A	N/A			
BATBH2ILMA008AU	Madison	1029.41	1029.42	53	0.2	0.1	10	977	0.01%	0	No PRTs	Linear distance is less than 0.5 miles between woodlots with 9 to 11% forest cover in the surrounding area. Of the eight woodlots, six were not assessed and two do not have PRTs. Approximately 0.01 to 0.30% forest cover within 3.5 km will be removed during construction. Narrow, wooded riparian corridors (Indian and Cahokia Creeks) cross the proposed pipeline at two locations. Due to the majority of sites not being assessed, we are assuming that one primary roost tree will be affected by construction.	1	BB
BATBH2ILMA009AU	Madison	1029.44	1029.45	53	0.2	0.1	10	977	0.01%	0	No PRTs			
BATBH_ILMA010AU	Madison	1029.66	1029.67	53	0.2	0.1	11	1018	0.01%	N/A	N/A			
BATBH_ILMA011AU	Madison	1029.67	1029.79	634	2.9	1.4	11	1010	0.14%	N/A	N/A			
BATBH_ILMA012AU	Madison	1030.01	1030.14	686	3.2	1.5	11	1016	0.15%	N/A	N/A			
BATBH_ILMA013AU	Madison	1030.50	1030.70	1056	4.8	2.3	10	947	0.24%	N/A	N/A			
BATBH_ILMA014AU	Madison	1030.85	1031.06	1109	5.1	2.4	9	874	0.28%	N/A	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH_ILMA015AU	Madison	1031.09	1031.26	898	4.1	2.0	9	834	0.23%	N/A	N/A			
BATBH_ILMA016AU	Madison	1031.82	1031.84	106	0.5	0.2	31	2928	0.01%	N/A	N/A			
BATBH_ILMA017AU	Madison	1031.89	1031.90	95	0.4	0.2	31	2968	0.01%	N/A	N/A			
BATBH_ILMA018AU	Madison	1031.94	1031.96	106	0.5	0.2	32	2995	0.01%	N/A	N/A			
BATBH_ILMA019AU	Madison	1032.07	1032.21	739	3.4	1.6	32	3029	0.05%	N/A	N/A			
BATBH2ILMA020AU	Madison	1032.25	1032.64	2059	9.5	4.5	32	3058	0.15%	2	Medium			
BATBH2ILMA021AU	Madison	1032.76	1033.04	1478	6.8	3.2	35	3297	0.10%	0	Medium			
BATBH2ILMA022AU	Madison	1033.06	1033.33	1426	6.5	3.1	35	3358	0.09%	3	Medium			
BATBH2ILMA023AU	Madison	1033.72	1033.74	106	0.5	0.2	36	3396	0.01%	0	No PRTs			
BATBH2ILMA024AU	Madison	1033.80	1033.89	475	2.2	1.0	36	3405	0.03%	1	Medium			
BATBH2ILMA025AU	Madison	1033.93	1034.09	845	3.9	1.8	37	3485	0.05%	0	Medium			
BATBH_ILMA026AU	Madison	1034.35	1034.42	370	1.7	0.8	37	3556	0.02%	N/A	N/A	Linear distance is less than 0.7 miles between woodlots with 17 to 37% forest cover in the surrounding area. Of the 23 woodlots, nine woodlots are of medium habitat quality, four do not have PRTs, and ten were not assessed. Woodlots up to 10 acres will be removed during construction. Approximately 0.01 to 0.37% forest cover within 3.5 km removed during construction. Cahokia Creek runs parallel to the proposed pipeline from site MA020 to MA022. Additionally, several tributaries cross the proposed pipeline within this grouping. Within the grouping, there are several large woodlots with multiple PRTs. Due to the majority of sites not assessed, we are assuming that one primary roost tree will be affected by construction.	**2**	**CC**
BATBH_ILMA027AU	Madison	1034.43	1034.45	106	0.5	0.2	37	3556	0.01%	N/A	N/A			
BATBH_ILMA028AU	Madison	1034.54	1034.58	185	0.8	0.4	37	3543	0.01%	N/A	N/A			
BATBH_ILMA029AU	Madison	1034.62	1034.86	1267	5.8	2.8	36	3464	0.08%	N/A	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH2ILMA030AU	Madison	1034.91	1035.03	634	2.9	1.4	35	3316	0.04%	0	No PRTs			
BATBH2ILMA031AU	Madison	1035.07	1035.18	581	2.7	1.3	34	3203	0.04%	0	Medium			
BATBH2ILMA032AU	Madison	1035.21	1035.24	158	0.7	0.3	33	3132	0.01%	0	No PRTs			
BATBH2ILMA033AU	Madison	1035.34	1035.36	106	0.5	0.2	32	3086	0.01%	0	No PRTs			
BATBH2ILMA034AU	Madison	1035.38	1036.31	4910	22.5	10.7	30	2869	0.37%	4	Medium			
BATBH_ILMA035AU	Madison	1036.33	1036.48	792	3.6	1.7	25	2382	0.07%	N/A	N/A			
BATBH_ILMA036AU	Madison	1036.53	1036.67	766	3.5	1.7	24	2265	0.07%	N/A	N/A			
BATBH1ILMA037	Madison	1036.73	1037.08	1848	8.5	4.0	22	2105	0.19%	14	Medium			
BATBH1ILMA038	Madison	1037.45	1037.58	660	3.0	1.4	17	1602	0.09%	0	Medium			
BATBH_ILMA039AU	Madison	1038.11	1038.15	238	1.1	0.5	11	1047	0.05%	N/A	N/A	Linear distance is less than 0.4 miles between woodlots with 10 to 11% forest cover in the surrounding area. The woodlots in this grouping are all less than 1 acre. Approximately 0.01 to 0.08% forest cover within 3.5 km will be removed during construction. A narrow, wooded riparian corridor (unnamed tributary of Silver Creek) crosses the proposed pipeline at site MA041. Since no sites in this grouping were assessed, we are assuming that one primary roost tree will be affected by construction.	**1**	**DD**
BATBH_ILMA040AU	Madison	1038.51	1038.52	53	0.2	0.1	10	905	0.01%	N/A	N/A			
BATBH_ILMA041AU	Madison	1038.54	1038.57	174	0.8	0.4	10	905	0.04%	N/A	N/A			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH1ILMA042AU	Madison	1040.38	1040.82	2323	10.7	5.1	15	1382	0.37%	2	Medium	Linear distance is less than 0.6 miles between woodlots with 11 to 15% forest cover in the surrounding area. One site within the grouping is medium quality, and five sites do not have PRTs. Approximately 0.02 to 0.37% forest cover within 3.5 km will be removed during construction. Two narrow, wooded riparian corridors (Silver Creek and unnamed tributary) cross the proposed pipeline. Due to the fact that most of the woodlots do not contain PRTs, we are assuming that no primary roost trees will be affected by construction.	0	EE
BATBH1ILMA043AU	Madison	1040.88	1040.91	158	0.7	0.3	14	1319	0.03%	0	No PRTs			
BATBH3ILMA044	Madison	1041.18	1041.50	1690	7.8	3.7	13	1205	0.31%	0	No PRTs			
BATBH3ILMA045	Madison	1041.50	1041.52	106	0.5	0.2	11	1050	0.02%	0	No PRTs			
BATBH3ILMA046	Madison	1041.62	1041.77	766	3.5	1.7	12	1167	0.14%	0	No PRTs			
BATBH3ILMA047	Madison	1042.29	1042.30	69	0.3	0.1	12	1142	0.01%	0	No PRTs			
BATBH1ILMA048AU	Madison	1044.10	1044.12	106	0.5	0.2	8	802	0.03%	1	Medium	Linear distance is less than 2.0 miles between woodlots with 8 to 17% forest cover in the surrounding area. Of the 15 woodlots, three are high quality, five are medium quality, two are low quality, and five have no PRTs. Approximately 0.03 to 0.49% forest cover within 3.5 km will be removed during construction. Narrow, wooded riparian corridors (East Fork Sugar Creek, Sand Creek, Sugar Fork) cross the proposed pipeline in four places. Due to the presence of several high and medium quality woodlots with a 7 mile linear distance in this grouping, we are assuming that two primary roost trees will be affected by construction.	2	FF
BATBH1ILMA049AU	Madison	1044.47	1044.60	660	3.0	1.4	12	1115	0.13%	0	No PRTs			
BATBH1ILMA050AU	Madison	1044.65	1044.74	475	2.2	1.0	12	1183	0.09%	1	Low			
BATBH1ILMA051AU	Madison	1044.90	1044.93	148	0.7	0.3	13	1234	0.03%	0	Medium			
BATBH1ILMA052AU	Madison	1045.09	1045.11	106	0.5	0.2	13	1258	0.02%	0	No PRTs			
BATBH1ILMA053AU	Madison	1046.43	1046.99	2957	13.6	6.4	14	1321	0.49%	4	Low			
BATBH1ILMA054AU	Madison	1047.02	1047.17	792	3.6	1.7	12	1134	0.15%	0	No PRTs			
BATBH1ILMA055AU	Madison	1047.21	1047.28	370	1.7	0.8	12	1133	0.07%	0	No PRTs			
BATBH_ILMA003NO	Madison	1049.33	1049.37	238	1.1	0.5	15	1426	0.04%	4	High			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH1ILMA057	Madison	1049.50	1049.61	581	2.7	1.3	16	1513	0.08%	0	No PRTs			
BATBH1ILMA058	Madison	1049.71	1049.90	1003	4.6	2.2	17	1586	0.14%	5	Medium			
BATBH1ILMA059	Madison	1049.96	1050.06	528	2.4	1.2	17	1603	0.07%	6	Medium			
BATBH1ILMA060	Madison	1050.08	1050.22	739	3.4	1.6	17	1618	0.10%	10	High			
BATBH1ILMA061	Madison	1050.49	1050.60	607	2.8	1.3	17	1570	0.08%	10	High			
BATBH1ILMA062	Madison	1050.86	1051.12	1346	6.2	2.9	15	1451	0.20%	1	Medium			
BATBH1ILMA063	Madison	1052.87	1052.90	132	0.6	0.3	3	330	0.09%	1	Medium	Linear distance is 1.9 miles between woodlots with 3 to 4% forest cover within 3.5 km. Of the two woodlots, one is medium quality and one does not have PRTs. Approximately 0.10% forest cover within 3.5 km will be removed during construction. Two narrow, wooded riparian corridors (two unnamed tributaries of Sugar Creek) cross the proposed pipeline. Due to the small number of PRTs, we are assuming that no primary roost trees will be affected by construction.	**0**	**GG**
BATBH2ILBO001AU	Bond	1054.77	1054.79	106	0.5	0.2	4	343	0.07%	0	No PRTs			
BATBH4ILBO002	Bond	1056.13	1056.16	158	0.7	0.3	15	1424	0.02%	0	No PRTs			
BATBH4ILBO003	Bond	1056.17	1056.20	158	0.7	0.3	15	1451	0.02%	0	No PRTs			
BATBH1ILBO004AU	Bond	1057.06	1057.38	1690	7.8	3.7	22	2066	0.18%	7	Medium			
BATBH1ILBO005AU	Bond	1057.78	1057.87	475	2.2	1.0	25	2340	0.04%	1	Medium			
BATBH4ILBO006	Bond	1058.06	1058.12	296	1.4	0.6	25	2422	0.03%	0	No PRTs			
BATBH1ILBO001NO	Bond	1059.11	1059.25	713	3.3	1.6	26	2471	0.06%	0	No PRTs	Linear distance is less than 1.1 miles between woodlots with 11 to 26% forest cover in the surrounding area. Of the 12 woodlots, three are medium quality, one is low quality, and eight do not have PRTs. Approximately 0.02 to 0.59% forest cover within 3.5 km will be removed during construction. Two narrow, wooded riparian corridors (Shoal Creek and unnamed tributary) cross the proposed pipeline. Due to the fact that the majority of woodlots do not contain PRTs, we are assuming that no primary roost trees will be affected by construction.	**0**	**HH**
BATBH1ILBO002NO	Bond	1059.32	1059.38	317	1.5	0.7	24	2281	0.03%	0	No PRTs			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH2ILBO003NO	Bond	1059.90	1059.94	211	1.0	0.5	17	1616	0.03%	0	No PRTs			
BATBH2ILBO004NO	Bond	1060.04	1060.08	211	1.0	0.5	16	1521	0.03%	0	Medium			
BATBH2ILBO005NO	Bond	1060.16	1060.18	90	0.4	0.2	14	1331	0.01%	0	No PRTs			
BATBH4ILBO009	Bond	1060.42	1060.52	528	2.4	1.2	12	1175	0.10%	0	No PRTs			
BATBH4ILBO010	Bond	1060.60	1060.80	1030	4.7	2.2	11	1088	0.21%	1	Low			
BATBH4ILBO011	Bond	1062.46	1062.60	739	3.4	1.6	14	1309	0.12%	1	Medium			
BATBH2ILBO012AU	Bond	1062.65	1062.68	158	0.7	0.3	15	1395	0.02%	0	Medium			
BATBH2ILBO013AU	Bond	1062.78	1062.79	84	0.4	0.2	15	1450	0.01%	0	No PRTs			
BATBH2ILBO014AU	Bond	1062.97	1063.50	2798	12.8	6.1	17	1637	0.37%	10	Medium			
BATBH4ILBO015	Bond	1063.76	1063.77	53	0.2	0.1	19	1806	0.01%	0	No PRTs			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH4ILBO016	Bond	1063.82	1064.01	977	4.5	2.1	19	1815	0.12%	0	Medium	Linear distance is less than 0.5 miles between woodlots with 7 to 19% forest cover in the surrounding area. Of the 14 woodlots, one is high quality, seven are medium quality, one is low quality, and five do not have PRTs. Approximately 0.01 to 0.37% forest cover within 3.5 km will be removed during construction. Three narrow, wooded riparian corridors (unnamed tributaries of Beaver Creek and Little Beaver Creek) cross the proposed pipeline. Due to the presence of high and medium quality habitat within this grouping, we are assuming that one primary roost tree will be affected by construction.	**1**	**II**
BATBH4ILBO017	Bond	1064.01	1064.28	1399	6.4	3.1	19	1810	0.17%	3	Medium			
BATBH3ILBO018	Bond	1064.53	1064.78	1320	6.1	2.9	18	1665	0.17%	6	High			
BATBH3ILBO019	Bond	1064.82	1064.88	317	1.5	0.7	17	1589	0.04%	0	Medium			
BATBH3ILBO020	Bond	1064.90	1064.92	90	0.4	0.2	16	1553	0.01%	0	No PRTs			
BATBH3ILBO021	Bond	1065.23	1065.31	407	1.9	0.9	14	1324	0.07%	0	No PRTs			
BATBH3ILBO022	Bond	1065.40	1065.43	158	0.7	0.3	13	1196	0.03%	0	Medium			
BATBH3ILBO023	Bond	1065.80	1066.05	1320	6.1	2.9	9	822	0.35%	0	No PRTs			
BATBH3ILBO024	Bond	1066.07	1066.27	1056	4.8	2.3	7	680	0.34%	0	Low			
BATBH3ILBO025	Bond	1068.06	1068.08	106	0.5	0.2	2	173	0.13%	0	No PRTs	Linear distance is less than 1.4 miles between woodlots with 1 to 8% forest cover in the surrounding area. Of the 6 woodlots, one is high quality, four do not have PRTs, and one was not assessed. Approximately 0.13 to 2.32% forest cover within 3.5 km will be removed during construction. One narrow, wooded riparian corridor (unnamed tributary of the Kaskaskia River) crosses the proposed pipeline. Due to the fact that the majority of woodlots do not contain PRTs, we are assuming that no primary roost trees will be affected by construction.	**0**	**JJ**
BATBH_ILBO026AU	Bond	1068.32	1068.58	1373	6.3	3.0	1	129	2.32%	N/A	N/A			
BATBH3ILBO027	Bond	1069.83	1069.84	53	0.2	0.1	3	293	0.04%	0	High			
BATBH3ILBO028	Bond	1070.31	1070.36	264	1.2	0.6	4	395	0.15%	0	No PRTs			
BATBH3ILBO029	Bond	1070.59	1070.85	1373	6.3	3.0	5	506	0.59%	0	No PRTs			
BATBH3ILBO030	Bond	1071.18	1071.37	1003	4.6	2.2	8	758	0.29%	0	No PRTs			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH2ILFA001	Fayette	1072.55	1072.57	84	0.4	0.2	16	1525	0.01%	0	High			
BATBH2ILFA002	Fayette	1073.19	1073.55	1901	8.7	4.1	19	1852	0.22%	2	Medium			
BATBH1ILFA001NO	Fayette	1073.80	1073.85	290	1.5	0.7	21	1996	0.03%	0	No PRTs			
BATBH1ILFA002NO	Fayette	1073.90	1073.92	132	0.7	0.3	21	1996	0.02%	0	No PRTs			
BATBH1ILFA003NO	Fayette	1073.96	1074.12	845	3.9	1.8	22	2091	0.09%	0	Medium			
BATBH1ILFA004NO	Fayette	1074.13	1074.27	739	3.4	1.6	22	2091	0.08%	0	No PRTs			
BATBH1ILFA005NO	Fayette	1074.34	1074.37	185	1.0	0.5	22	2091	0.02%	0	No PRTs			
BATBH1ILFA006NO	Fayette	1074.50	1074.66	845	3.9	1.8	22	2091	0.09%	0	No PRTs			
BATBH1ILFA009AU	Fayette	1074.71	1074.74	158	0.7	0.3	22	2130	0.02%	0	No PRTs			
BATBH1ILFA010AU	Fayette	1074.80	1074.88	422	1.9	0.9	23	2174	0.04%	0	No PRTs			
BATBH1ILFA011AU	Fayette	1074.90	1074.92	106	0.5	0.2	23	2205	0.01%	0	No PRTs	Linear distance is less than 1.0 miles between woodlots with 7 to 25% forest cover in the surrounding area. Of the 23 woodlots, one is high quality, six are medium quality, two are low quality, thirteen do not have PRTs, and one was not assessed. Approximately 0.13 to 2.32% forest cover within 3.5 km will be removed during construction. Two wooded, riparian corridors (Hurricane Creek and Kaskaskia River) cross the proposed pipeline. Due to the presence of high and medium quality woodlots within this grouping, we are assuming that one primary roost tree will be affected during construction.	**1**	**KK**
BATBH1ILFA012AU	Fayette	1074.97	1075.19	1162	5.3	2.5	24	2280	0.11%	0	Medium			
BATBH1ILFA013AU	Fayette	1075.38	1075.44	317	1.5	0.7	25	2331	0.03%	0	Medium			
BATBH1ILFA014AU	Fayette	1075.56	1075.69	686	3.2	1.5	25	2344	0.06%	0	Medium			
BATBH1ILFA007NO	Fayette	1075.78	1075.80	106	0.5	0.2	24	2281	0.01%	0	No PRTs			

CHARACTERISTICS OF INDIANA BAT HABITAT ALONG THE KEYSTONE PIPELINE IN ILLINOIS.

Woodlot ID	County (Illinois)	July 07 Alignment Enter Mile Post	July 07 Alignment Exit Mile Post	Distance Crossed (ft)	Woodlot Area Based on 200 ft Survey Corridor (acres)	Forest to be Removed in 95 ft Construction Corridor (acres)	Percent Forest Cover Within 3.5 km	Acres Forest Cover Within 3.5 km	Percent of Forest Within 3.5 km removed	Number of PRTs Based on 95 ft Construction Corridor	Overall Habitat Suitability*	Comments	Estimated Primary Roost Trees Affected	Group ID
BATBH1ILFA008NO	Fayette	1075.86	1075.92	317	1.5	0.7	24	2281	0.03%	1	Medium			
BATBH1ILFA009NO	Fayette	1075.93	1076.00	343	14.5	6.9	23	2186	0.32%	1	Low			
BATBH1ILFA010NO	Fayette	1076.06	1076.08	106	0.2	0.1	22	2091	0.01%	0	No PRTs			
BATBH1ILFA011NO	Fayette	1076.19	1076.43	1267	6.1	2.9	21	1996	0.14%	0	Low			
BATBH_ILFA020AU	Fayette	1077.28	1077.30	106	0.5	0.2	15	1384	0.02%	N/A	N/A			
BATBH1ILFA021AU	Fayette	1077.54	1077.57	158	0.7	0.3	12	1160	0.03%	0	No PRTs			
BATBH2ILFA022	Fayette	1078.56	1078.60	185	0.8	0.4	7	702	0.06%	0	No PRTs			
BATBH2ILMR001	Marion	1079.08	1079.11	158	0.7	0.3	8	751	0.05%	0	No PRTs			
BATBH2ILMR002	Marion	1080.78	1081.00	1162	5.3	2.5	14	1364	0.19%	2	Medium	Linear distance is less than 0.4 miles between woodlots with 14 to 17% forest cover in the surrounding area. Of the 4 woodlots, one is medium quality and three do not have PRTs. Approximately 0.01 to 0.19% forest cover within 3.5 km will be removed during construction. Due to the fact that the majority of woodlots do not contain PRTs, we are assuming that no primary roost trees will be affected by construction.	**0**	**LL**
BATBH2ILMR003	Marion	1081.16	1081.25	475	2.2	1.0	15	1467	0.07%	0	No PRTs			
BATBH2ILMR004	Marion	1081.56	1081.61	264	1.2	0.6	17	1600	0.04%	0	No PRTs			
BATBH2ILMR005	Marion	1081.60	1081.61	53	0.2	0.1	17	1587	0	0	No PRTs			
*Based on 200 ft survey corridor, not 95 ft construction corridor												**TOTAL**	**8**	

Appendix C

Construction Mitigation and Reclamation Plan

KEYSTONE PIPELINE PROJECT

CONSTRUCTION MITIGATION AND RECLAMATION PLAN



Prepared By



April 4, 2006
Rev. 3

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Figure 1 Typical Site Specific Plan

1.0 INTRODUCTION

The construction mitigation and reclamation requirements described in this Plan apply to work on all project lands including the following:

- Uplands including agricultural (cultivated or capable of being cultivated) lands, pasture lands; range lands; grass lands; forested lands; lands in residential, commercial, or industrial areas; lands in public rights of way; and lands in private rights of way
- Wetlands
- Waterbodies and Riparian lands

Keystone shall implement the construction mitigation and reclamation actions contained in this Plan to the extent that they do not conflict with the requirements of any applicable federal, state and local rules and regulations and other permits and approvals that are obtained by Keystone for the Project. Additionally, Keystone may deviate from specific requirements of this Plan on specific private lands as determined through negotiations with Landowners or as required to suit actual site conditions as determined and directed by Keystone. All work must be in compliance with federal, State, and Local permits.

2.0 GENERAL CONDITIONS

2.1 Training

The Contractor shall ensure that all persons (Contractor's and Subcontractors' Personnel) engaged in work associated with the pipeline's construction are informed of the construction issues and concerns, and that they attend and receive training regarding these requirements as well as all laws, rules and regulations applicable to the work.

Different levels of training shall be required for different groups of Contractor personnel. Contractor supervisors, managers, field foremen and other Contractor personnel designated by Keystone shall attend a full-day, comprehensive environmental training session. All other Contractor personnel shall attend a one-to-two-hour group training session before the beginning of construction, and during construction as environmental issues and incidents warrant. Additional training sessions shall be held for newly assigned personnel.

All Contractor personnel shall attend the training session prior to entering the construction right-of-way. All Contractor personnel shall sign an acknowledgement of having attended the appropriate level of training and shall display a hard hat sticker acknowledging attendance at environmental training. In order to insure successful compliance, Contractor personnel shall attend repeat or supplemental training, if compliance is not satisfactory or as new, significant issues arise.

All visitors and any other personnel without specific work assignments shall be required to attend a brief safety and environmental awareness orientation.

Experienced, well-trained personnel are essential for the successful implementation of this Plan. Keystone and its Contractors shall undergo prevention and response, as well as safety training. The program shall be designed to improve awareness of safety requirements, pollution control laws and procedures and proper operation and maintenance of equipment.

2.2 Advance Notice of Access to Property Prior to Construction

Prior to the start of construction of the pipeline, Keystone shall provide the Landowner or tenant with a minimum of 24 hours prior notice (unless otherwise negotiated with the landowner and as described in the project line list) before accessing his/her property for the purpose of constructing the pipeline. Additionally, the Landowner or tenant shall be provided with Keystone contact information. Landowners may utilize contact information to inform Keystone of any concerns related to the work. Keystone

Prior notice shall first consist of a personal contact or a telephone contact, whereby the Landowner or tenant is informed of Keystone's intent to access the land. If the Landowner or tenant cannot be reached in person or by telephone, Keystone shall mail or hand deliver to the Landowner or tenant's home a dated, written notice of Keystone's intent. The Landowner or tenant need not acknowledge receipt of the written notice before Keystone can enter the Landowner's property.

2.3 Other Notifications

The Contractor shall notify, in writing, both Keystone's Representative and the authority having jurisdiction over any road, railroad, canal, drainage ditch, river, foreign pipeline, or other utility, at least 48 hours (excluding Saturdays, Sundays, and Statutory Holidays), or as specified on the applicable permit(s), prior to commencement of pipeline construction, in order that the said authority may appoint an Inspector to ensure that the crossing is constructed in a satisfactory manner.

The Contractor shall notify Keystone immediately of any spill of a potentially hazardous substance as well as any existing soil contamination discovered during construction.

The Contractor shall immediately notify Keystone of the discovery of previously unreported historic property, other significant cultural materials, or suspected human remains uncovered during pipeline construction activities.

2.4 Damages to Private Property

Pipeline construction activities shall be confined to the construction right-of-way, temporary work space, and additional temporary work space and approved access routes.

Keystone shall reasonably compensate Landowners for any construction-related damages caused by Keystone which occur on or off of the established pipeline construction right-of-way.

Keystone shall reasonably compensate Landowners for damages to private property caused by Keystone beyond the initial construction and reclamation of the pipeline, to include those damages caused by Keystone during future construction, operation, maintenance, and repairs relating to the pipeline.

2.5 Appearance of Worksite

The construction right-of-way shall be maintained in a clean neat condition at all times. At no time shall litter be allowed to accumulate at any location on the construction right-of-way. The Contractor shall provide a daily garbage detail with each major construction crew to keep the construction right-of-way clear of trash, pipe banding and spacers, waste from coating products, welding rods, timber skids, defective materials and all construction and other debris immediately behind construction operations unless otherwise approved by Keystone. Paper from wrapping or coating products or lightweight items shall not be permitted to be scattered around by the wind.

The traveled surfaces of roads, streets, highways, etc. (and railroads when applicable) shall be cleaned free of mud, dirt or any debris deposited by equipment traversing these roads or exiting from the construction right-of-way.

2.6 Access

Prior to the pipeline's installation, Keystone and the Landowner shall reach a mutually acceptable agreement on the route that shall be utilized by the Contractor for entering and exiting the pipeline construction right-of-way should access to the construction right-of-way not be practicable or feasible from adjacent segments of the pipeline construction right-of-way or from public highway or railroad right-of-way.

All construction vehicles and equipment traffic shall be confined to the public roads, private roads acquired for use by Keystone and the construction right of way. If temporary alternative private roads for access are constructed they shall be designed to not impede proper drainage and shall be built to minimize soil erosion.

Sufficiently sized gaps shall be left in all spoil and topsoil wind rows at all temporary private access roads and obvious livestock or wildlife trails unless agreed with the Landowner prior to construction that these access points can be blocked during construction.

All construction related private roads and access points to the right of way shall be marked with signs. Any private roads not to be utilized during construction shall also be marked.

2.7 Above-Ground Facilities

Locations for above-ground facilities shall be selected in a manner so as to be as unobtrusive as reasonably possible to on-going agricultural or other Landowner activities occurring on the lands adjacent to the facilities. If this is not feasible,

such facilities shall be located so as to incur the least hindrance to the adjacent agricultural operations (i.e., located in field corners or areas where at least one side is not used for cropping purposes) provided the location is consistent with the design constraints of the pipeline. Additionally, they shall be located to avoid existing drain tile systems to the extent possible.

2.8 Minimum Depth of Cover

The pipeline shall be installed so that the top of the pipe and coating is:

- A minimum depth of 4 feet below the surface of all uplands and wetlands except in consolidated rock where the minimum shall be 3 feet
- A minimum clearance of 1 foot below any existing foreign pipeline, utility, drain tile or any other existing underground facility and a minimum of 4 feet below the surface of all uplands and wetlands. Should any existing foreign pipeline, utility, drain tile or any other existing underground facility owner permit the pipeline to cross above, there must be a minimum 1 foot clearance and a minimum of 4 feet below the surface of all uplands and wetlands
- At a minimum depth of 5 feet below the bottom of road ditches
- At a minimum depth of 5 feet below the bottom of waterbodies including rivers, creeks, streams, ditches and drains. This depth shall normally be maintained over a distance of 15 feet on each side of the waterbody measured from the top of the defined stream channel

If concrete weights are utilized for negative buoyancy of the pipeline, the minimum depth of cover shall be measured from the top of the concrete weight to the original ground contour.

Depth of cover requirements may be modified by Keystone based on site specific conditions. However, all depths shall be in compliance with all established codes.

2.9 Threatened and Endangered Species

Keystone will contract a qualified biologist to conduct a survey of sensitive species associated with native tall-grass prairie. The biologist will document locations of the sensitive species found during the survey. If sensitive species are identified in the construction right of way, Keystone will work with the relevant regulatory authorities to determine if any additional protection measures would be required. Once construction is complete, disturbance in native prairie will be reclaimed to native prairie species using native seed mixes specified by applicable state and federal agencies with the intent there will be no net loss of native prairie habitat.

A number of sensitive species are associated with native tall-grass prairie, especially where larger remnant tracts are present. In order to minimize impacts to native prairie, no permanent developments such as access roads or pump stations will be constructed in native prairie tracts if possible. Where avoidance of native tall-grass prairie by the pipeline ROW is unfeasible, appropriate surveys

will be implemented to ensure populations of sensitive wildlife species are not affected.

Keystone will contract a qualified biologist to conduct a survey of breeding bird habitat within 330 feet (100 meters) from proposed surface disturbance activities that would occur within the breeding season. The biologist will document active nests, bird species, and other evidence of nesting (e.g., mated pairs, territorial defense, birds carrying nesting material, transporting of food). If an active nest for Important Migratory Bird Species (USFWS BCC, PIF Priority Bird Species, State Sensitive Species) is documented during the survey, Keystone will work with the relevant regulatory authorities to determine if any additional protection measures would be required.

Immediately prior to construction activities during the raptor breeding season (February 1 – July 31), breeding raptor surveys will be conducted by a qualified biologist through areas of suitable nesting habitat to identify any potentially active nest sites in the project area. If raptors are identified within 0.5 mile to the construction right of way, Keystone will work with the relevant regulatory authorities to develop mitigation measures. These measures will be implemented on a site-specific and species-specific basis in coordination with state agency wildlife biologists.

Along the ROW within historical range of Indiana bat and gray bat (Missouri, Illinois and eastern Oklahoma), Surveys shall be completed during the roosting season in suitable woodland habitats to determine if any active maternity roosts are present in or near the pipeline ROW. If a maternity roost is located, then applicable mitigation will be developed in consultation with USFWS and state wildlife agency personnel.

Prior to surface disturbance activities within karst terrain, a geological investigation will be completed to determine the presence and type of karst features. The investigation will identify the location, distribution, and dimensions of rock cavities within the potential influence zone of construction. In addition, a qualified biologist will conduct surveys for exposed caves that may contain sensitive resources (e.g., bat roosts and nesting raptors) within 0.25 mile from surface disturbance activities. In the event that cave features or sensitive resources are identified, the USFWS or appropriate state wildlife agency will be contacted and applicable mitigation measures developed.

2.10 Non-Hazardous Waste Disposal

Non-hazardous pipeline construction wastes include human waste, trash, pipe banding and spacers, waste from coating products, welding rods, timber skids, cleared vegetation, stumps, rock and all other construction debris.

All waste which contains (or at any time contained) oil, grease, solvents, or other petroleum products falls within the scope of the oil and hazardous substances control, clean up and disposal procedures. This material shall be segregated for handling and disposal as hazardous wastes.

The Contractor shall be responsible for human wastes to be handled and disposed of exclusively by means of portable self-contained toilets during all construction operations. Wastes from these units shall be collected by a licensed Contractor for disposal only at licensed and approved facilities.

The Contractor shall remove all trash from the construction right-of-way on a daily basis unless otherwise approved or directed by Keystone.

The Contractor shall dispose of all drill cuttings and drilling mud at a Keystone-approved location. Disposal options may include spreading over the construction right-of-way in an upland location approved by Keystone, hauling to an approved licensed landfill, or other site approved by Keystone.

The Contractor shall remove all extraneous vegetative, rock and other natural debris from the construction right-of-way by the completion of clean-up

The Contractor shall remove all trash and wastes from Contractor yards, pipe yards and staging areas when work is completed at each location.

The Contractor shall dispose of all waste materials at licensed waste disposal facilities. Wastes shall not be disposed of in any other fashion such as un-permitted burying or burning.

2.11 Hazardous Wastes

The Contractor shall ensure that all hazardous and potentially hazardous materials are transported, stored and handled in accordance with all applicable legislation. Workers exposed to or required to handle dangerous materials shall also be trained in accordance with the applicable legislation and the manufacturer's recommendations.

The Contractor shall dispose of all hazardous materials at licensed waste disposal facilities. Hazardous wastes shall not be disposed of in any other fashion such as un-permitted burying or burning.

All transporters of oil, hazardous substances, and hazardous wastes shall be licensed and certified according to the applicable state vehicle code. Incidents on public highways shall be reported to the appropriate agencies.

All hazardous wastes being transported off-site shall be manifested. The manifest shall conform to requirements of the appropriate state agency. The transporter shall be licensed and certified to handle hazardous wastes on the public highways. The vehicles as well as the drivers must conform to all applicable vehicle codes for transporting hazardous wastes. The manifest shall conform to regulations of the DOT 49 CFR 172.101, 172.202, and 172.203.

If toxic or hazardous waste materials or containers are encountered during construction, the Contractor shall stop work immediately to prevent disturbing or further disturbing the waste material and shall immediately notify Keystone. The Contractor shall not restart work until clearance is granted by Keystone.

2.12 Noise Control

The Contractor shall minimize noise during non-daylight hours and within 1 mile of residences or other noise-sensitive areas such as hospitals, motels or campgrounds. Keystone shall attempt to abide by municipal bylaws regarding noise near residential and commercial/industrial areas. The Contractor shall provide notice to Keystone if noise levels are expected to exceed bylaws for a short duration.

The Contractor shall minimize noise in the immediate vicinity of herds of livestock or poultry operations, which are particularly sensitive to noise.

Keystone shall install noise attenuation, if necessary, to ensure that noise levels from Keystone's above-ground facilities comply with the applicable state or local standards.

2.13 Weed Control

The Contractor shall thoroughly clean all construction equipment, including timber mats, prior to moving the equipment to the job site to limit the potential for the spread of noxious weeds, insects and soil-borne pests. The Contractor shall clean the equipment with high-pressure washing equipment.

Prior to construction, Keystone will mark all areas of the right of way which contain infestations of noxious, invasive species or soil borne pests. Such marking will clearly indicate the limits of the infestation along the right of way. During construction, the Contractor shall clean the tracks, tires, and blades of equipment by hand (track shovel) or compressed air to remove excess soil prior to movement of equipment out of weed and/or soil-borne pest infested areas.

The Contractor shall use mulch and straw or hay bales that are free of noxious weeds for temporary erosion and sediment control.

The Contractor shall implement pre-construction treatments such as mowing prior to seed development or herbicide application to areas of noxious weed infestation prior to other clearing, grading, and trenching or other soil disturbing work at the identified locations as indicated on the construction drawings.

The Contractor shall apply herbicides, where required, within 1 week, or as deemed necessary for optimum mortality success, prior to disturbing the area by clearing, grading, trenching or other soil disturbing work. Herbicides shall be applied by applicators appropriately licensed or certified by the state in which the work is conducted. All herbicides applied preconstruction shall be non-residual or shall have a significant residual effect no longer than 30 days. Herbicides applied during construction shall be non-residual.

The Contractor shall not use herbicides in or within 100 feet of a wetland or waterbody.

After pipeline construction, on any construction right-of-way over which Keystone has jurisdiction as to the surface use of such land (i.e., valve sites, metering

stations, pump stations, etc.), Keystone shall provide for weed control to limit the potential for the spread of weeds onto adjacent lands used for agricultural purposes. Any weed control spraying performed by Keystone shall be done so by a State licensed pesticide applicator.

Keystone shall be responsible for reimbursing all reasonable costs incurred by owners of land adjacent to above-ground facilities when the Landowners must control weeds on their land which can be reasonably determined to have spread from land with Keystone's above-ground facilities.

2.14 Dust Control

The Contractor shall at all times control air borne dust levels during construction activities to levels acceptable to Keystone. The Contractor shall employ water trucks, sprinklers or calcium chloride as necessary to reduce dust to acceptable levels. Utilization of calcium chloride would be limited to roads.

Dust shall be strictly controlled where the work approaches dwellings, farm buildings and other areas occupied by people and when the pipeline parallels an existing road or highway. This shall also apply to access roads where dust raised by construction vehicles may irritate or inconvenience local residents. The speed of all Contractor vehicles shall be controlled while in these areas.

The Contractor shall take appropriate precautions to prevent fugitive emissions caused by sand blasting operations from reaching any residence or public building. The Contractor shall place curtains of suitable material, as necessary, to prevent wind-blown particles from sand blasting operations from reaching any residence or public building.

2.15 Off Road Vehicle Control

Keystone shall offer to Landowners or managers of forested lands to install and maintain measures to control unauthorized vehicle access to the construction right-of-way where appropriate. These measures may include the following unless otherwise approved or directed by Keystone based on site specific conditions or circumstances:

- Signs;
- Fences with locking gates;
- Slash and timber barriers, pipe barriers, or boulders lined across the construction right-of-way; and
- Conifers or other appropriate trees or shrubs across the construction right-of-way.

2.16 Fire Prevention and Control

The Contractor shall comply with all Federal, State, County and Local fire regulations pertaining to burning permits and the prevention of uncontrolled fires. The following mitigative measures shall be implemented to prevent fire hazards and control of fires:

- A list of relevant Authorities and their designated representative to contact shall be maintained on the construction site by construction personnel
- Adequate fire fighting equipment in accordance with the regulatory requirements shall be available on site.
- The level of forest fire hazard shall be posted at the construction office (where visible for all workers) and make them aware of it and related implications.
- The Contractor shall provide equipment to handle any possible fire emergency. This shall include, although not be limited to, water trucks, portable water pumps, chemical fire extinguishers, hand tools such as shovels, axes, chain saws, etc. and heavy equipment adequate for the construction of fire breaks when required.
- Specifically, the Contractor shall supply and maintain in working order an adequate supply of fire extinguishers for each crew that is engaged in work such as welding, cutting, grinding, burning of brush or vegetative debris, etc.
- In the event of a fire, the Contractor shall immediately use resources required to contain the fire. The Contractor shall then notify local emergency response personnel.
- All tree clearing activities are to be carried out in accordance with local rules and regulations for the prevention of forest fires.
- Burning shall be done in compliance with state and/or county regulations and in the center of the right of way and in small piles to avoid overheating or damage to trees or other structures along the right of way.
- Flammable wastes shall be removed from the construction site on a regular basis.
- Flammable materials kept on the construction site must be stored in approved containers away from ignition sources.
- Smoking shall be prohibited around areas with flammable products.
- Smoking shall be prohibited on the construction site when the fire hazard is high.

2.17 Road and Railroad Crossings

Railroad and highway crossings shall be bored or where permitted by the local road authorities having jurisdiction, open-cut. The pipeline shall be installed without casing unless required by permit. Generally, secondary and unimproved roads, public and private roads, shall be open-cut.

The Contractor shall maintain access across all open-cut roads during construction where an alternate bypass is not available.

At all road crossings and/or contiguous construction where workers and equipment are working, approaching traffic shall be cautioned to reduce speed

by road signs. All signage shall be in accordance with crossing permits and state or county highway regulations.

2.18 Adverse Weather

The Contractor shall restrict certain construction activities and work in cultivated agricultural areas in excessively wet soil conditions to minimize rutting and soil compaction. In determining when or where construction activities should be restricted or suspended during wet conditions, the Contractor shall consider the following factors:

- the extent that rutting may cause mixing of topsoil with subsoil layers or damage to tile drains.
- excessive buildup of mud on tires and cleats.
- excessive ponding of water at the soil surface.
- the potential for excessive soil compaction.

The Contractor shall implement mitigative measures as directed by Keystone in order to minimize rutting and soil compaction in excessively wet soil conditions which may include:

- restricting work to areas on the spread where conditions are not prohibitive.
- using low ground weight or wide-track equipment or other low impact construction techniques.
- limiting work to areas that have adequately drained soils or have a cover of vegetation such as sod, crops or crop residues sufficient to prevent mixing of topsoil with subsoil layers or damage to drain tiles.
- installing geotextile material or construction mats in problem areas.

3.0 SPILL PREVENTION AND CONTAINMENT

Spill prevention and containment applies to the use and management of hazardous materials on the construction right-of-way and all ancillary areas during construction. This includes the refueling or servicing of all equipment with diesel fuel, gasoline, lubricating oils, grease, hydraulic and other fluids during normal upland applications and special applications within 100 feet of perennial streams or wetlands.

3.1 Spill Prevention

3.1.1 Staging Areas

Staging areas (including Contractor yards and pipe stockpile sites) shall be set up for each construction spread. Hazardous materials at staging areas shall be stored in compliance with federal and state laws. The following spill prevention measures shall be implemented by the Contractor:

- Contractor fuel trucks shall be loaded at existing bulk fuel dealerships or from bulk tanks set up for that purpose at the staging area. In the former case, the bulk dealer is responsible for preventing and controlling spills;

- Fuels and lubricants shall be stored only at designated staging areas. Storage of fuel and lubricants in the staging area shall be at least 100 feet away from the water's edge. Refueling and lubrication of equipment shall be restricted to upland areas at least 100 feet away from stream channels and wetlands;
- Contractors shall be required to perform all routine equipment maintenance at the staging area and recover and dispose of wastes in an appropriate manner;
- Temporary liners and berms and/or dikes (secondary containment) shall be constructed around the above-ground bulk tanks, so that potential spill materials shall be contained and collected in specified areas isolated from any waterbodies. Tanks shall not be placed in areas subject to periodic flooding or washout;
- Drivers of tank trucks are responsible for safety and spill prevention during tank truck unloading. Procedures for loading and unloading tank trucks shall meet the minimum requirements established by the Department of Transportation;
- Warning signs requiring drivers to set brakes and chock wheels shall be displayed at all tanks. Proper grounding of equipment shall be undertaken during fuel transfer operations. Drivers shall observe and control the fueling operations at all times to prevent over-filling the temporary tank;
- Prior to departure of any tank truck, all vehicle outlets shall be closely examined by the driver for leakage, and tightened, adjusted or replaced to prevent liquid leakage while in transit;
- A supply of sorbent and barrier materials sufficient to allow the rapid containment and recovery of any spill shall be maintained at the construction staging areas. Sorbent and barrier materials shall also be utilized to contain runoff from contaminated areas;
- Shovels and drums shall be kept at each of the individual staging areas. In the event that small quantities of soil become contaminated, shovels shall be utilized to collect the soil and the material shall be stored in 55 gallon drums. Large quantities of contaminated soil may be bio-remediated on-site, subject to government approval, or collected utilizing heavy equipment, and stored in drums or other suitable containers prior to disposal. Should contamination occur adjacent to staging areas as a result of runoff, shovels and/or heavy equipment shall be utilized to collect the contaminated material. Contaminated soil shall be disposed of in accordance with state and federal regulations;
- Temporary above-ground tanks shall be subject to visual inspection on a monthly basis and when the tank is refilled. Inspection records shall be maintained. Operators shall routinely keep tanks under close surveillance and potential leaks or spills shall be quickly detected;
- Visible fuel leaks shall be reported to the Contractors' designated representative and corrected as soon as conditions warrant. Keystone's designated representative shall also be informed;
- Drain valves on temporary tanks shall be locked to prevent accidental or unauthorized discharges from the tank.

Keystone may allow modification of the above specifications as necessary

to accommodate specific situations or procedures. Any modifications must comply with all applicable regulations and permits.

3.1.2 Construction Right-of-way

Rubber-tired vehicles (pick-up trucks, buses) shall normally refuel at the construction staging areas or commercial gas stations. Tracked machinery (backhoes, bulldozers) shall be refueled and lubricated on the construction right-of-way. Equipment maintenance shall be conducted in staging areas when practical. When impractical, repairs to equipment can be made on the construction right of way when approved by Keystone's representative.

The following preventive measures apply to refueling and lubricating activities on the construction right-of-way:

- Construction activities shall be conducted to allow for prompt and effective clean up of spills of fuel and other hazardous materials. Each construction crew, including clean-up crews shall have on hand sufficient tools and material to stop leaks and supplies of absorbent and barrier materials to allow rapid containment and recovery of spilled materials and must know and follow the procedure for reporting spills;
- Refueling and lubrication of construction equipment shall be restricted to upland areas at least 100 feet away from stream channels and wetlands. Where this is not possible (e.g., trench dewatering pumps), the equipment shall be fueled by designated personnel with special training in refueling and spill containment and clean up. The Environmental Inspector shall ensure that signs are installed identifying restricted areas;
- Spent oils, lubricants, filters, etc. shall be collected and disposed of at an approved location in accordance with state and federal regulations;
- Equipment shall not be washed in streams.

Keystone may allow modification of the above specifications as necessary to accommodate specific situations or procedures. Any modifications must still comply with all applicable regulations and permits.

3.2 Contingency Plans

The Contractor shall develop emergency response procedures for all incidents (e.g., spills, leaks, fires) involving hazardous materials which could pose a threat to human health and/or the environment. The procedures shall address activities in all work areas, as well as during transport to and from the construction right-of-way and to any disposal or recycling facility.

3.3 Equipment

The Contractor shall retain emergency response equipment that shall be available at all areas where hazardous materials are handled or stored. This equipment shall be readily available to respond to a hazardous material emergency. Such equipment shall include, but not be limited to, the following:

- first aid kit/supplies
- phone or communications radio
- protective clothing (tyvek suit, gloves, goggles, boots)
- hand held fire equipment
- absorbent material and storage containers
- non-sparking bung wrench and shovel
- brooms and dust pan

Hazardous material emergency equipment shall be carried in all mechanic and supervisor vehicles. This equipment shall include, at a minimum:

- first aid kit/supplies
- phone or communications radio
- 2 sets of protective clothing (tyvek suit, gloves, goggles, boots)
- 1 non-sparking shovel
- 6 plastic garbage bags (20 gallon)
- 10 absorbent socks and spill pads
- hand held fire extinguisher
- barrier tape
- 2 orange reflector cones

Fuel and service trucks shall carry a minimum of 20 pounds of suitable commercial sorbent material.

The Contractor shall inspect emergency equipment weekly, and service and maintain equipment regularly. Records shall be kept of all inspections and services.

3.4 Emergency Notification

Emergency notification procedures between the Contractor and Keystone shall be established in the preplanning stages of construction, and the Keystone representative shall be identified to serve as contact in the event of a: spill during construction activities. In the event of a spill which meets government reporting criteria, the Contractor shall notify the Keystone representative immediately who, in turn, shall notify the appropriate regulatory agencies.

If a spill occurs into navigable waters of the United States, Keystone shall notify the National Response Center (NRC) at 1·800-424-8802. For spills which occur on public lands, into surface waters or into sensitive areas the appropriate governmental agency's district office shall also be notified.

3.5 Spill Containment and Countermeasures

In the event of a spill of hazardous material, Contractor personnel shall:

- notify the appointed Keystone representative;
- identify the product hazards related to the spilled material and implement appropriate safety procedures, based on the nature of the hazard;

- control danger to the public and personnel at the site;
- implement spill contingency plans and mobilize appropriate resources and manpower;
- isolate or shutdown the source of the spill;
- block manholes or culverts to limit spill travel;
- initiate containment procedures to limit the spill to as small an area as possible, to prevent damage to property or areas of environment concern (e.g., watercourses);
- commence recovery of the spill and clean-up operations.

When notified of a spill, the Keystone representative shall immediately ensure that:

- action is taken to control danger to the public and personnel at the site;
- spill contingency plans are implemented and that necessary equipment and manpower are mobilized;
- measures are taken to isolate or shutdown the source of the spill;
- all resources necessary to contain, recover and clean up the spill are available;
- any resources requested by the Contractor from Keystone are provided;
- the appropriate agencies are notified. For spills which occur on public lands, into surface waters or into sensitive areas the appropriate federal or state managing office office shall also be notified and involved in the incident.

On a land spill, berms shall be constructed with available equipment to physically contain the spill. Personnel entry and travel on contaminated soils shall be minimized. Sorbent materials shall be applied or, if necessary, heavily contaminated soils shall be removed to an approved facility. Contaminated sorbent materials and vegetation shall also be disposed of at an approved facility.

On a spill threatening a water body, berms and/or trenches shall be constructed to contain the spill prior to entry into a water body. Deployment of booms, skimmers and sorbent materials shall be necessary if the spill reaches the water. The spilled product shall be recovered and the contaminated area shall be cleaned up with in consultation with spill response specialists and appropriate government agencies.

4.0 UPLANDS (AGRICULTURAL, FOREST, PASTURE, RANGE AND GRASS LANDS)

4.1 Interference with Irrigation Systems

If existing irrigation systems (pivot, wheel or other type spray irrigation systems), irrigation ditches, or sheet flow irrigation shall be impacted by the construction of the pipeline, the following mitigative measures shall be implemented unless otherwise approved or directed by Keystone:

- If it is feasible and mutually acceptable to Keystone and the Landowner or Landowner's designate, temporary measures shall be implemented to

allow an irrigation system to continue to operate across land on which the pipeline is also being constructed.

- If the pipeline and/or temporary work areas intersect an operational (or soon to be operational) pivot or other spray irrigation system, Keystone shall establish with the Landowner or Landowner's designate an acceptable amount of time the irrigation system may be out of service or if, as a result of pipeline construction activities, an irrigation system interruption results in crop damages, either on the pipeline construction right-of-way or off the construction right-of-way, the Landowner shall be reasonably compensated for all such crop damages.
- If the pipeline and/or temporary work areas intersect an operational sheet flow irrigation system, Keystone shall establish with the Landowner or Landowner's designate an acceptable amount of time the irrigation system may be out of service or if, as a result of pipeline construction activities, an irrigation system interruption results in crop damages, either on the pipeline construction right-of-way or off the construction right-of-way, the Landowner shall be reasonably compensated for all such crop damages.
- Irrigation ditches that are active at the time of construction shall not be stopped or obstructed except for the length of time to install the pipeline beneath the ditch (typically, one day or less) unless otherwise approved or directed by Keystone.

4.2 Clearing

The objective of clearing is to provide a clear and unobstructed right of way for efficient construction of the pipeline. The following mitigative measures shall be implemented:

- construction traffic shall be restricted to the construction right-of-way, existing roads and approved private roads
- construction right-of-way boundaries including pre-approved temporary workspace shall be clearly staked to prevent disturbance to unauthorized areas
- if crops are present, they shall be mowed or disced to ground level unless an agreement is made for the Landowner to remove for personal use.
- burning is prohibited on cultivated land.
- construction right of way at timber shelterbelts in agricultural areas shall be reduced to the minimum necessary to construct the pipeline

4.3 Topsoil Removal and Storage

The objective of topsoil handling is to maintain topsoil capability by conserving topsoil for future replacement and reclamation and to minimize the degradation of topsoil from compaction, rutting, loss of organic matter, or soil mixing so that successful reclamation of the right of way can occur. The following mitigative measures shall be implemented during topsoil removal and storage unless otherwise approved or directed by Keystone based on site specific conditions or circumstances However, all work shall be conducted in accordance with applicable permits.

- In cultivated agricultural lands, unless otherwise specified by the Landowner, the actual depth of the topsoil shall be stripped from the area to be excavated above the pipeline to a maximum of 12 inches. When grading is required, the topsoil shall be removed from the entire area to be graded and stored. When grading is required, the topsoil shall be removed from the entire area to be graded and stored.
- In non-cultivated agricultural lands, the actual depth of topsoil shall be stripped from the area to be excavated above the pipeline. When grading is required, the topsoil shall be removed from the entire area to be graded and stored.
- Stripped topsoil is to be stockpiled in a windrow along the edge of the right of way. The Contractor shall perform its work in order to minimize the potential for subsoil and topsoil to be mixed.
- Under no circumstances shall the Contractor use topsoil to fill a low area
- If required due to excessively windy conditions, following the removal of the topsoil, topsoil piles shall be tackified using either water or a suitable tackifier.
- The surface drainage network in the vicinity of the right of way shall be maintained by keeping gaps in the rows of topsoil in order to prevent any accumulation of water on the land.
- Topsoil shall not be utilized to construct ramps at road or waterbody crossings.

4.4 Grading

The objective of grading is to develop a right of way that allows the safe passage of equipment and meets the bending limitations of the pipe. The following mitigative measures shall be implemented during grading unless otherwise approved or directed by Keystone based on site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- All grading shall be undertaken with the understanding that original contours and drainage patterns shall be re-established during clean up.
- Agricultural areas that have been land formed with terraces shall be surveyed to establish pre-construction contours to be utilized for restoration of the terraces after construction.
- On steep slopes, or wherever erosion potential is high, temporary erosion control measures shall be implemented.
- Bar ditches adjacent to existing roadways that shall be crossed during construction shall be adequately ramped with grade or ditch spoil to prevent damage to the road shoulder and ditch.
- Where the construction surface remains inadequate to support equipment travel, timber mats, timber riprap or other method shall be used to stabilize surface conditions.

The Contractor shall limit the interruption of the surface drain network in the vicinity of the right of way, using the appropriate methods:

- Providing gaps in the rows of subsoil and topsoil in order to prevent any accumulation of water on the land.
- Preventing obstructions in furrows, furrow drains and ditches.
- Installing flumes and ramps in furrows, furrow drains and ditches to facilitate water flow across the construction right of way and allow for construction equipment traffic.
- Installing flumes over the trench for any watercourse where flow is continuous during construction.

4.5 Temporary Erosion and Sediment Control

4.5.1 General

Temporary erosion and sediment control measures shall be installed immediately after initial disturbance of the soil and maintained throughout construction (on a daily basis) and reinstalled as necessary until replaced by permanent erosion control structures or restoration of the construction right-of-way is complete.

Specifications and configurations for erosion and sediment control measures may be modified by Keystone as necessary to suit actual site conditions. However, all work shall be conducted in accordance with applicable permits.

The Contractor shall inspect all temporary erosion control measures at least daily in areas of active construction or equipment operation, weekly in areas with no construction or equipment operation, and within 24 hours of each significant rainfall event. The Contractor shall repair all ineffective temporary erosion control measures as expediently as practicable.

4.5.2 Sediment Barriers

Sediment barriers shall be constructed of silt fence, staked hay or straw bales, compacted earth (e.g., driveable berms across travel lanes), sand bags, or other appropriate materials.

The Contractor shall install sediment barriers in accordance with **Details 1 and 2** or as otherwise approved or directed by Keystone. The aforementioned sediment barriers may be used interchangeably or together depending on site specific conditions. In most cases, silt fences shall be utilized where longer sediment barriers are required.

Sediment barriers shall be installed below disturbed areas where there is a hazard of off-site sedimentation. These areas include:

- The base of slopes adjacent to road crossings
- The edge of the construction right-of-way adjacent to and up gradient of a roadway, flowing stream, spring, wetland or impoundment
- At trench or test water discharge locations where required

- Where waterbodies or wetlands are adjacent to the construction right-of-way, the Contractor shall install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil and sediment within the construction right-of-way
- Across the entire construction right-of-way at flowing waterbody crossings
- Right-of-way immediately upslope of the wetland boundary at all standard (saturated or standing water) wetland crossings as necessary to prevent sediment flow into the wetland. Sediment control barriers are not required at "dry" wetlands
- Along the edge of the construction right-of-way within standard (saturated or standing water) wetland boundaries as necessary to contain spoil and sediment within the construction right-of-way. Sediment control barriers are not required at "dry" wetlands

Sediment barriers placed at the toe of a slope shall be set with sufficient distance from the toe of the slope, if possible, in order to increase ponding volume.

Sediment control barriers shall be placed so as not to hinder construction operations. If silt fences or straw bale sediment barriers in lieu of driveable berms are placed across the entire construction right-of-way at waterbodies, wetlands, or upslope of roads, a provision shall be made for temporary traffic flow through a gap for vehicles and equipment to pass within the structure. Immediately following each day's shutdown of construction activities, a row of straw bales or a section of silt fence shall be placed across the up-gradient side of the gap with sufficient overlap at each end of the barrier gap to eliminate sediment bypass flow, followed by bales tightly fitted to fill the gap. Following completion of the equipment crossing, the gap shall be closed using silt fence or straw bale sediment barrier.

The Contractor shall maintain straw bale and silt fence sediment barriers by removing collected sediment and replacing damaged bales. If sediment loading is greater than approximately 40% full behind a straw bale or silt fence sediment barrier, or if directed by Keystone, sediment shall be removed and placed in an area where it shall not reenter the barrier. If straw bale filters cannot be cleaned out due to access problems, the Contractor shall place a new row of sediment barriers upslope.

The Contractor shall use mulch and straw bales that are free of noxious weeds. Mulch or straw bales that contain evidence of noxious weeds or other undesirable species shall be rejected by the Contractor.

The Contractor shall remove sediment barriers except those needed for permanent erosion and sediment control during clean up of the construction right-of-way.

4.5.3 Trench Plugs

The Contractor shall use trench plugs at the edge of flowing waterbody crossings and at the edge of wetlands with standing water to prevent diversion of water into upland portions of the pipeline trench and to keep any accumulated trench water out of the waterbody. Trench plugs shall be of sufficient size to withstand upslope water pressure.

4.5.4 Temporary Slope Breakers (Water Bars)

The Contractor shall not install temporary slope breakers (water bars) in cultivated land.

The Contractor shall install temporary slope breakers on slopes greater than approximately 5% in non-cultivated lands where the base of the slope is less than 50 feet from waterbody, wetland, and road crossings at the following recommended spacing:

Slope (%)	Spacing (feet)
5 - 15	300
>15 - 30	200
>30	100

The gradient of each slope breaker shall be 2 to 8 percent.

Temporary slope breakers shall be constructed of soil, silt fence, staked straw bales, sand bags or similar materials authorized by Keystone.

The Contractor shall direct the outfall of each temporary slope breaker to a stable, well vegetated area or construct an energy-dissipating device at the end of the slope breaker and off the construction right-of-way as shown in **Detail 3.** The outfall of each temporary slope breaker shall be installed to prevent sediment discharge into wetlands, waterbodies, or other sensitive resources.

Specifications and configurations for temporary slope breakers may be modified by Keystone as necessary to suit actual site conditions. However, all work shall be conducted in accordance with applicable permits.

4.5.5 Drainage Channels or Ditches

Drainage channels or ditches shall be used on a limited basis to provide drainage along the construction right-of-way and toe of cut slopes as well as to direct surface runoff across the construction right-of-way or away from disturbances and onto natural undisturbed ground. Channels or ditches shall be constructed by the Contractor during grading operations. Where there is inadequate vegetation at the channel's or ditch's outlet, sediment barriers, check berms or other appropriate measures shall be used to control erosion.

4.5.6 Temporary Mulching

The Contractor shall install temporary mulch before seeding if construction or restoration activity is interrupted for extended periods. The Contractor shall not apply temporary mulch in cultivated areas unless specifically requested by the Landowner. The Contractor shall not apply mulch within wetland boundaries.

Temporary mulch applied on slopes shall be spread uniformly to cover at least 75 percent of the ground surface at an approximate rate of 2 tons/acre of straw or its equivalent. Mulch application on slopes within 100 feet of waterbodies and wetlands shall be increased to an approximate rate of 3 tons/acre of straw or equivalent

4.5.7 Tackifier

When inordinately windy conditions result in excessive topsoil movement and topsoil piles wetted with water is not preventing wind erosion, the Contractor shall temporarily suspend topsoil handling operations and apply a tackifier to topsoil stockpiles at the rate recommended by the manufacturer.

Should construction traffic, cattle grazing, heavy rains, or other related construction activity disturb the tackified topsoil piles and there is a potential for wind erosion, additional tackifier shall be applied by the Contractor.

4.6 Stringing

The objective of stringing is to place the line pipe along the construction right of way for bending and welding in an expedient and efficient manner.

The Contractor shall utilize one or more of the following mitigation measures as applicable and when necessary to reduce compaction on the working side of the right of way or as directed by Keystone. However, all work shall be conducted in accordance with applicable permits.

- Prohibiting access by certain vehicles.
- Using only machinery possessing low ground pressure (tracks or extra-wide tires).
- Control access thus minimizing the frequency of all vehicle traffic.
- Hastening drainage through digging drainage ditch to re-establish surface drainage as required.
- Using timber riprap, matting, or geotextile fabric overlain with soil.
- Stopping construction entirely for a period of time.

4.7 Trenching

The objective of trenching is to provide a ditch of sufficient depth and width with a bottom to continuously support the pipeline. During trenching operations, the following mitigative measures shall be implemented unless otherwise approved or directed by Keystone based on site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- Segregating subsoil materials from topsoil in separate, distinct rows with a separation that shall limit any admixing of topsoil and subsoil during handling of these materials.
- Gaps must be left in the spoil piles that coincide with breaks in the strung pipe to facilitate natural drainage patterns and to allow the passage of livestock or wildlife.
- Trenching operation shall be followed as closely as practicable by lower-in and backfill operations to minimize the length of time the ditch is open
- Construction debris (e.g., welding debris) and other garbage shall not be deposited in the ditch.

Should blasting be necessary for removal of rock, the following mitigation measures shall be implemented:

- Where blasting is required, operations shall be done accordingly to laws and regulations governing explosives.
- Prior to using explosives, the Contractor shall advise residents of the immediate area, in order to prevent any risk of accidents or undue disturbances.
- Blasting mats or subsoil shall be piled over the trench line to prevent any rocks from being blown outside the construction right of way.
- Each blasting location shall be cleared and cleaned up before and after all blasting operations
- Blasting shall be carried out during regular daylight working hours.

4.7.1 Trench Dewatering/Well Points

The Contractor shall make all reasonable efforts to discharge trench water in a manner that avoids damage to adjacent agricultural land, crops and pasture. Damage includes, but is not limited to the inundation of crops for more than 24 hours, deposition of sediment in ditches, and the deposition of gravel in fields or pastures.

If trench dewatering is necessary in an area where salt damage to adjacent crops is evident, the Keystone Inspector shall conduct a field conductivity test on the trench water before it is discharged. If the conductivity of the trench water is determined to potentially affect soil quality, it shall not be discharged to areas where salt damage to crops is evident, but shall be directed as feasible so that water flows over a well vegetated, non-cropland area or through an energy dissipater and sediment barrier, then directed to nearby ditches or brackish wetlands or waterbodies.

When pumping water from the trench for any reason the Contractor shall ensure that adequate pumping capacity and sufficient hose is available to permit dewatering as follows:

- No heavily silt-laden trench water shall not be allowed to enter a waterbody or wetland directly but shall instead be diverted through a well vegetated area, a geotextile filter bag or a permeable berm (straw bale or Keystone approved equivalent); and

- Trench water shall not be disposed of in a manner which could damage crops or interfere with the functioning of underground drainage systems.

The Contractor shall screen the intake hose and keep the hose either one foot off the bottom of the trench or in a container to minimize entrainment of sediment.

4.8 Welding, Field Joint Coating, and Lower In

The objectives of welding, field joint coating and lower in are to provide continuous segments of pipeline, to provide corrosion protection to the weld areas of the pipeline, and to place the pipeline in the center of the trench, without stress, at the required depth of cover. The following mitigative measures shall be followed during pipe welding, field joint coating, and lower in, unless otherwise specified by Keystone in response to site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- Shavings produced during bevelling of the line pipe are to be removed immediately following this operation to ensure that livestock and wildlife do not ingest this material. When welding operations have created a continuous line of pipe that may be left on the right of way for an extended period of time due to construction or weather constraints, a gap in the welded pipe shall be provided to allow for access at farm road crossings and also for passage of livestock and/or wildlife.
- Prior to the application of epoxy powder, urethane epoxy or other approved pipe coatings, a tarp shall be placed underneath the pipe to collect any overspray of epoxy powder and/or liquid drippings. Excess powder and/or liquid or other hazardous materials (e.g. brushes, rollers, gloves, etc.) shall be continuously collected and removed from the construction right-of-way.

4.9 Padding and Backfilling

The objective of padding (when required) and backfilling is to cover the pipe with material that is not detrimental to the pipeline and pipeline coating. The following mitigative measures shall be utilized during backfilling, unless otherwise approved or directed by Keystone based on site specific conditions or circumstances. All work shall be conducted in accordance with applicable permits.

- Excessive water accumulated in the trench shall be eliminated prior to backfilling.
- In the event it becomes necessary to pump water from open trenches, the Contractor shall pump the water and discharge it into existing water drainages in a manner that shall avoid damaging adjacent agricultural land, crops, and/or pasture.
- If it is impossible to avoid water-related damages (including inundation of crops for more than 24 hours, deposition of sediment in ditches and other water courses, and the deposition of gravel in fields, pastures, and any water courses), Keystone shall reasonably compensate the Landowners for the damages or shall correct the damages so as to restore the land, crops, pasture, water courses, etc. to their pre construction condition.
- All pumping of water shall comply with existing drainage laws and local ordinances relating to such activities and provisions of the Clean Water Act.
- Prior to backfilling, all drain tile shall be permanently repaired, inspected and the repair documented as described in Section 5.5
- Prior to backfilling, trench breakers shall be installed on slopes where required to minimize the potential for water movement down the ditch and potential subsequent erosion.
- In backfilling the trench, the stockpiled subsoil shall be placed back into the trench before replacing the topsoil.
- Topsoil shall not be utilized for padding the pipe.
- Backfilling shall be done without mixing spoil with topsoil.
- Backfill shall be compacted to a minimum of 90% of pre-existing conditions where the trench line crosses tracks of wheel irrigation systems (pivots).
- To reduce the potential for ditch line subsidence, spoil shall be replaced and compacted by backhoe bucket and/or by the wheels or tracks of equipment traversing down the trench.
- The top 4 feet or the actual depth of top cover, whichever is less, within the pipeline trench, bore pits, or other excavations shall not be backfilled with soil containing rocks of any greater concentration or size than existed prior to the pipeline's construction.

4.10 Clean Up

The objective of clean up activities shall be to prepare the right of way and other disturbed areas to approximate pre-activity ground contours where appropriate and to replace spoil and stockpiled material in a manner which preserves soil capability and quality to a degree reasonably equivalent to the original or that of representative undisturbed land. The following mitigative measures shall be utilized during clean up, unless otherwise approved or directed by Keystone based on specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- Clean up shall occur immediately following backfilling operations when weather allows it.
- All garbage and construction debris (i.e., lathing, ribbon, welding rods, pipe bevel shavings, pipe spacer ropes end caps, pipe skids, etc.) shall be collected and disposed of at approved disposal sites.

- The right of way shall be re-contoured with spoil material to approximate pre-construction contours and as necessary to limit erosion and subsidence. Loading of slopes with unconsolidated spoil material shall be avoided during slope re-contouring. Topsoil shall be replaced after re-contouring of the grade with subsoil. The topsoil shall be replaced on the subsoil storage area and over the trench so that after settling occurs, the topsoil's approximate original depth and contour (with an allowance for settling) shall be achieved.
- Surface drainage shall be restored and re-contoured to conform to the adjacent land drainage system.
- Erosion control structures such as permanent slope breakers and cross ditches shall be installed on steep slopes where necessary to control erosion by diverting surface run-off from the right of way, to stable and vegetated off right of way areas.
- After construction, all temporary access shall be returned to prior construction conditions unless specifically agreed with the Landowner or otherwise specified by Keystone.
- Installation of warning signs, aerial markers, and cathodic protection test leads in locations that shall not impair farming operations and are acceptable to the Landowner
- All bridges, fences and culverts existing prior to construction shall be restored to meet or exceed approximate pre-construction conditions. Caution shall be utilized when re-establishing culverts to ensure that drainage is not improved to a point that would be detrimental to existing waterbodies and wetlands.
- All temporary gates installed during construction shall be replaced with permanent fence unless otherwise requested by the Landowner.

4.11 Reclamation and Re-vegetation

The objectives of reclamation and re-vegetation are to return the disturbed areas to approximately pre-construction use and capability. This involves the treatment of soil as necessary to preserve approximate pre-construction capability and the stabilization of the work surface in a manner consistent with the initial land use. The following mitigative measures will be utilized unless otherwise approved or directed by Keystone based on site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

4.11.1 Relieving Compaction

- Compaction shall be alleviated on all agricultural land traversed by construction equipment. Cropland that has been compacted shall be ripped a minimum of 3 passes at least 18 inches deep and all pasture and woodland shall be ripped or chiseled a minimum of three passes at least 12 inches deep.
- Areas of the construction right of way that were stripped for topsoil salvage shall be ripped a minimum of 3 passes (in cross patterns) prior to topsoil replacement. The approximate depth of ripping shall be 18 inches (or a lesser depth if damage may occur to existing drain tile systems). Following ripping, the subsoil surface shall be graded

smooth and any subsoil clumps broken up (disc and harrow) in an effort to avoid topsoil mixing.

- The decompacted construction right of way shall be tested by the Contractor at regular intervals for compaction in agricultural and residential areas disturbed by construction activities. Tests shall be conducted on the same soil type under similar moisture conditions in undisturbed areas immediately adjacent to the right of way to approximate pre-construction conditions. Penetrometers or other appropriate devices shall be used to conduct tests
- Topsoil shall be replaced to pre-existing depths once ripping and discing of subsoil is complete. Topsoil compaction on cultivated fields shall be alleviated by cultivation.
- If there is any dispute between the Landowner and Keystone as to what areas need to be ripped or chiseled, the depth at which compacted areas should be ripped or chiseled, or the necessity or rates of lime and fertilizer application, the appropriate county Soil and Water Conservation District's opinion shall be considered by Keystone and the Landowner.

Plowing under of organic matter including wood chips, manure, or planting of a new crop, such as alfalfa, to decrease soil bulk density and improve soil structure or any other measures in consultation with the Soil Conservation service shall be considered if mechanical relief of compaction is deemed not satisfactory.

4.11.2 Rock Removal

- In agricultural land, rocks that are exposed on the surface due to construction activity shall be removed from the right of way prior to and after topsoil replacement to an equivalent quantity, size and distribution of rocks to that of adjacent lands.
- Clearing of rocks may be carried out with a mechanical rock picker or by manual means, provided that preservation of topsoil is assured. Rock removed from the right of way shall be hauled off the Landowner’s premises or disposed of on the Landowner’s premises at a location that is mutually acceptable to the Landowner and to Keystone.

4.11.3 Soil Additives

If site specific conditions warrant and if agreed to by the Landowner, the Contractor shall apply amendments (fertilizer and soil pH modifier materials and formulations) that are commonly used for agricultural soils in the area in which they are applied and in accordance with written recommendations from the local soil conservation authority, land management agencies, or Landowner. Amendments shall be incorporated into the normal plow layer as soon as possible after application.

4.11.4 Seeding

- The final seed mix shall be based on input from the local Soil Conservation Services and the availability of seed at the time of reclamation. The Landowner may request specific seeding requirements during easement negotiations.
- Certificates of seed analysis are required for all seed mixes to limit the introduction of noxious weeds.
- Seed not utilized within 12 months of seed testing shall be approved by Keystone prior to use.Seeding shall follow clean up and topsoil replacement as closely as possible. Seed shall be applied to all disturbed surfaces (except cultivated fields unless requested by the Landowner) as indicated on the Consruction Drawings
- If mulch was applied prior to seeding for temporary erosion control, the Contractor shall remove and dispose of the excess mulch prior to seedbed preparation to ensure that seedbed preparation equipment and seed drills do not become plugged with excess mulch; to ensure that seed can adequately contact the soil surface; and to ensure that seed incorporation or soil packing equipment can operate without becoming plugged with mulch.
- The Contractor may evenly re-apply and anchor (straw crimp) the removed temporay mulch on the construction right-of-way following seeding.
- Identified seeding areas shall be seeded at a rate appropriate for the region and stability of the reclaimed surface. Seeding rates shall be based on Pure Live Seed.
- Weather conditions, construction right-of-way constraint, site access, and soil type shall influence the seeding method to be used (i.e., drill seeding versus broadcast seeding). All areas seeded by the Contractor, except for temporary cover crops, shall be drill seeded unless the right of way is too steep to facilitate drill seeding. Temporary cover crop seed shall be broadcast.
- The Contractor shall delay seeding as necessary until the soil is in the appropriate condition for drill seeding.
- The Contractor shall use a Truax (brand) or equivalent-type drill seeder equipped with a cultipacker designed and equipped to apply grass and grass-legume seed mixtures with mechanisms such as seed box agitators to allow even distribution of all species in each seed mix, with an adjustable metering mechanism to accurately deliver the specified seeding rate and with a mechanism such as depth bands to accurately place the seed at the specified depth.
- The Contractor shall operate drill seeders at an appropriate speed so the specified seeding rate and depth is maintained.
- The Contractor shall calibrate drill seeders so that the specified seeding rate is planted. The row spacing on drill seeders shall not exceed 8 inches.
- The Contractor shall plant seed at depths cosistent with the local or regional agricultural practices.
- Broadcast or hydro seeding used, in lieu of drilling, shall utilize double the recommended seeding rates. Where seed is broadcast, the Contractor shall use a harrow, cultipacker or other equipment

immediately following broadcasting to incorporate the seed to the specified depth and to firm the seedbed.

- The Contractor shall delay broadcast seeding during high wind conditions if even distribution of seed is impeded.
- The Contractor shall hand rake all areas that are too steep, or otherwise cannot be safely harrowed or cultipacked, in order to incorporate the broadcast seed to the specified depth.
- Hydro-seeding may be used, on a limited basis, where the slope is too steep or soil conditions do not warrant conventional seeding methods. Fertilizer, where specified, may be included in the seed, virgin wood-fiber, tackifier and water mixture. When hydro-seeding, virgin wood-fiber shall be applied at the rate of approximately 3,000 pounds per acre on an air-dry weight basis as necessary to provide at least 75% ground cover. Tackifier shall consist of biodegradable, vegetable-based material and shall be applied at the rate recommended by the manufacturer. The seed, mulch and tackifier slurry shall be applied so that it forms a uniform, mat-like covering of the ground.
- Keystone shall work with Landowners to discourage cattle from using the construction right-of-way during the first growing season by utilization of temporary fencing or deferred grazing.

4.11.5 Permanent Erosion and Sediment Control

The Contractor shall restore all existing Landowner soil conservation improvements and structures disturbed by pipeline construction to the approximate pre-construction line and grade. Soil conservation improvements and structures include, but are not limited to, grassed waterways, toe walls, drop inlets, grade control works, terraces, levees and farm ponds.

4.11.5.1 Trench Breakers

The Contractor shall install trench breakers in steep terrain where necessary to limit the potential for trench line erosion and at the base of slopes adjacent to waterbodies and wetlands.

Trench breakers shall be constructed of materials such as sand bags, sand/cement bags, bentonite bags, or polyurethane foam by the Contractor **(Detail 7)**. The Contractor shall not use topsoil in trench breakers.

4.11.5.2 Permanent Slope Breakers (Water Bars)

Permanent slope breakers (water bars) shall be constructed of soil or, in some instances, sand bags.

The Contractor shall construct permanent slope breakers (water bars) on the construction right-of-way where necessary to limit erosion, except in cultivated and residential areas. Slope breakers shall divert surface runoff to adjacent stable vegetated areas or to energy-dissipating devices as shown on **Detail 3.** Permanent slope breakers (water bars) shall be installed as specified on the Construction Drawings or generally with a minimum spacing as shown on the following table:

Slope (%)	Spacing (feet)
5 - 15	300
>15 – 30	200
>30	100

The gradient (fall) for each slope breaker shall be two percent (2%) to eight percent (8%) unless otherwise approved by Keystone based on site specific conditions.

The Contractor shall construct slope breakers to divert surface flow to a stable, well-vegetated area. In the absence of a stable area, the Contractor shall construct appropriate energy-dissipating devices at the end of the slope breaker and beyond the area disturbed by construction. .

4.11.5.3 Mulching

The Contractor shall apply mulch on all areas with high erosion potential and on slopes greater than 8 percent unless otherwise approved by Keystone based on site specific conditions or circumstances. The Contractor shall spread mulch uniformly over the area to cover at least 75 percent of the ground surface at an approximate rate of 2 tons/acre of straw or its equivalent.

Mulch application includes straw mulch or hydro mulch and tackifier. The Contractor shall not apply mulch in cultivated areas unless requested by the Landowner.

The Contractor shall use mulch that is free of noxious weeds.

The Contractor shall apply mulch immediately following seeding. The Contractor shall not apply mulch in wetlands.

If a mulch blower is used, the majority of strands of the mulching material shall not be shredded to less than 8 inches in length to allow anchoring. The Contractor shall anchor mulch immediately after application to minimize loss by wind and water.

When anchoring (straw crimping) by mechanical means, the Contractor shall use a tool specifically designed for mulch anchoring with flat, notched disks to properly crimp the mulch to a depth of approximately 2 to 3 inches. A regular farm disk shall not be used to crimp mulch.

In soils possessing high erosion potential, the Contractor may be required to make two passes of the mulch-crimping tool, passes must be as perpendicular to the others as possible.

When anchoring with liquid mulch binders (tackifiers), the Contractor shall use a biodegradable tackifier derived from a vegetable-based, organic source. The Contractor shall apply mulch binders at rates recommended by the manufacturer.

The Contractor shall limit the use of liquid mulch binders (tackifiers) for anchoring straw and the use of hydromulch and tackifier to areas that are too steep or rocky to safely or effectively operate mechanical mulch-anchoring tools.

4.11.5.4 Erosion Control Matting

Erosion control matting shall be applied where shown on the Construction Drawings as shown on **Detail 4.** The Contractor shall anchor the erosion control matting with staples or other approved devices.

The Contractor shall use erosion control matting made of biodegradable, natural fiber such as straw or coir (coconut fiber).

The Contractor shall prepare the soil surface and install the erosion control matting to ensure it is stable and the matting makes uniform contact with the soil of the slope face or stream bank underneath with no bridging of rills, gullies or other low areas.

4.11.5.5 Riprap and Stream Bank Stabilization

In most cases, the banks and streambeds of waterbodies shall be restored to their approximate original contours. Erosion protection shall be applied as specified in the construction drawings.

Generally most restored banks will be protected through the use of flexible channel liners installed as specified in **Detail 19.**

If the original stream bank is excessively steep and unstable and/or flow conditions are severe, a more stable final contour

may be specified and alternate stabilization measures may be installed.

Alternate stabilization measures may consist of rock rip rap, or bio-stabilization or engineered structures such as brush layering, logwalls, cribwalls, or vegetated geo-grids. See **Details 20, 22, 23, and 24.**

Stream bank riprap structures shall consist of a layer of stone, underlain with approved filter fabric or a gravel filter blanket. Riprap shall extend from the stabilized streambed to the top of the stream bank, where practicable, native rock shall be utilized.

4.11.6 Fences

Upon completion of all backfilling, clean-up and restoration including mulching and seeding of the construction right-of-way, permanent repairs shall be made to all fences by using either the original material or good quality new material similar to existing fences.

Early or historic fences shall be carefully reassembled by hand from the original material. Where the original material has deteriorated to a state that makes it unsalvageable, replacement material similar to the original shall be used if possible.

4.11.7 Right-of-way and Pipeline Markers

Upon completion of all backfilling, clean-up and restoration including mulching and seeding of the construction right-of-way and during the time when the Contractor is making permanent repairs to fences, the Contractor shall install pipeline markers on each side of all roads, railroads, fence lines, stream crossings and other areas where the pipeline markers do not conflict with intended land use.

4.12 Pasture and Range Lands

The following mitigative measures shall be implemented in addition to the requirements previously stated in Sections 4.1 thru 4.11 unless otherwise approved by Keystone based on site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- Access across the right of way during construction shall be provided at locations requested by Landowners, if practicable.
- Bevel shavings produced during pipe bevel operations are to be removed immediately to ensure that livestock and wildlife do not ingest this material.
- Litter and garbage shall be collected and removed from the construction site at the end of the day's activities.
- Temporary gates shall be installed at fence lines for access to the construction right of way. These gates shall remain closed at all times. Upon completion of construction, the temporary gates shall be removed and the permanent fence replaced.

- Feeding or harassment of livestock or wildlife is prohibited.
- Construction personnel shall not be permitted to have firearms or pets on the construction right-of-way.
- All food and wastes shall be stored and secured in vehicles and/or appropriate facilities.
- Areas of disturbance in native range shall be seeded with a native seed mix after topsoil re-placement.
- Improved pasture shall be seeded with a seed mix approved by individual Landowners.

4.13 Forested Lands

Mitigation measures are required to ensure that pipeline construction activities have a minimal impact on forested lands and their habitat.

Clearing, grubbing and grading of trees, brush and stumps shall be performed in accordance with the following mitigative measures in addition to the requirements previously stated in Sections 4.1 thru 4.11 unless otherwise approved or directed by Keystone based on site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- Prior to the start of clearing activity, right of way boundaries including pre-approved temporary workspaces shall be clearly staked to prevent disturbance to unauthorized areas.
- If trees are to be removed from the construction right-of-way, Keystone shall consult with the Landowner or Landowner's designate to see if there are trees of commercial or other value to the Landowner. Timber shall be salvaged as per Landowner request.
- If there are trees of commercial or other value to the Landowner, Keystone shall allow the Landowner the right to retain ownership of the trees with the disposition of the trees to be negotiated prior to the commencement of land clearing and included in the easement agreement.
- If not performed by the Landowner, the construction right of way Contractor shall salvage all merchantable timber from designated areas.
- Tree stumps shall be grubbed only 5 feet either side of the trench line and where necessary for grading a level surface for pipeline construction equipment to operate safely
- Keystone shall follow the Landowner's or Landowner designate's desires as stated in the easement agreement regarding the disposal of trees, brush, and stumps of no value to the Landowner by burning, burial, etc., or complete removal from any affected property.
- Timber salvage operations shall use cut off-type saw equipment. Felling shall be undertaken in a manner that minimizes butt shatter, breakage and off right of way disturbance. Skidders or alternate equipment shall be used to transport salvaged logs to stacking sites.
- Trees shall be felled in such a way that they fall toward the centre line of the right of way to avoid breaking trees and branches off right of way. Leaners or felled trees that inadvertently fall into adjacent undisturbed vegetation shall be salvaged.
- Trees and slash falling outside the right of way shall be recovered and disposed of

- Salvaged logs shall be limbed and topped before removal from the construction right-of-way. Log decks (if required) shall be oriented to best facilitate loading by picker trucks and be located adjacent to the working side of the right of way where possible.
- The Contractor shall not be allowed to dispose of woody debris in wooded areas along the pipeline right of way.
- Pruning of branches hanging over the right of way shall be done only when necessary for construction. Any branch that is broken or seriously damaged should be cut off near its fork and the collar of the branch preserved.
- All tree wastes, stumps, tree crowns, brushes, branches and other forest debris shall be either burned, chipped (using a mobile chipper) or removed from the right of way according to Keystone instructions contained in the specific mitigation measures. Burial of this waste material on the site by the Contractor shall require the Landowner's specific authorization. Chips must not be spread over cultivated land. However, they may be spread and incorporated with mineral soil over the forest floor at a density that shall not prevent re-vegetation of grass.
- Stump removal and brush clearing shall be done with bulldozers equipped with brush rakes to preserve organic matter.
- Decking sites shall be established, approximately 2000 feet apart in timbered areas, on sites located on approved temporary workspace in existing cleared areas, in non-merchantable stands of timber or, if no other options are available, in merchantable timber stands. Deck sites shall be appropriately sized to accommodate the loading equipment.
- The Contractor shall remove decked timber from the construction right-of-way and transport to a designated all weather access point or mill if the Landowner does not want the timber.

4.14 Residential and Commercial/Industrial Areas

4.14.1 Residential Area

The principal measures that shall be used to mitigate impacts on existing residential areas include the following unless otherwise directed or approved by Keystone based on site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- notifying Landowners prior to construction;
- posting warning signs as appropriate
- reducing the width of construction right of way, if practicable, by eliminating the construction equipment passing lane, reducing the size of work crews, or utilizing the "stove pipe" or "drag section" construction techniques;
- removing fences, sheds, and other improvements as necessary for protection from construction activities;
- preserving, to the extent possible, mature trees and landscaping while ensuring the safe operation of construction equipment;
- fencing the edge of the construction work area adjacent to a residence for a distance of 100 feet on either side of the residence to ensure that construction equipment and materials, including the spoil pile, remain within the construction work area;

- limiting the hours during which operations with high-decibel noise levels (i.e., drilling and boring) can be conducted;
- limiting dust impact through prearranged work hours and by utilizing dust minimization techniques;
- ensuring that construction proceeds quickly through such areas (thus, minimizing exposure to nuisance effects such as noise and dust);
- maintaining access and traffic flow during construction activities, particularly for emergency vehicles;
- cleaning up construction trash and debris daily;
- fencing or plating open ditches during non-construction activities;
- immediately after backfilling the trench, restoring all lawn areas, shrubs, specialized landscaping, fences and other structures, etc. within the construction work area consistent with its pre-construction appearance or the requirements of the Landowner. Restoration work shall be done by personnel familiar with local horticultural and turf establishment practices;
- If the pipeline centerline is within 25 feet of a residence, ensuring that the trench is not excavated until the pipe is ready for installation and that the trench shall be backfilled immediately after pipe installation.

4.14.2 Commercial / Industrial Area

Commercial/industrial areas traversed by the pipeline would be subjected to both short and long-term impacts similar to residential areas. Temporary, short-term construction impacts may include disruption, inconvenience, and loss of potential revenues.

The principal measures that shall be used to mitigate impacts on existing commercial/industrial areas are as follows unless otherwise directed or approved by Keystone based on site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- notifying business owners prior to construction;
- reducing the width of construction right of way, if practicable, by eliminating the construction equipment passing lane, reducing the size of work crews, or utilizing the “stove pipe” or “drag section” construction techniques;
- removing fences and other improvements as necessary for protection from construction activities;
- fencing the edge of the construction work area adjacent to a business for a distance of approximately 100 feet on either side of the commercial/industrial building to ensure that construction equipment and materials, including the spoil pile, remain within the construction work area;
- preserving, to the extent possible, mature trees and landscaping while ensuring the safe operation of construction equipment;
- limiting the hours during which operations with high-decibel noise levels (i.e., drilling and boring) can be conducted;
- limiting dust impact through prearranged work hours and by utilizing dust minimization techniques;

- ensuring that construction proceeds quickly through such areas (thus, minimizing exposure to nuisance effects such as noise and dust);
- maintaining access and traffic flow during construction activities, particularly for emergency vehicles;
- cleaning up construction trash and debris daily;
- fencing or plating open ditches during non-construction activities;
- immediately after backfilling the trench, restoring all lawn areas, shrubs, specialized landscaping, fences and other structures, etc. within the construction work area consistent with its pre-construction appearance or the requirements of the business owner. Restoration work shall be done by personnel familiar with local horticultural and turf establishment practices;
- If the pipeline centerline is within 25 feet of a commercial/industrial building, ensuring that the trench is not excavated until the pipe is ready for installation and that the trench shall be backfilled immediately after pipe installation.

4.14.3 Site – Specific Plans

For any residence or commercial/industrial building closer than 25 feet to the construction work area, Keystone shall prepare a site-specific construction plan. The plan shall include:

- a description of construction techniques to be used;
- a dimensioned site plan that shows, as a minimum:
    - the location of the residence or commercial/industrial area in relation to the new pipeline;
    - the edge of the construction work area;
    - the edge of the new permanent construction right-of-way; and
    - other nearby topographical obstacles including landscaping, trees, structures, roads, parking areas, or ditches/streams, etc.
- a description of how Keystone would ensure that the trench is not excavated until the pipe is ready for installation and that the trench is backfilled immediately after pipe installation.

Figure 1 represents a typical site specific plan.

4.14.4 Landowner Complaint Resolution Procedure

Keystone shall implement a Landowner complaint procedure as follows:

- Landowners should first contact the construction spread office to express their concern over restoration and/or mitigation of environmental damages on their property. The Construction Manager, or his designated representative, shall respond to the Landowner within approximately 24 hours of receipt of the phone call.
- If the Landowner has not received a response or are not satisfied with the response, they can then contact Keystone's representative at XXX-

XXX-XXXX. The Landowners should expect a response within 48 hours.

- If the Landowner has not received a response or is not satisfied with the response, they should contact Keystone's Hotline at XXX-XXX-XXXX.

4.15 Operations and Maintenance

Operations and maintenance programs such as vegetation management, pipeline maintenance, integrity surveys, hydrostatic testing or other programs may have an impact on the final reclamation of the right of way. To ensure that the integrity of the facility and land surface reclamation of the right of way is maintained after completion of construction and that regulatory requirements are adhered to during operations, the following measures shall be implemented unless otherwise directed by Keystone in response to site specific conditions or circumstances. However, all work shall be conducted in accordance with applicable permits.

- Keystone shall monitor the pipeline right of way and all stream crossings for erosion or other potential problems that could affect the integrity of the pipeline. Any erosion identified shall be reclaimed as expediently as practicable by Keystone or by compensation of the Landowner to reclaim the area.
- Trench depressions on ditch line which may interfere with natural drainage, vegetation establishment or land use shall be repaired as expediently as practicable by Keystone or by compensation of the Landowner to repair the area.
- Post construction monitoring inspections shall be conducted of disturbed areas after the first growing season to determine the success of revegetation. Areas which have not been successfully re-established shall be revegetated by Keystone or by compensation of the Landowner to reseed the area. If, after the first growing season, revegetation is successful, no additional monitoring shall be conducted.
- In non-agricultural areas, revegetation shall be considered successful if, upon visual survey, the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands.
- In agricultural areas, revegetation shall be considered successful if crop yields are similar to adjacent undisturbed portions of the same field.
- Restoration shall be considered successful if the surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless requested otherwise by the Landowner or land managing agency), revegetation is successful, and drainage has been restored.
- Weed control measures shall be implemented as required in conjunction with the Landowner.
- Keystone shall be responsible for correcting all tile line repairs or irrigation systems that fail due to pipeline construction, provided those repairs were made by Keystone. Keystone shall not be responsible for tile line repairs which Keystone compensates the Landowner to perform.
- When requested by Landowners, in cultivated land, Keystone shall monitor the yield of land impacted by construction with the help of agricultural specialists. If alterations are indicated from that of adjacent lands, Keystone

will compensate the Landowner for reduced yields and shall implement procedures to return the land to equivalent capability.

- In residential areas, Landowners may use the right-of-way provided they do not interfere with the rights granted to Keystone. Trees or bushes, structures, including houses, toolsheds, garages, poles, guy wires, catch basins, swimming pools, trailers, leaching fields, septic tanks, and any other objects not easily removable, shall not be permitted on the permanent construction right-of-way without the written permission of Keystone, because they could impair access for maintenance of the pipeline.
- Keystone shall maintain communication with the Landowner and or tenant throughout the operating life of the pipeline to allow expedient communication of issues and problems as they occur. Keystone shall provide the Landowners with corporate contact information for these purposes. Keystone shall work with Landowners to prevent excessive erosion on lands disturbed by construction. Reasonable methods shall be implemented to control erosion. This may not be implemented if the property across which the pipeline is constructed is bare cropland which the Landowner intends to leave bare until the next crop is planted.
- If the Landowner and Keystone cannot agree upon a reasonable method to control erosion on the Landowner's property, the recommendations of the appropriate county Soil and Water Conservation District shall be considered by Keystone and the Landowner.

5.0 DRAIN TILE SYSTEMS

5.1 General

If underground drainage tile is damaged by the pipeline installation, it shall be repaired in a manner that assures the tile line's proper operating condition at the point of repair. Keystone may elect to negotiate a fair settlement with the affected county or Landowner for repair of the damaged drain tile. In the event the Landowner chooses to have the damaged tile repaired by Keystone, the Contractor shall follow these guidelines and procedures to identify the location of drain tiles; to mitigate damages to drain tiles prior to and during construction; to repair drain tiles damaged during installation of the pipeline; to inspect the proper repair of drain tiles; and to provide post-construction monitoring to determine any impacts caused by repair of drain tiles. Since all public and private drain tile systems are unique, i.e., varying age, depth of cover, type of material, geometry on the land, etc., it is not possible to develop a standard procedure for resolving each county's or Landowner's drain tile issues. These guidelines provide a basis on which to develop site specific methodology to mitigate damage and to repair drain titles affected by construction of the Keystone pipeline. Actual measures will be developed based on site specific information unique to specific installations. However, all work will be conducted in accordance with applicable permits.

5.2 Identification and Classification of Drain Tile Systems

Personnel shall attempt to identify and classify existing drain tile systems by meeting with local public officials and county engineers, and meeting with individual private Landowners and/or tenants.

5.2.1 Publicly Owned Drain Tiles

Personnel shall identify and meet with the responsible county or local authority responsible for publicly owned drain tiles. Publicly owned drain tiles shall be identified and documented onto Keystone's 1" = 2000' USGS quad strip maps and additional data collected for input into an electronic spreadsheet by county; township, range, and section; responsible agency; and size, type, and depth of cover (if known). This data shall be cross referenced to the centerline survey to be completed by Keystone. Additionally, any public records including maps or easement instruments on the drain tiles shall be acquired as well as any requirements of the local authority for installation of the Keystone pipeline.

5.2.2 Privately Owned Drain Tiles

Right-of-way agents shall meet with Landowners and tenants of privately owned land along Keystone's pipeline route. As a minimum, the right-of-way agents shall ascertain the data concerning drain tiles outlined on a Landowner questionnaire. The questionnaire requests data concerning type of drain tile system; size, type of material and depth of cover; preference for repair of drain tiles; and identification of local drain tile contractors. These data shall be collected into an electronic spreadsheet for utilization by right-of-way personnel in negotiating payments for easements and damages and by engineering/construction personnel for inclusion in specifications for the construction contractor.

5.3 Mitigation of Damage to Drain Tile Systems

Keystone shall undertake mitigation measures to reduce damage to publicly and privately owned drain tile systems prior to and during installation of the pipeline.

5.3.1 Non-interference with Drain Tile

Keystone's pipeline shall be installed at a depth of cover and elevation to not interfere with the elevation and grade of existing drain tiles where practicable. Where not practicable, Keystone shall pursue alternative mitigation measures mutually acceptable to the Landowner and jurisdictional agencies. Typically, the pipeline shall be installed below the elevation of drain tiles with a minimum clearance of 12 inches. **Detail 25**, Typical ROW Layout/Soil Handling, represents a typical drain tile crossing by the pipeline with additional temporary work space to facilitate handling of topsoil and trench spoil created by the additional depth of cover for the pipeline.

5.3.2 Non-disturbance of Drain Tile Mains

Publicly owned and privately owned drain tile mains shall be identified through the processes identified in Section 5.2. Drain tile mains are essential to the overall drainage system of a land area and may cause the pipeline construction Contractor excessive pumping/dewatering of the pipe

trench unless temporarily repaired and maintained until permanently repaired.

Keystone shall review drain tile mains and consider their size, flow rate, type of material, depth of cover, and geographic location. If determined to be practicable and reasonable for construction, the drain tile main shall not be cut and repaired during mainline installation (a pipe section shall be left out and installed by a tie-in crew without damaging the drain tile main).

5.3.3 Relocation or Replacement of Existing Drain Tiles Prior to Construction

In many instances, drain tile systems that have been installed after the installation of adjacent existing pipelines, were installed with "headers" parallel to the existing pipeline with periodic jumpovers as depicted on **Detail 26**, Header/Main Crossovers of Keystone Pipeline. The distance of these headers from the existing pipeline may vary.

Some of these drain tile headers may be most effectively relocated and/or replaced to the east of the Keystone pipeline and the existing header capped and made into a single drain tile as depicted on **Detail 27**, Relocate/Replace Drainage Header/Main. This could reduce the number of drain tile crossings on a particular Landowner by a significant quantity, thereby reducing the risk that repairs will fail.

5.3.4 Future Drain Tiles/Systems

Personnel shall attempt to determine where public agencies and private Landowners or tenants are proposing to install drain tile systems in the future to the extent possible. These locations shall be input into an electronic spreadsheet by county; township, range, and section; Landowner or responsible public agency; and proposed size and depth of cover. Keystone shall endeavor to construct the pipeline at a depth and elevation to accommodate the future installation of the proposed drain tile systems.

5.3.5 Other Mitigation Measures

Other mitigation measures that may be implemented during installation of the pipeline are as follows:

- Not removing topsoil from the working side of the construction right-of-way to prevent crushing of drain tile by heavy equipment
- Spreading ditch and spoil side topsoil (not subsoil) over the working side to provide additional soil depth to protect existing drain tiles.
- The Contractor shall restrict the work, if practicable, of the pipe lower-in crew if ground conditions are too wet to adequately support the heavy equipment.
- Travel of heavy equipment shall be limited to the working lane of the construction right-of-way where possible.

- Travel of heavy equipment shall be limited to one pass over the drain tile per work crew where possible.
- Should tile be crushed on the working side of the right of way, the topsoil would be removed and replaced during the drain tile replacement.

5.4 Responsibility for Repair of Drain Tile Systems

Temporary and permanent drain tile repairs shall be the responsibility of the Contractor. The physical repairs shall be made by qualified and experienced drain tile repair personnel.

5.4.1 Local Drain Tile Contractor Repair

Keystone shall identify and qualify local drain tile contractors in the geographical area of the pipeline route from interviews with local public officials and Landowners/tenants as well as the drain tile contractors. The preferred responsibility for permanent repair of drain tiles shall be for the pipeline Contractor to subcontract the supervision and repair to local reputable drain tile contractors that are acceptable to the local Landowners/tenants.

5.4.2 Pipeline Contractor Repair

In the event local drain tile contractors are not available to subcontract the supervision and repair, responsibility for permanent repair shall be with the pipeline contractor's supervision, equipment, and labor.

5.4.3 Landowner/Tenant Repair

Keystone shall allow the Landowner or tenant responsibility for the permanent repair of his drain tiles if requested during negotiations for the easement and if not precluded by jurisdictional regulatory agencies. The Landowner/tenant shall be requested to ensure their ability to coordinate and complete the drain tile repair in a timely manner to accommodate the pipeline Contractor to allow the pipeline Contractor to completely backfill the damaged drain tile for repair by Landowner/tenant in the immediate future. Keystone shall require that its representative be present to ensure the permanent drain tile repairs are made in accordance with the minimum requirements of this manual.

5.5 Drain Tile Repairs

The Contractor shall endeavour to locate all tile lines within the construction right-of-way prior to and during the pipeline's installation so repairs can be made if necessary.

5.5.1 Temporary Repairs During Construction

Drain tiles damaged/cut by excavation of the pipeline trench shall be marked with a lath and ribbon in the spoil bank. Care shall be taken to locate markers where the chance of disturbance shall be minimized and a written record maintained of each drain tile crossing. A work crew following the pipeline trench crew shall complete a temporary repair to allow continuing flow. **Detail 28**, Temporary Drain Tile Repair, depicts the materials and installation to complete the temporary repair. If a drain tile

line shall not be temporarily repaired, the open ends of the drain tile shall be screened to prevent entry of foreign materials and small animals.

5.5.2 Permanent Repairs

Permanent repairs shall be made for all drain tiles damaged by installation of the pipeline.

5.5.2.1 Ditch Line Only Repairs

If water is flowing through a damaged tile line, the tile line shall be immediately and temporarily repaired until such time that permanent repairs can be made. If tile lines are dry and water is not flowing, temporary repairs are not required if the permanent repair is made within 7 days of the time damage occurred. The temporary repair shall be removed just prior to lowering-in the pipeline.

Drain tiles must be permanently repaired before the pipeline trench is backfilled and within 14 days of construction completion, weather and soil conditions permitting. All tile lines shall be repaired with materials of the same or better quality as that which was damaged. The drain tile marker shall not be removed until the tile repairs have been inspected, approved, and accepted by Keystone's inspectors, the Counties' inspectors, where applicable, and/or the Landowner or tenant. **Detail 29**, Permanent Repair Method of Drain Tiles, depicts the minimum materials and installation to complete a permanent repair.

5.5.2.2 Ditch Line and Temporary Work Space Repairs

Prior to making the permanent drain tile repair, the Contractor shall probe a segmented sewer rod with a plug that is not more than 15% smaller than the internal diameter of the drain tile to determine if additional damage has occurred to the drain tile. If the probe does not freely insert into the drain tile across the temporary workspace of pipeline construction, the Contractor shall excavate, expose and repair the damaged drain tile to its original or better condition.

5.6 Inspection/Acceptance of Drain Tile Repairs

Drain tile repairs shall be inspected by Keystone pipeline construction inspectors, County inspectors, as applicable, and the Landowner or tenant or their representative.

Keystone pipeline shall designate inspector(s) for the sole purpose and responsibility for inspection of repair of drain tiles. These inspectors shall be, if possible, employed from local drain tile installation contractors, local farmers with extensive drain tile experience, or previously employed or retired employees of local

jurisdictions familiar with drain tile installation and repair. In the event that a sufficient quantity of inspectors from the prior described sources are not available, Keystone shall conduct in-the-field training seminars on drain tile repair for additional inspection personnel.

Inspection personnel shall observe the permanent repair of all drain tiles to ensure utilization of the proper type and size of replacement drain tile; the drain tile is installed at the proper grade; the drain tile is properly supported; backfill beneath the drain tile is properly placed and compacted; and the replacement drain tile is properly tied into the existing drain tile. The inspections shall be documented on the Drain Tile Inspection Report Forms.

A drain tile repair shall not be accepted until Keystone's construction inspector AND the Landowner or tenant or their designated representative approves the inspection form.

6.0 WETLAND CROSSINGS

6.1 General

Aboveground facilities shall not be located in a wetland, except where the location of such facilities outside of wetlands would preclude compliance with U.S. Department of Transportation pipeline safety regulations.

Wetland boundaries shall be clearly marked in the field with signs and/or highly visible flagging during construction.

In the event a waterbody crossing is located within or adjacent to a wetland crossing, the measures of Section 7 shall be implemented to the extent practicable.

A "dry" wetland typically has groundwater level existing some depth below the surface. Trench excavations are typically stable and normal in width. Equipment can traverse the wetland without the support of mats or timber rip-rap.

A "standard" wetland environment typically has soils that are saturated and non-cohesive. Difficult trenching conditions are likely resulting in excessively wide trenches. In these wetland environmental types, supplemental support in the form of timber rip-rap or prefabricated equipment mats may be required for construction equipment to safely and efficiently operate.

A "flooded" wetland involves the presence of standing water over much of the wetland area. Equipment typically cannot traverse the wetland and must generally move around that portion of the area. Access is typically limited to marsh backhoes or equipment working from flexi floats or equivalent.

Keystone may allow modification of the following specifications as necessary to accommodate site specific conditions or procedures. Any modifications must still comply with all applicable regulations and permits.

6.2 Easement and Workspace

The Contractor shall maintain wetland boundary markers in place during construction in all areas and until permanent seeding are completed in non-cultivated areas.

The width of the construction right-of-way shall be reduced to 85 feet or less in "standard" wetlands unless non-cohesive soil conditions require utilization of a greater width.

The Contractor shall locate all extra work areas (such as staging areas and additional spoil storage areas) at least 10 feet away from wetland boundaries, where topographic conditions permit.

The Contractor shall limit clearing of vegetation between extra work areas and the edge of the wetland to the construction right-of-way and limit the size of extra work areas to the minimum needed to construct the wetland crossing.

6.3 Vehicle Access and Equipment Crossing

The only access roads, other than the construction right-of-way, that the Contractor shall use in wetlands are those existing roads shown on the Construction Drawings.

The Contractor's construction equipment operating in saturated wetlands or wetlands with standing water shall be limited to that needed to clear the construction right-of-way, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the construction right-of-way to the extent practicable

If equipment must operate within a wetland containing standing water or saturated soils, the Contractor shall use the following methods for equipment access unless otherwise approved by Keystone based on site specific conditions:

- Wide-track or balloon-tire construction equipment.
- Conventional equipment operated from timber and slash (riprap) cleared from the right of way, timber mats, or prefabricated equipment mats

6.4 Temporary Erosion and Sediment Control

The Contractor shall install sediment barriers across the entire construction right-of-way immediately upslope of the wetland boundary at all standard wetland crossings, as necessary, to prevent sediment flow into the wetland. Sediment barriers must be properly maintained by the Contractor throughout construction and reinstalled as necessary. In the travel lane, these may incorporate removable sediment barriers or driveable berms. Removable sediment barriers can be removed during the construction day, but shall be re-installed after construction has stopped for the day and/or when heavy precipitation is imminent The Contractor shall maintain sediment barriers until replaced by permanent erosion controls or restoration of adjacent upland areas is complete. The

Contractor shall not install sediment barriers at wetlands designated as “dry” unless otherwise specified by Keystone.

Where standard wetlands are adjacent to the construction right-of-way, the Contractor shall install sediment barriers along the edge of the construction right-of-way as necessary to prevent a sediment flow into the wetland.

6.5 Wetland Crossing Procedures

The following general mitigative procedures shall be followed by the Contractor in all wetlands unless otherwise approved or directed by Keystone based on site specific conditions. However, all work shall be conducted in accordance with applicable permits.

- Minimizing the duration of construction-related disturbance within wetlands to the extent practicable.
- Attempting to use no more than two layers of timber riprap to stabilize the construction right-of-way.
- Cutting vegetation off at ground level leaving existing root systems in place and remove it from the wetland for disposal.
- Limiting pulling of tree stumps and grading activities to directly over the trench line. Not grading or removing stumps or root systems from the rest of the construction right-of-way in wetlands unless safety-related construction constraints require removal of tree stumps from under the working side of the construction right-of-way.
- Segregating the top 12 inches of topsoil from the area disturbed by trenching in standard wetlands, where practicable. After backfilling is complete, restoring topsoil to its approximate original stratum.
- Dewatering the trench in such a manner that does not cause erosion and heavily silt-laden water does not flow directly into any wetland or waterbody.
- The Contractor shall avoid sand blasting in wetlands to the extent practicable. If sandblasting is performed within a wetland, the Contractor shall place a tarp or suitable material in such a way as to collect as much waste shot as possible and dispose of the collected waste. The Contractor shall clean up all visible deposits of wastes and dispose of the waste at an approved disposal facility.
- Removing all timber riprap and prefabricated equipment mats upon completion of construction.
- Locating hydrostatic test manifolds outside wetlands and riparian areas to the maximum extent practicable.
- Locating hydrostatic test manifolds outside wetlands and riparian areas to the maximum extent practicable.
- Not storing hazardous materials, chemicals, fuels, lubricating oils, or perform concrete coating activities in a wetland, or within 100 feet of any wetland boundary.
- Attempting to refuel all construction equipment in an upland area at least 100 feet from a wetland boundary. If construction equipment must be refueled in a wetland or within 100 feet of any wetland boundary, follow the procedures outlined in Section 3.

- Where the pipeline trench may drain a wetland, the Contractor shall construct trench breakers and/or seal the trench to maintain the original wetland hydrology.
- After backfilling is complete, restoring the segregated topsoil to its approximate original location over the trench.

Specific procedures for each type of wetland crossing method are listed below and shall be designated on the Construction Drawings but may be modified depending on site conditions at the time of construction. However, all work shall be conducted in accordance with applicable permits.

6.5.1 "Dry" Wetland Crossing Method

Topsoil shall be segregated. Pipe stringing and fabrication may occur within the wetland adjacent to the trench line or adjacent to the wetland in a designated extra workspace.

The "dry" wetland crossing procedure depicted in **Detail 8** shall be used where this type of wetland is identified on the Construction Drawings. The following are exceptions to "standard" wetland crossing methods:

- The width of the construction right-of-way for upland construction is maintained through the wetland.
- Where extra work areas (such as staging areas and additional spoil storage areas) are designated on the Construction Drawings, they may be placed no closer than 10 feet from the wetland's edge.
- Sediment barriers are not required across or along the edges of the construction right-of-way.
- If the wetland is cultivated, the topsoil shall be stripped using the trench and spoil side method at the same depth as the adjacent upland areas
- Seeding requirements for agricultural lands shall be applied to farmed wetlands.

6.5.2 "Standard" Wetland Crossing Method

Topsoil stripping is impracticable due to the saturated nature of the soil. Pipe stringing and fabrication may occur within the wetland adjacent to the trench line or adjacent to the wetland in a designated extra workspace. Based upon the length of a standard wetland crossing and presence of sufficient water to float the pipe, the Contractor may elect to install a standard wetland crossing utilizing the “push/pull” method.

The standard wetland crossing procedure depicted in **Detail 9** shall be used where this type of wetland is identified on the Construction Drawings.

Procedures unique to standard wetlands include:

- Limiting construction right of way width to a maximum of 85 feet unless site conditions warrant a wider width
- Utilizing low ground pressure construction equipment or support equipment on timber rip rap or timber mats
- Installing sediment barriers across the entire right of way where the right of way enters and exits the wetland

6.5.3 Flooded "Push/Pull" Wetland Crossing Method

In these wetlands, standing surface water or high groundwater levels are present. Difficult trenching conditions may exist, and trench widths of up to 35 feet are common. Topsoil stripping is impossible due to the flooded conditions. Pipe stringing and fabrication is required adjacent to the wetland in a designated extra workspace. And the pipe pushed and/or pulled with floatation into place.

The "Push/Pull" Wetland crossing procedure as depicted in **Detail 10** shall be used where water is sufficient to float the pipeline in the trench and other site conditions allow.

Clean metal barrels or styrofoam floats may be used to assist in the flotation of the pipe. Metal banding shall be used to secure the barrels or floats to the pipe. All barrels, floats and banding shall be recovered and removed upon completion of lower-in. Back fill shall not be allowed before recovery of barrels, floats and banding.

6.6 Restoration and Reclamation

All timber riprap, timber mats, and prefabricated equipment mats shall be removed upon completion of construction. The Contractor shall replace topsoil, as applicable, and spread to its original contours in the wetland as possible with no crown over the trench. Any excess spoil shall be removed from the wetland. The Contractor shall stabilize wetland edges and adjacent upland areas by establishing permanent erosion control measures and re-vegetation, as applicable, during final clean up.

For each standard wetland crossed, the Contractor shall install a permanent slope breaker and trench breaker at the base of slopes near the boundary between the wetland and adjacent upland areas. The Contractor shall locate the trench breaker immediately upslope of the slope breaker.

In the absence of detailed re-vegetation plans or until the appropriate seeding season for permanent wetland vegetation in standard wetlands, the Contractor shall apply a temporarily cover crop on the construction right-of-way at a rate adequate for germination and ground cover using annual ryegrass or oats unless standing water is present. The Contractor shall apply the temporary cover crop during final clean up. For farmed wetlands, apply seeding requirements for agricultural lands or as required by the Landowner.

The Contractor shall not use fertilizer, lime or mulch in wetlands unless required in writing by the appropriate land management or state agency.

6.7 Operations and Maintenance

Vegetation maintenance shall not be conducted over the full width of the permanent right-of-way in wetlands. However, to facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 30 feet wide may be maintained in an herbaceous state. In addition, trees within 30 feet of the pipeline greater than 15 feet in height may be selectively cut and removed from the permanent right-of-way.

Herbicides and pesticides shall not be used in or within 100 feet of a wetland except as allowed by the appropriate land management agency or state agency.

The success of wetland re-vegetation shall be monitored after construction until wetland re-vegetation is successful except in circumstances where property is purchased and developed.

Wetland re-vegetation shall be considered successful if the cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in adjacent wetland areas that were not disturbed by construction. If re-vegetation is not successful at the end of 3 years, a remedial re-vegetation plan shall be developed in consultation with a professional wetland ecologist to actively re-vegetate the wetland. Re-vegetation efforts shall continue until wetland re-vegetation is successful.

7.0 WATERBODIES AND RIPARIAN LANDS

7.1 General

The Contractor shall comply with requirements of all permits issued for the waterbody crossings by Federal, State or local agencies.

"Waterbody" includes any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing, and other permanent waterbodies such as ponds and lakes:

- "Minor Waterbody" includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction.
- "Intermediate Waterbody" includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of construction.
- "Major Waterbody" includes all waterbodies greater than 100 feet wide at the water's edge at the time of construction.

In the event a waterbody crossing is located within or adjacent to a wetland crossing, the Contractor shall implement the provisions of Section 6, Wetland Crossings, to the extent practicable.

The Contractor shall supply and install advisory signs in a readily visible location along the construction right-of-way, a distance of approximately 100 feet on each

side of the crossing and on all roads which provide direct construction access to waterbody crossing sites. Signs shall be supplied, installed, maintained and then removed upon completion of the project. Additionally, signs shall be supplied and installed by the Contractor on all intermediate and major waterbodies accessible to recreational boaters warning boaters of pipeline construction operations.

The Contractor shall not store hazardous materials, chemicals, fuels, lubricating oils, or perform concrete coating within approximately 100 feet of any waterbody. The Contractor shall not refuel construction equipment within 100 feet of any waterbody. If the Contractor must refuel construction equipment within 100 feet of a waterbody, it must be done in accordance with the requirements outlined in Section 3.

Throughout construction, the Contractor shall maintain adequate flow rates to protect aquatic life and to prevent the interruption of existing downstream uses.

Keystone may allow modification of the following specifications as necessary to accommodate specific situations or procedures. Any modifications must comply with all applicable regulations and permits.

7.2 Easement and Work Space

The permanent easement, temporary work space, additional temporary work space and any special restrictions shall be depicted on the Construction Drawings. The work shall be contained within these areas and be limited in size to the minimum required to construct the waterbody crossing.

The Contractor shall locate all extra work areas (such as staging areas and additional spoil storage areas) at least 10 feet from the water's edge if practicable.

At all waterbody crossings, the Contractor shall install flagging across the construction right-of-way at least 10 feet from the banks prior to clearing and ensure that riparian cover is maintained where practicable during construction.

7.3 Vehicle Access and Equipment Crossings

The Contractor shall inspect equipment for fluid leaks prior to entering or crossing over waterbodies.

Equipment bridges are not required at minor waterbodies unless dry crossing procedures are specified or unless the waterbody supports a state designated fishery.

Equipment crossings shall be constructed as described in **Details 16, 17 and/or 18**.

Equipment crossings shall be perpendicular to drainage bottoms whenever possible.

The Contractor shall be responsible for the installation, maintenance and removal of all temporary access crossings including portable bridges, bridges made from timber or mats, flumes, culverts, sand bags, subsoil, or coarse granular material and riprap.

The Contractor shall ensure that culverts and flumes are sized and installed of sufficient diameter to accommodate the existing flow of water and those that may potentially be created by sudden runoffs. Flumes shall be installed with the inlet and outlet at natural grade if possible.

Where bridges, culverts or flumes are installed across the working area, the Contractor shall be responsible for maintaining them (e.g. preventing collapse, clogging or tilting). All flumes and culverts shall be removed as soon as possible upon completion of construction

The width of the temporary access road across culverts and flumes and the design of the approaches and ramps shall be adequate for the size of vehicle and equipment access required. The ramps shall be of sufficient depth and constructed to prevent collapse of the flumes, and the approaches on both sides of the flume shall be feathered.

Where culverts are installed for access and a waterbody is expected or possibly shall be constructed by the dry flume method, the culvert shall be of sufficient length to convey the stream flow through the construction zone.

The Contractor shall maintain equipment bridges to minimize soil from entering the waterbody.

7.4 Waterbody Crossing Methods

Construction methods pertinent to waterbody crossings are presented below. Selection of the most appropriate method at each crossing shall be depicted on the Construction Drawings but may be amended or changed based on site-specific conditions (i.e., environmental sensitivity of the waterbody, depth and rate of flow, subsurface soil conditions, site specific construction considerations, and the expected time and duration of construction) at the time of crossing. Each waterbody crossing shall be accomplished using one of the following construction methods:

- Non-flowing Open Cut Crossing Method - (**Detail 11**)
- Flowing Open Cut Crossing Method – Minor, Intermediate or Major Waterbody - (**Detail 12**)
- Flowing Open Cut Crossing – Dry Flume Method - (**Detail 13**)
- Flowing Open Cut Crossing – Dry Dam and Pump Method - (**Detail 14**)
- Horizontal Directional Drill Crossing - (**Detail 15**)
- Horizontal Bore Crossing - (**Detail 21**)

7.4.1 Non-flowing Open Cut Crossing Method

The Contractor shall utilize the Non-flowing Open Cut Crossing Method (**Detail 11**) for all waterbody crossings (ditches, gullies, drains, swales, etc.) with no perceptible flow at the time of construction. Should site conditions change and the waterbody is flowing at the time of construction, the Contractor shall install the crossing utilizing the flowing open cut crossing method unless otherwise approved by Keystone.

7.4.2 Flowing Open Cut Crossing Method of Minor, Intermediate and Major Waterbodies

For minor waterbody crossings, except where the flume method is used, the Contractor shall complete construction in the waterbody (not including blasting, if required) as shown on **Detail 12** within 24 hours if practicable.

For intermediate waterbodies, the Contractor shall attempt to complete trenching and backfill work within the waterbody (not including blasting if required) within 48 hours if practicable as shown on **Detail 12.**

The Contractor shall construct each major waterbody crossing in accordance with a Site Specific Plan as shown in the Construction Drawings. The Contractor shall complete in-stream construction activities as expediently as practicable.

7.4.3 Flowing Open Cut Crossing – Dry Flume Method

Where required, the Contractor shall utilize the Flowing Open Cut Crossing – Dry Flume Method as shown on **Detail 13** with the following "dry ditch" techniques:

- flume pipe shall be installed after blasting (if necessary), but before any trenching;
- sand bag or sand bag and plastic sheeting diversion structure or equivalent shall be used to develop an effective seal and to divert stream flow through the flume pipe (some modifications to the stream bottom may be required in order to achieve an effective seal);
- flume pipe(s) shall be aligned to prevent bank erosion and streambed scour;
- flume pipe shall not be removed during trenching, pipe laying, or backfilling activities, or initial streambed restoration efforts; and
- all flume pipes and dams that are not also part of the equipment bridge shall be removed as soon as final clean up of the stream bed and bank is complete

7.4.4 Flowing Open Cut Crossing – Dry Dam and Pump Method

Where specified in the construction drawings, the Contractor shall utilize the Flowing Open Cut Crossing – Dry Dam and Pump Method as shown

on **Detail 14**. The dam and pump crossing method shall meet the following performance criteria:

- sufficient pumps shall be used to maintain 1.5 times the flow present in the stream at the time of construction;
- at least one back up pump must be available on site;
- dams shall be constructed with materials that prevent sediment and other pollutants from entering the waterbody (e.g., sandbags or clean gravel with plastic liner);
- screen pump intakes shall be installed;
- streambed scour shall be prevented at pump discharge; and dam and pumps shall be monitored to ensure proper operation throughout the waterbody crossing.

7.4.5 Horizontal Directional Drill Crossings

Where required, the horizontal directional drill method **as shown on Detail 15** shall be utilized for designated major and sensitive waterbodies. The Contractor shall construct each directional drill waterbody crossing in accordance with a Site Specific Plan as shown in the Construction Drawings.

Drilling fluids and additives utilized during implementation of a directional drill shall be non-toxic to the aquatic environment.

The Contractor shall develop a contingency plan to address a frac-out during a directional drill. The plan shall include instructions for monitoring during the directional drill and mitigation in the event that there is a release of drilling fluids. Additionally, the waterbody shall be monitored downstream by the Contractor for any signs of drilling fluid.

The Contractor shall dispose of all drill cuttings and drilling mud at a Keystone-approved location. Disposal options may include spreading over the construction right-of-way in an upland location approved by Keystone, hauling to an approved licensed landfill, or other site approved by Keystone.

7.4.6 Horizontal Bore Crossings

Where required, the horizontal bore method **as shown on Detail 21** shall be utilized for crossing waterbodies. The Contractor shall construct each horizontal bore waterbody crossing in accordance with a Site Specific Plan as shown in the Construction Drawings.

7.5 Clearing

Except where rock is encountered and at non flowing open cut crossings, all necessary equipment and materials for pipe installation must be on-site and assembled prior to commencing trenching in a waterbody. All staging areas for materials and equipment shall be located at least 10 feet from the waterbody

edge. The Contractor shall preserve as much vegetation as possible along the waterbody banks while allowing for safe equipment operation.

Clearing and grubbing for temporary vehicle access and equipment crossings shall be carefully controlled to minimize sediment entering the waterbody from the construction right-of-way.

Clearing and grading shall be performed on both sides of the waterbody prior to initiating any trenching work. All trees shall be felled away from watercourses.

Plant debris or soil inadvertently deposited within the high water mark of waterbodies shall be promptly removed in a manner that minimizes disturbance of the waterbody bed and bank. Excess floatable debris shall be removed above the high water mark from areas immediately above crossings.

Vegetation adjacent to waterbodies which are to be installed by horizontal directional drill or boring methods shall not be disturbed except by hand clearing as necessary for drilling operations.

7.6 Grading

The construction right-of-way adjacent to the waterbody shall be graded so that soil is pushed away from the waterbody rather than towards it when possible.

In order to minimize disturbance to woody riparian vegetation within extra workspaces adjacent to the construction right-of-way at waterbody crossings, the Contractor shall minimize grading and grubbing of waterbody banks. Grubbing shall be limited to the ditchline plus an appropriate width to accommodate the safe installation of vehicle access and the crossing to the extent practicable.

7.7 Temporary Erosion and Sediment Control

The Contractor shall install sediment barriers across the entire construction right-of-way at all flowing waterbody crossings.

The Contractor shall install sediment barriers immediately after initial disturbance of the waterbody or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration of adjacent upland areas is complete.

Where waterbodies are adjacent to the construction right-of-way, the Contractor shall install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil and sediment within the construction right-of-way.

7.8 Trenching

The following requirements apply to all waterbody crossings except those being installed by the non-flowing open cut crossing method.

All equipment and materials shall be on site before trenching in the active channel of all minor waterbodies containing state designated fisheries, and in intermediate and major waterbodies. All activities shall proceed in an orderly manner without delays until the trench is backfilled and the stream banks stabilized. The Contractor shall not begin in-stream activity until the in-stream pipe section is complete and ready to be installed in the waterbody.

The Contractor shall use trench plugs at the end of the excavated trench to prevent the diversion of water into upland portions of the pipeline trench and to keep any accumulated upland trench water out of the waterbody. Trench plugs must be of sufficient size to withstand upslope water pressure.

The Contractor shall conduct as many in-stream activities as possible from the banks of the waterbodies. The Contractor shall limit the use of equipment operating in waterbodies to that needed to construct each crossing.

The Contractor shall place all spoil from minor and intermediate waterbody crossings, and upland spoil from major waterbody crossings in the construction right-of-way at least 10 feet from the water's edge or in additional extra work areas. No trench spoil, including spoil from the portion of the trench across the stream channel, shall be stored within a waterbody unless the crossing cannot be reasonably completed without doing so.

The Contractor shall install and maintain sediment barriers around spoil piles to prevent the flow of spoil into the waterbody.

Spoil removed during ditching shall be used to backfill the trench usually with a backhoe, clamshell or a dragline working from the waterbody bank. Sand, gravel, rockshield, or fill padding shall be placed around the pipe where rock is present in the channel bottom.

7.9 Pipe Installation

The following requirements apply to all waterbody crossings except those being installed by the non-flowing open cut crossing method.

A "free stress" pipe profile shall be used at all minor, intermediate, and major waterbodies with gradually sloping stream banks. The "box bend" pipe profile shall be used for intermittent and major waterbodies with steep stream banks.

The trench shall be closely inspected to confirm that the specified cover and that adequate bottom support can be achieved, and shall require Keystone approval prior to the pipe being installed. Such inspections shall be performed by visual inspection and/or measurement by a Keystone Representative. In rock trench, the ditch shall be adequately padded with clean granular material to provide continuous support for the pipe.

The pipe shall be pulled into position or lowered into the trench and shall, where necessary, be held down by weights, as-built recorded and backfilled immediately to prevent the pipe from floating.

The Contractor shall provide sufficient approved lifting equipment to perform the pipe installation in a safe and efficient manner. As the coated pipe is lowered in, it shall be prevented from swinging or rubbing against the sides of the trench. Only properly manufactured slings, belts and cradles suitable for handling coated pipe shall be used. All pipes shall be inspected for coating flaws and/or damage as it is being lowered into the trench. Any damage to the pipe and/or coating shall be repaired.

7.10 Backfilling

The following requirements apply to all waterbody crossings except those being installed by the non-flowing open cut crossing method.

Trench spoil excavated from waterbodies shall be used to backfill the trench across waterbodies.

After lowering-in has been completed, but before backfilling, the line shall be re-inspected to ensure that no skids, brush, stumps, trees, boulders or other debris is in the trench. If discovered, such materials or debris shall be removed from the trench prior to backfilling.

For each major waterbody crossed, the Contractor shall install a trench breaker at the base of slopes near the waterbody unless otherwise directed by Keystone based on site specific conditions. The base of slopes at intermittent waterbodies shall be assessed on-site and trench breakers installed only where necessary.

Slurred muck or debris shall not be used for backfill. At locations where the excavated native material is not acceptable for backfill or must be supplemented, the Contractor shall provide granular material approved by Keystone.

If specified in the Construction Drawings, the top of the backfill in the stream shall be armored with rock riprap or bio-stabilization materials as appropriate.

7.11 Stabilization and Restoration of Stream Banks and Slopes

The stream bank contour shall be re-established. All debris shall be removed from the streambed and banks. Stream banks shall be stabilized and temporary sediment barriers shall be installed within 24 hours of completing the crossing if practicable.

Approach slopes shall be graded to an acceptable slope for the particular soil type and surface run off controlled by installation of permanent slope breakers. Where considered necessary, the integrity of the slope breakers shall be ensured by lining with erosion control blankets.

Immediately following reconstruction of the stream banks, the Contractor shall install seed and flexible channel liners on waterbody banks as shown in **Detail 19**.

If the original stream bank is excessively steep and unstable and/or flow conditions are severe or if specified on the Construction Drawings, the banks

shall be stabilized with rock riprap, gabions, stabilizing cribs, or bio-stabilization measures to protect backfill prior to reestablishing vegetation.

Stream bank riprap structures shall consist of a layer of stone, underlain with approved filter fabric or a gravel filter blanket in accordance with **Detail 20**. Riprap shall extend from the stabilized streambed to the top of the stream bank, where practicable, native rock shall be utilized.

Bio-stabilization techniques which may be considered for specific crossings are shown in **Details 22, 23, and 24.**

The Contractor shall remove equipment bridges as soon as possible after final clean up.

8.0 HYDROSTATIC TESTING

8.1 Testing Equipment Location

The Contractor shall provide for the safety of all pipeline construction personnel and the general public during hydrostatic test operations by placing warning signs in populated areas.

The Contractor shall locate hydrostatic test manifolds 100 feet outside wetlands and riparian areas to the maximum extent practicable.

8.2 Test Water Source and Discharge Locations

Keystone is responsible for acquiring all permits required by federal, state and local agencies for procurement of water and for the discharge of water used in the hydrostatic testing operation. Keystone shall provide the Contractor with a copy of the appropriate withdrawal/discharge permit for hydrostatic test water. The Contractor shall keep the water withdrawal/discharge permit on site at all times during testing operations.

Any water obtained or discharged shall be in compliance with permit notice requirements and with sufficient notice for Keystone's Testing Inspector to make water sample arrangements prior to obtaining or discharging water. In some instances sufficient quantities of water may not be available from the permitted water sources at the time of testing. Withdrawal rates may be limited as stated by the permit. Under no circumstances shall an alternate water source be used without prior authorization from Keystone.

The Contractor shall be responsible for obtaining any required water analyses from each source to be used in sufficient time to have a lab analysis performed prior to any filling operations. The sample bottle shall be sterilized prior to filling with the water sample. The analysis shall determine the pH value and total suspended solids. Each bottle shall be marked with:

- Source of water with pipeline station number
- Date taken
- Laboratory order number

- Name of person taking sample

Staging/work areas for filling the pipeline with water shall be located a minimum of 50 feet from the waterbody or a wetland boundary if topographic conditions permit. The Contractor shall install temporary sediment filter devices adjacent to all streams that runoff may enter.

The Contractor shall screen the intake hose to prevent the entrainment of fish or debris. The hose shall be kept off the bottom of the waterbody. Refueling of construction equipment shall be conducted a minimum distance of 100 feet from the stream or a wetland. Pumps used for hydrostatic testing within 100 feet of any waterbody or wetland shall be operated and refueled in accordance with Section 3.

The Contractor shall maintain adequate flow rates in the waterbody to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

The Contractor shall not use chemicals in the test water. The Contractor shall not discharge any water containing oil or other substances that are in sufficient amounts as to create a visible color film or sheen on the surface of the receiving water.

Potential hydrostatic water sources for the mainline and the Cushing Extension are as follows:

Table 1 – Mainline Drainage Basins and Water Sources

Drainage Basins & Water Sources	Approximate Location Where Pipeline Crosses Water Source (Mile Post)
Pembina River	7
Tongue River	17
Carter Creek	24
Branch Forest River	46
Sheyenne River	167
Logen Dam	290
Nat'l Wildlife Prod. Area	351
Rock Creek	358
Lutz Lake	363
Wolf Creek	387
James River	417
Missouri River	431
Elk Horn River	498
Shell Creek	527
Platte River	537
Big Blue River	568
West Fork Big Blue River	587
Big Blue River	652
Missouri River	743
Grand River	834
Mussel Fork River	850
Mussel Fork River	856
Silver Creek (East Fork)	865
South Fork Salt River	912
Culver River	972
Pardenne Creek Runs Into Miss. River	988
Mississippi River	1014
Cahokie Creek	1020
Shoal Creek	1048

Table 2 – Cushing Extension Drainage Basins and Water Sources

Drainage Basins & Water Sources	Approximate Location Where Pipeline Crosses Water Source (Mile Post)
Little Blue River	4.2
Republican River	52.1
Smokey Hill River	76.2
Cottonwood River	117.0
Whitewater River	158.0
Stewart Creek (0.3 mile upstream of Walnut River)	185.1
Arkansas River	206.1
Salt Fork Arkansas River	238.5
Cimarron River	284.4

Selected road, railroad, and river crossing pipe sections may be specified to be pre-tested for a minimum of 4 hours. The water for pre-testing of any road and railroad crossings shall be hauled by a tanker truck from an approved water source. Water for pre-testing of a river crossing may be hauled or taken from the respective river if it is an approved water source. Since the volume of water utilized in these pretests shall be relatively small, the water shall be discharged overland along the construction right-of-way and allowed to soak into the ground utilizing erosion and sediment control mitigative measures.

Selection of final test water sources will be determined based on site conditions at the time of construction and applicable permits.

8.3 Filling the Pipeline

After final positioning of the pipe, the Contractor shall fill the pipe with water. Pipe ends shall not be restrained during the fill. The fill pump shall be set on a metal catch pan of sufficient dimensions to contain all leaking lubricants or fuel and prevent them from entering the water source. The suction inlet must be placed in a screened enclosure located at a depth that shall not allow air to be drawn in with the water. The screened enclosure shall be such that the fill water is free of organic or particulate matter.

The Contractor shall provide a filter of the backflushing or cartridge type with a means of cleaning without disconnecting the piping. The filter shall have the specifications of 100 mesh screen. If the cartridge type is used, a sufficient quantity of cartridges shall be on hand at the filter location. The Contractor shall install the filter between the fill pump and the test header. The Contractor shall be responsible for keeping the backflush valve on the filter closed during the filling operation. The Contractor shall be responsible for the proper disposal of materials backflushed from the filter or filter cartridges. The Contractor shall not be allowed to backflush the filter into the stream or other water source.

During water-filling of the pipeline, the Contractor shall employ the use of fill pumps capable of injecting water into the pipeline at a maximum rate of approximately 0.7 to 1.0 mile per hour, except as limited by permits or the maintenance of adequate flow rates in the waterbody, as indicated approximately as follows:

Nominal OD	Max. GPM
30"	3000

The Contractor shall restrict flow rates if necessary to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

8.4 Dewatering the Pipeline

The Contractor shall comply with state-issued NPDES permits for discharging test water.

The Contractor shall not discharge any water containing oil or other substances that are in sufficient amounts as to create a visible color film on the surface of the receiving water.

The Contractor shall not discharge into state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate Federal, State, and local permitting agencies grant written permission.

The Contractor shall calculate, record and provide to Keystone the day, date, time, location, total volume, maximum rate and methods of all water discharged to the ground or to surface water in association with hydrostatic testing.

The Contractor shall regulate the pig velocity discharge rate (3000 gpm maximum), use energy dissipation device(s), and install sediment barriers, as necessary, to prevent erosion, streambed scour, suspension of sediments, or excessive stream flow. Water must be disposed of using good engineering judgment so that all federal, state, and local environmental standards are met. Dewatering lines shall be sufficient strength and be securely supported and tied down at the discharge end to prevent whipping during this operation.

To reduce the velocity of the discharge, The Contractor shall utilize an energy-dissipating device described as follows:

8.4.1 Splash Pup

A splash pup consists of a piece of large diameter pipe (usually over 20" O.D.) of variable length with both ends partially blocked that is welded perpendicularly to the discharge pipe. As the discharge hits against the inside wall of the pup, the velocity is rapidly reduced and the water is allowed to flow out either end. A variation of the splash pup concept, commonly called a diffuser, incorporates the same design, but with capped ends and numerous holes punched in the pup to diffuse the energy.

8.4.2 Splash Plate

The splash plate is a quarter section of 36-inch pipe welded to a flat plate and attached to the end of a 6-inch discharge pipe. The velocity is reduced by directing the discharge stream into the air as it exits the pipe. This device is also effective for most overland type discharge.

8.4.3 Plastic Liner

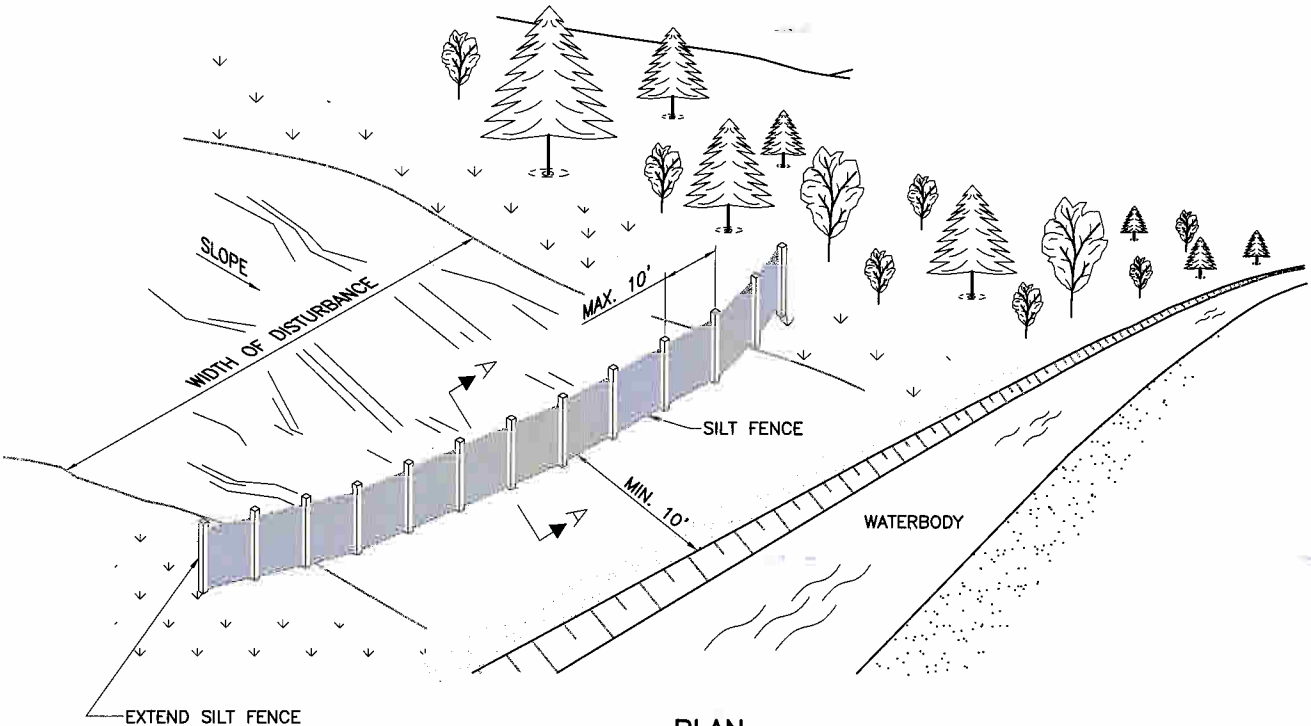
In areas where highly erodible soils exist or in any low flow drainage channel, it is a common practice to use layers of visqueen (or any of the new construction fabrics currently available) to line the receiving channel for a short distance. One anchoring method may consist of a small load of rocks to keep the fabric in place during the discharge.

8.4.4 Straw Bale Dewatering Structure

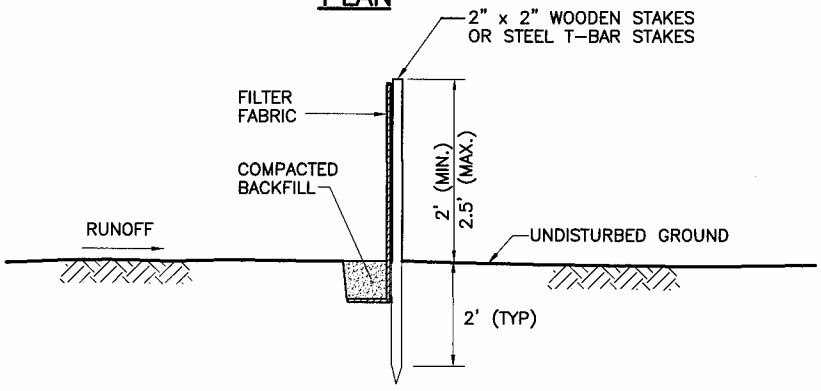
Straw bale dewatering structures are designed to dissipate and remove sediment from the water being discharged. Straw bale structures are used for on-land discharge of wash water and hydrostatic test water and in combination with other energy dissipating devices for high volume discharges. A straw bale dewatering structure is shown In Detail 6.

9.0 DRAWINGS AND FIGURES

Detail 1	Typical Silt Fence Barrier
Detail 2	Typical Straw or Hay Bale Barrier
Detail 3	Permanent Slope Breakers (Water Bars)
Detail 4	Erosion Control Matting Installation
Detail 5	Typical Dewatering Filter Bag
Detail 6	Typical Straw Bale Dewatering Structure
Detail 7	Typical Permanent Trench Breakers
Detail 8	”Dry” Wetland Crossing Method
Detail 9	Standard Wetland Crossing Method
Detail 10	Push/Pull Wetland Crossing Method
Detail 11	Non-Flowing Water Body Crossing Method
Detail 12	Typical Flowing Waterbody Crossing Method
Detail 13	Typical Dry Flume Crossing Method
Detail 14	Typical Dam & Pump Crossing
Detail 15	Typical Horizontal Drill (HDD) Site Plan & Profile
Detail 16	Typical Temporary Bridge Crossing
Detail 17	Typical Flume Bridge Crossing
Detail 18	Typical Railcar Bridge Crossing
Detail 19	Flexible Channel Liner Installation
Detail 20	Typical Rock Rip-Rap
Detail 21	Typical Road Bore Crossing
Detail 22	Streambank Reclamation – Brush Layer In Cross Cut Slope
Detail 23	Streambank Reclamation – Log Wall
Detail 24	Streambank Reclamation – Vegetated Geotextile Installation
Detail 25	Typical ROW Layout/Soil Handling
Detail 26	Header/Main Crossovers of Keystone Pipeline
Detail 27	Relocate/Replace Drainage Header/Main
Detail 28	Temporary Drain Tile Repair
Detail 29	Permanent Repair Method of Drain Tiles
Figure 1	Typical Site Specific Plan



PLAN



SECTION A–A

NOTES:

1. MATERIAL SHOULD BE WOVEN GEOTEXTILE FABRIC SUCH AS EXXON GTF 180 OR MIRAFI 600X, OR AN APPROVED EQUIVALENT. SECONDARY REINFORCEMENT, SUCH AS A CONSTRUCTION BARRIER FENCE OR WIRE MESH CAN ALSO BE USED BEHIND THE FILTER FABRIC.
2. SILT FENCE TO BE REINFORCED WITH 2" x 2" WOODEN STAKES OR STEEL T–BAR STAKES PLACED EVERY 8' OR CLOSER AS CONDITIONS REQUIRE.
3. ATTACH FILTER FABRIC AT EACH POST AT A MINIMUM OF 3 LOCATIONS.
4. THE FILTER FABRIC MINIMUM LENGTH OF 1' IS TO BE ANCHORED IN A TRENCH WITH WELL COMPACTED BACKFILL OVER THE FABRIC TO PREVENT UNDERMINING.
5. TO ELIMINATE POSSIBLE END FLOW, BOTH ENDS OF THE SILT FENCE SHALL BE TURNED AND EXTENDED UPSLOPE.
6. SILT FENCES ARE TO BE CHECKED AND MAINTAINED ON A REGULAR BASIS. REMOVE ANY BUILD–UP OF SEDIMENT.
7. WHERE ANCHORING CONDITIONS FOR THE SILT FENCE ARE POOR, PLACE STRAW BALES ON DOWNSTREAM SIDE OF THE SILT FENCE.
8. INSTALLATION TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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TYPICAL SILT FENCE BARRIER

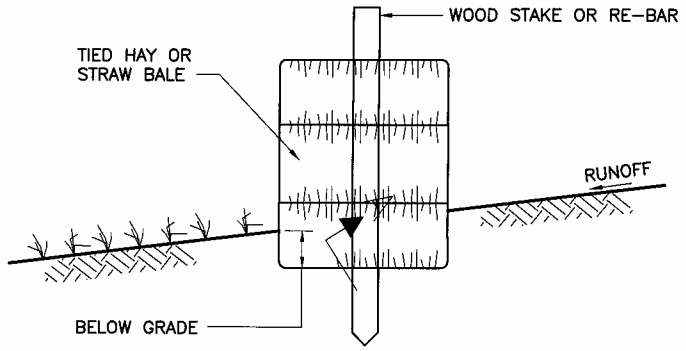
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DETAIL 1

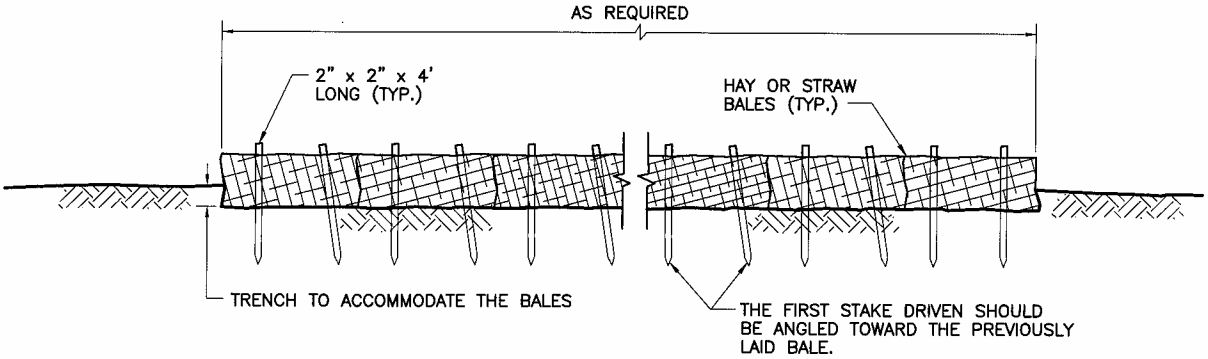
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SECTION



SECTION

NOTES:

1. TO ELIMINATE POSSIBLE END FLOW, BOTH ENDS OF THE STRAW BALE BARRIER SHOULD BE TURNED AND EXTENDED UPSLOPE.
2. EACH BALE SHOULD BE SECURED BY AT LEAST 2 STAKES. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE TO FORCE THE BALES TOGETHER. ANY GAPS CAN BE FILLED IN BY WEDGING LOOSE STRAW BETWEEN THE BALES. STAKES SHOULD BE DRIVEN. REBAR OR STANDARD "T" OR "U" STEEL POSTS CAN BE USED AS STAKES, BUT IT SHOULD BE NOTED THAT THEY MAY POSE A HAZARD TO EQUIPMENT IF THE BALES DISINTEGRATE.
3. COMPACT THE EXCAVATED SOIL AGAINST THE UPHILL SIDE OF THE BARRIER TO PREVENT PIPING.
4. STRAW OR HAY BALE BARRIERS REQUIRE CONTINUAL MAINTENANCE TO REMOVE COLLECTED SEDIMENT AND REPLACE DAMAGED BALES. PAY CLOSE ATTENTION TO THE REPAIR OF DAMAGED BALES, END RUNS AND UNDERCUTTING BENEATH BALES.
5. TO ELIMINATE POSSIBLE END FLOW, BOTH ENDS OF STRAW OR HAY BALE RUNS SHOULD BE TURNED AND EXTENDED UPSLOPE
6. INSTALLATION TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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TYPICAL STRAW OR HAY BALE BARRIER

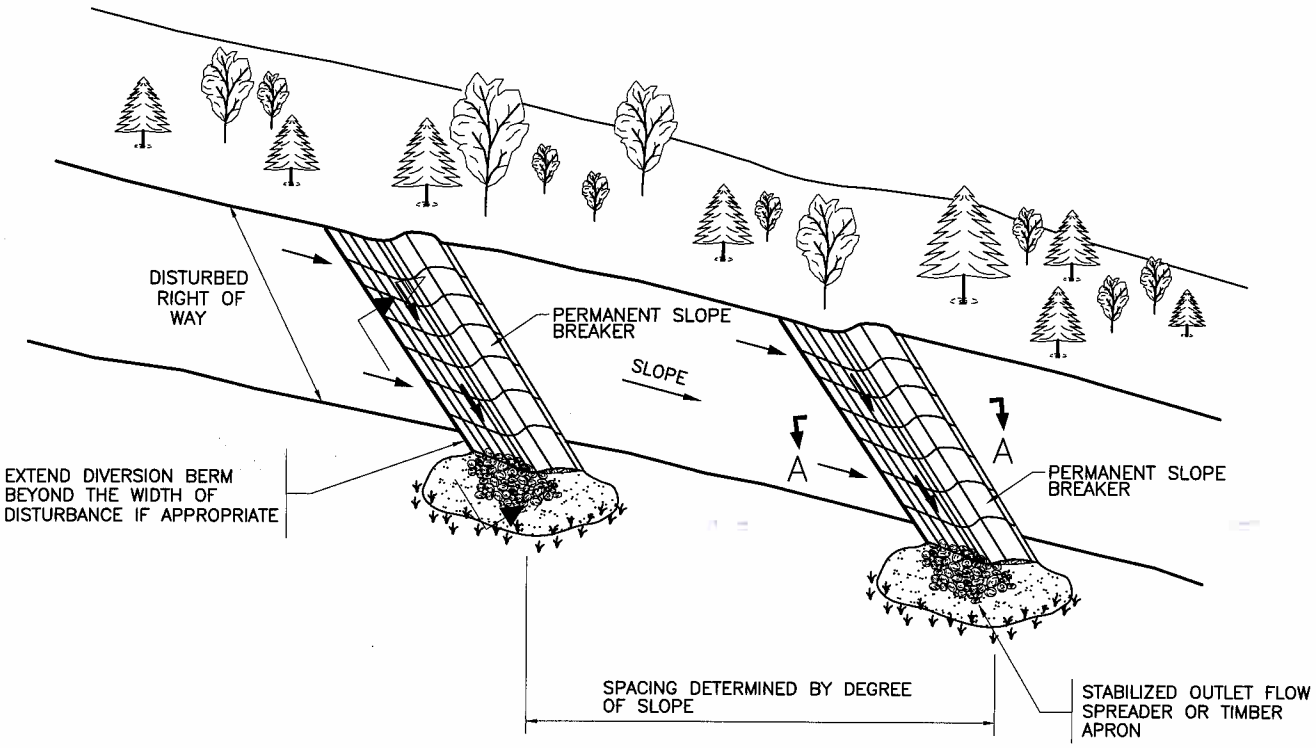
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DETAIL 2

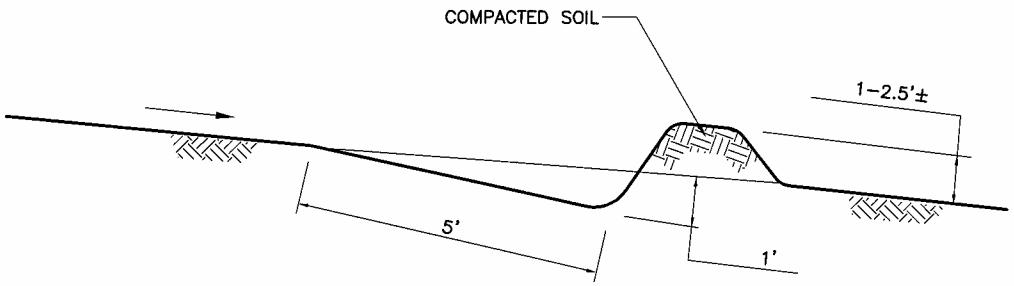
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SECTION



SECTION A–A

PERMANENT SLOPE BREAKER DETAIL

NOTES:

1. PERMANENT SLOPE BREAKERS TO PROVIDE POSITIVE DRAINAGE TO A STABILIZED OUTLET.
2. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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PERMANENT SLOPE BREAKERS (WATER BARS)

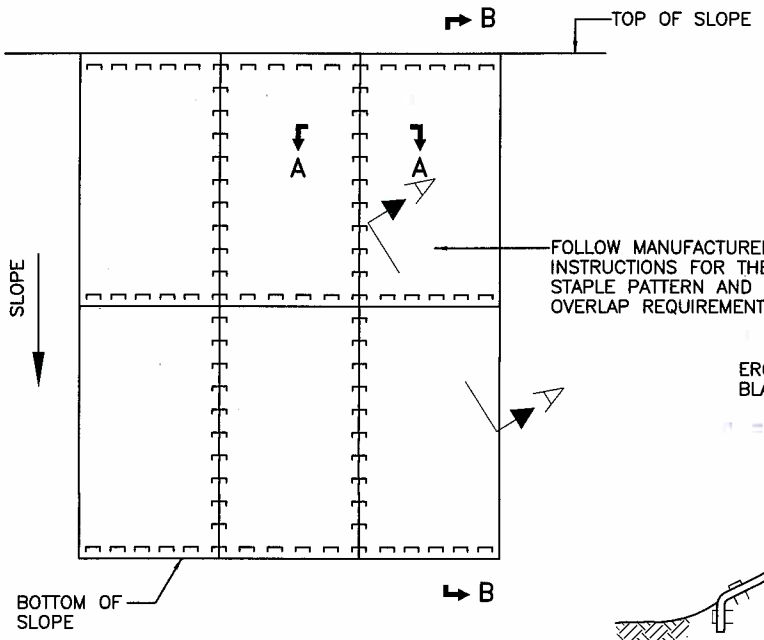
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DETAIL 3

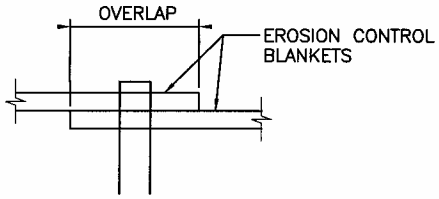
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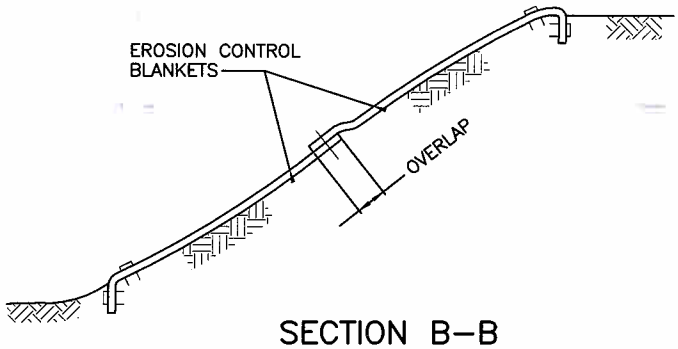
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PLAN VIEW



SECTION A–A



SECTION B–B

NOTES:

1. INSTALL MATTING IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
2. PREPARE SOIL BEFORE INSTALLING MATTING, INCLUDING GRADING, REMOVAL OF LARGE ROCKS AND DEBRIS, AND THE APPLICATION OF SEED AND FERTILIZER IF NOT USING PRE–SEEDED MATTING.
3. EROSION CONTROL MATTING SHALL EXTEND COMPLETELY ACROSS DISTURBED AREAS TO PROTECT ERODIBLE SURFACES.
4. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE MATTING IN A TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
5. ROLL THE MATTING DOWN THE SLOPE IN THE DIRECTION OF THE WATER FLOW.
6. AS AN ALTERNATIVE TO STAPLES, WOODEN STAKES CAN BE USED.
7. ENSURE COMPLETE CONTACT BETWEEN THE MATTING AND THE SLOPE FACE. ADDITIONAL STAPLES CAN BE USE TO ELIMINATE GAPS.
8. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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EROSION CONTROL MATTING INSTALLATION

NO.	REVISION	DATE
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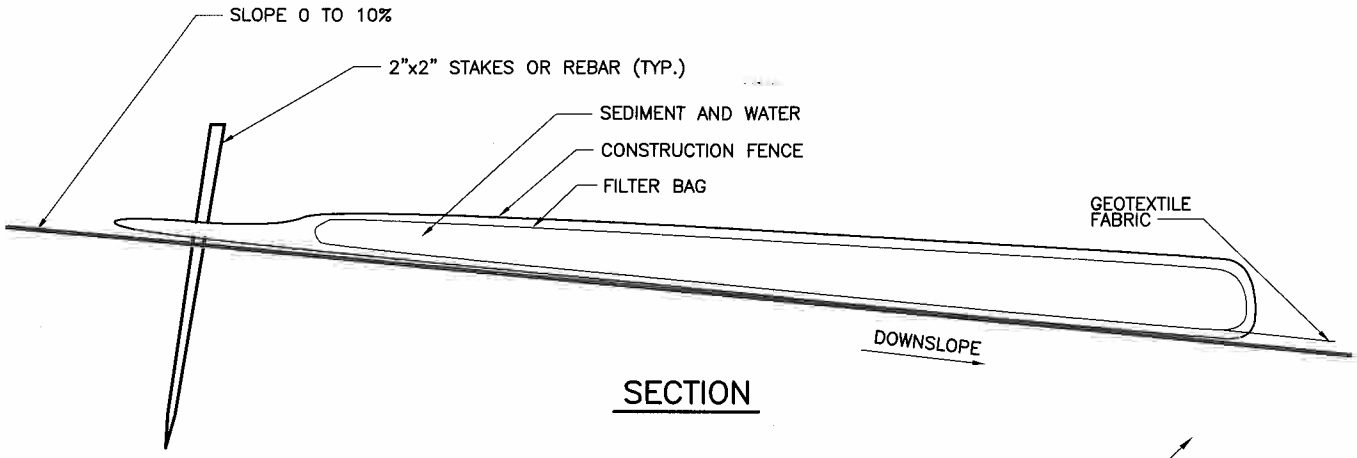
PROJECT: 50388E

DETAIL 4

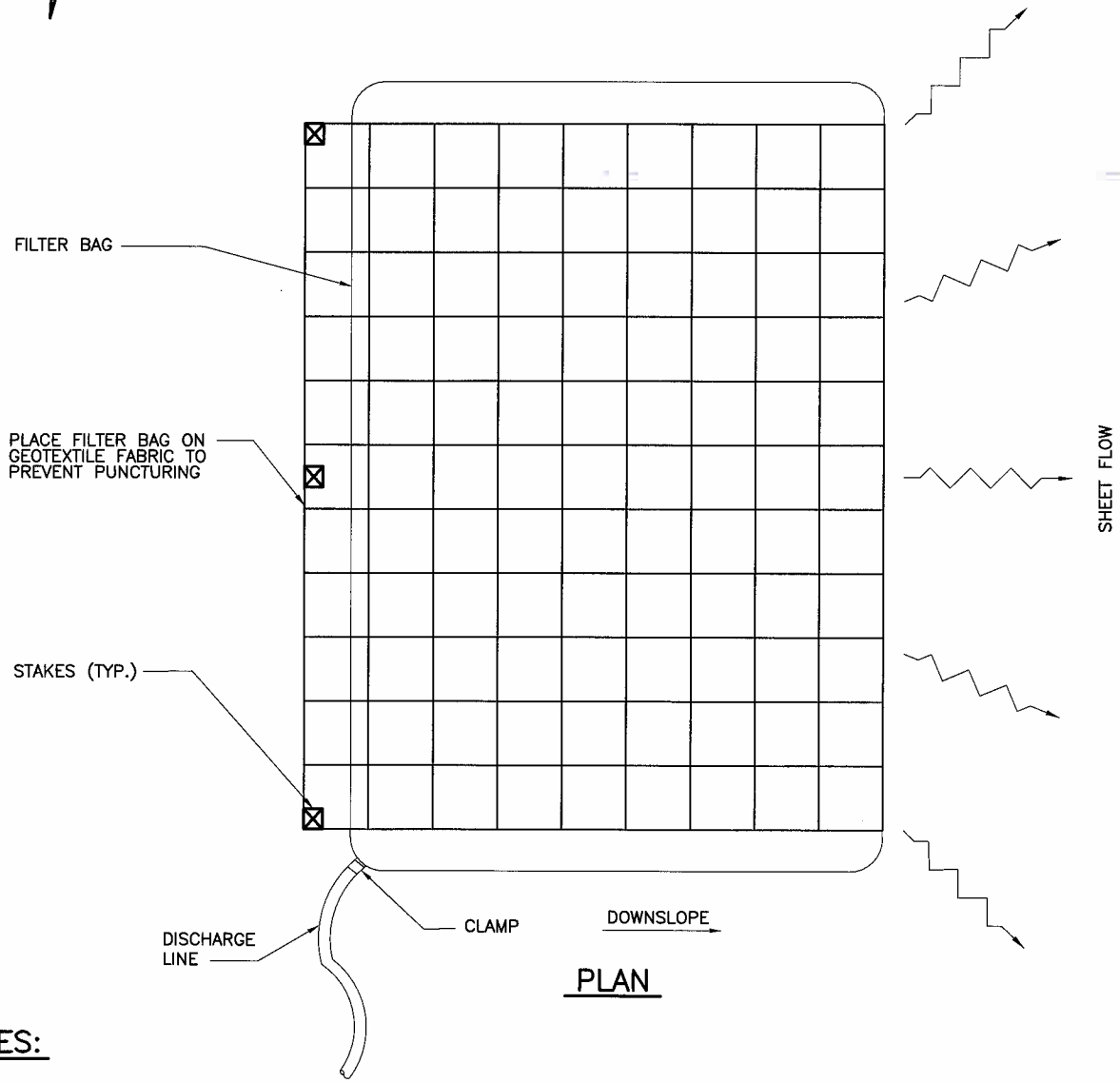
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K-00-P-7000-300	ALS	JTG	RG

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SECTION



PLAN

NOTES:

1. MANUFACTURED FILTER BAGS ARE A SUITABLE ALTERNATIVE TO STRAW BALE STRUCTURES FOR TRENCH DEWATERING. FILTER BAGS SHALL BE INSTALLED AS SPECIFIED BY THE MANUFACTURER.
2. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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TYPICAL DEWATERING FILTER BAG

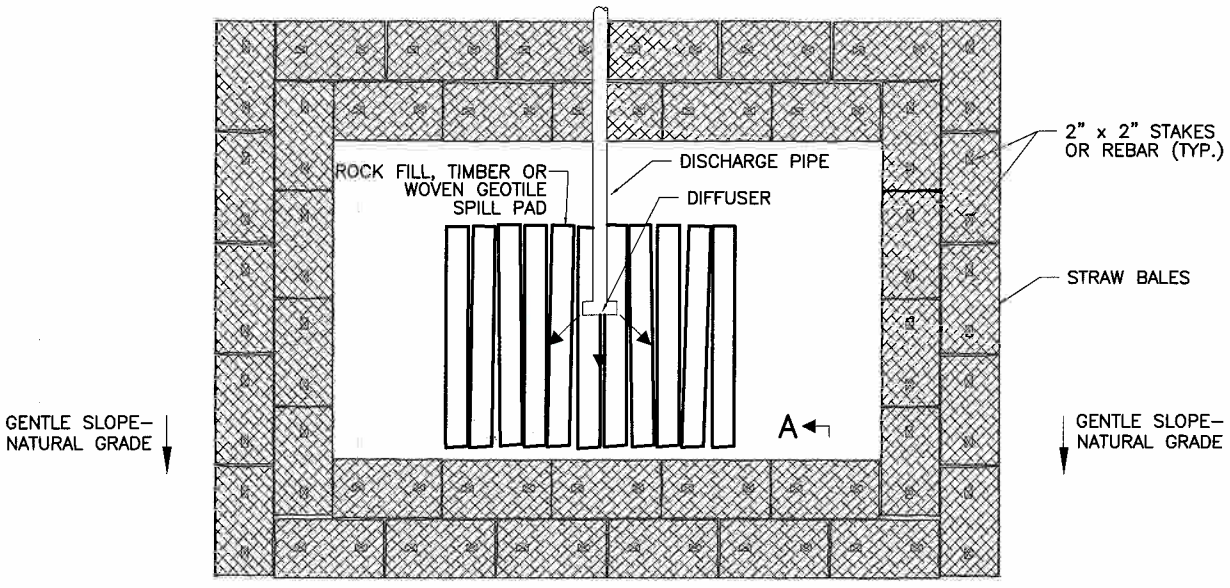
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DETAIL 5

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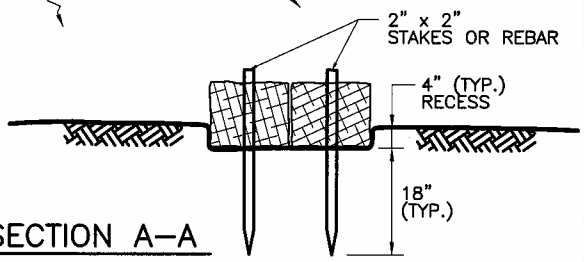
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PLAN

SCALE: N.T.S.



SECTION A–A

NOTES:

1. INSTALL A STRAW BALE DEWATERING STRUCTURE WHEREVER IT IS NECESSARY AND AS DIRECTED BY THE ENVIRONMENTAL INSPECTOR TO PREVENT THE FLOW OF HEAVILY SILT LADEN WATER INTO WATERBODIES OR WETLANDS.

2. DISCHARGE SITE SHOULD BE WELL VEGETATED AND LOCATED AT LEAST 50 FEET FROM ANY WATERBODY. THE TOPOGRAPHY OF THE SITE SHOULD BE SUCH THAT WATER WILL FLOW INTO THE DEWATERING STRUCTURE AND AWAY FROM ANY WORK AREAS. THE AREA DOWNSLOPE FROM THE DEWATERING SITE MUST BE REASONABLY FLAT OR STABILIZED BY VEGETATION OR OTHER MEANS TO ALLOW THE FILTERED WATER TO CONTINUE AS SHEET FLOW.

3. DIRECT THE PUMPED WATER ONTO A STABLE SPILL PAD CONSTRUCTED OF ROCKFILL, WEIGHTED TIMBERS, OR A WOVEN GEOTEXTILE STAKED TO THE GROUND SURFACE, SUCH AS MIRAFI 600X, TERRAFIX 400W, OR A COMPANY APPROVED EQUIVALENT. BEYOND THE SPILL PAD FORCE THE DISCHARGE WATER INTO SHEET FLOW USING STRAW BALES AND THE NATURAL TOPOGRAPHY.

4. DISCHARGE RATES SHOULD BE SUCH THAT THE CAPACITY OF THE STRUCTURE WILL NOT BE EXCEEDED.

5. DISCHARGE WATER SHALL BE FORCED INTO SHEET FLOW IMMEDIATELY BEYOND THE SPILL PAD USING A COMBINATION OF STRAW BALES AND THE NATURAL TOPOGRAPHY. RECESS STRAW BALES. DRIVE TWO (2) STAKES OR REBAR INTO EACH BALE TO ANCHOR THEM IN PLACE.

6. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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TYPICAL STRAW BALE DEWATERING STRUCTURE

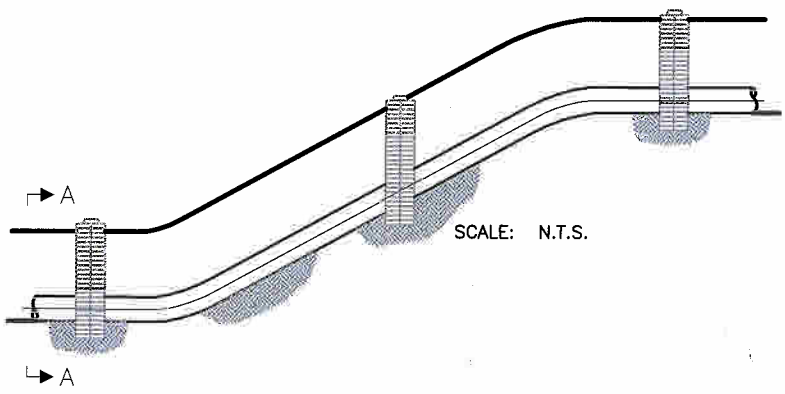
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DETAIL 6

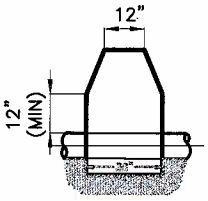
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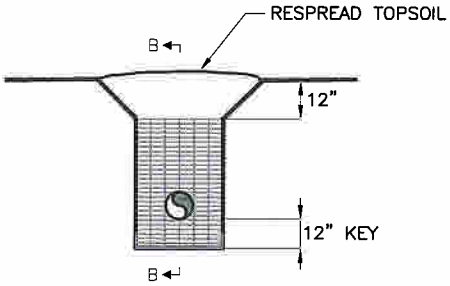
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SECTION
SCALE: N.T.S.



SECTION 'B–B'
SCALE: N.T.S.



SECTION 'A–A'
SCALE: N.T.S.

NOTES:

1. TRENCH BREAKERS TO BE INSTALLED AS SHOWN ON THE CONSTRUCTION DRAWINGS, WHERE DESCRIBED IN THE PLAN, AND AS DIRECTED BY KEYSTONE.

2. OPEN WEAVE HEMP OR JUTE SACKS SHALL BE FILLED WITH AN AVERAGE 55 LBS. MIXTURE OF:
   1) ONE (1) PART CEMENT AND SIX (6) PARTS SAND OR SUBSOIL, OR
   2) ONE (1) PART CEMENT, THREE (3) PARTS FLYASH, AND FIVE (5) PARTS SAND OR SUBSOIL
   3) SAND
   WITH JUST SUFFICIENT WATER TO PERMIT MIXTURE TO EXUDE AND BOND SACKS TOGETHER. TOPSOIL IS NOT TO BE USED IN SACKS.

3. KEY EACH TRENCH BREAKER A MINIMUM OF ONE (1) FT. INTO BOTTOMS AND SIDES OF TRENCH.

4. FOAM TRENCH BREAKERS MAY BE USED IN LIEU OF SAND SACK TRENCH BREAKERS.

5. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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TYPICAL PERMANENT TRENCH BREAKERS

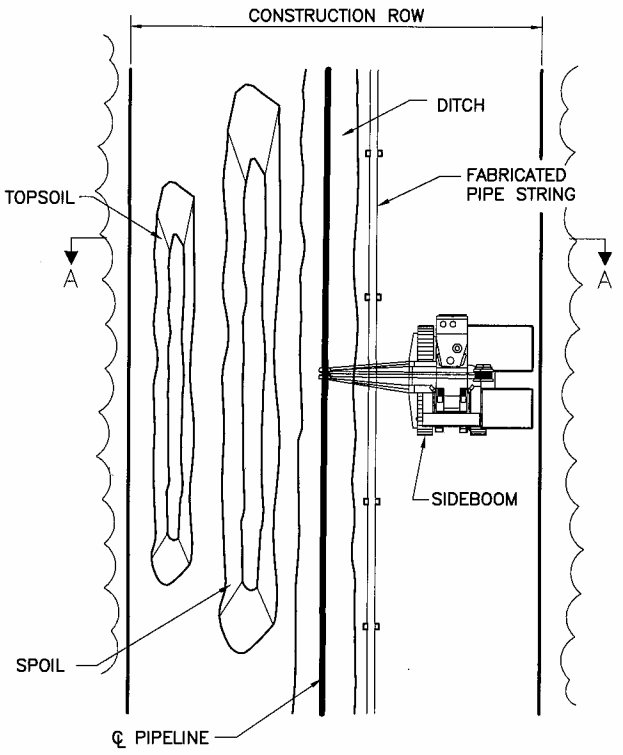
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DETAIL 7

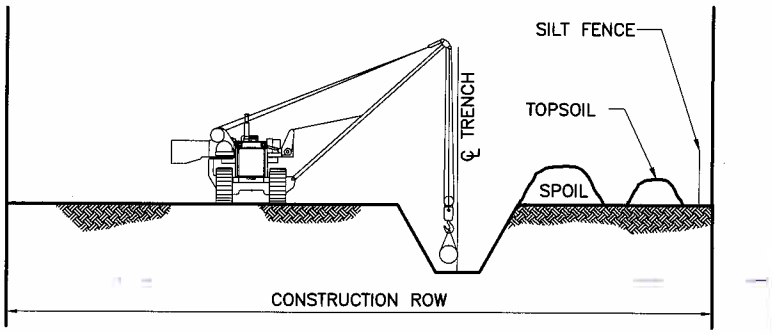
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PLAN VIEW



SECTION "A–A"

CONSTRUCTION PROCEDURES:

1. IF A WETLAND IS BEING CULTIVATED AND BEING FARMED, NO WETLAND CONSTRUCTION PROCEDURES ARE REQUIRED.
2. FLAG WETLAND BOUNDARIES PRIOR TO CLEARING.
3. NO REFUELING OF MOBILE EQUIPMENT IS ALLOWED WITHIN 100 FEET OF WETLAND. PLACE "NO FUELING" SIGN POSTS APPROXIMATELY 100 FEET BACK FROM WETLAND BOUNDARY. REFUEL STATIONARY EQUIPMENT AS PER KEYSTONE'S SPILL PREVENTION PROCEDURES.
4. INSTALL TEMPORARY SLOPE BREAKER UPSLOPE WITHIN 100 FEET OF WETLAND BOUNDARY IF DIRECTED BY KEYSTONE.
5. CONSTRUCT WHEN DRY, IF POSSIBLE. IF SITE BECOMES WET AT TIME OF TRENCHING, AVOID SOIL COMPACTION BY UTILIZING TIMBER RIP–RAP OR PREFABRICATED EQUIPMENT MATS.
6. AVOID ADJACENT WETLANDS. INSTALL SEDIMENT BARRIERS (STRAW BALES AND/OR SILT FENCE) AT DOWN SLOPE EDGE OF RIGHT–OF–WAY ALONG WETLAND EDGE IF EVIDENT, OTHERWISE INSTALL BARRIER ON BOTH EDGES.
7. RESTRICT ROOT GRUBBING TO ONLY THAT AREA OVER THE DITCHLINE AND REMOVE STUMPS FROM WETLAND FOR DISPOSAL.
8. CONDUCT TRENCH LINE TOPSOIL STRIPPING (IF TOPSOIL IS NOT SATURATED). SALVAGE TOPSOIL TO ACTUAL DEPTH OR A MAXIMUM DEPTH OF 12 INCHES,
9. TRENCH THROUGH WETLANDS.
10. PIPE SECTION TO BE FABRICATED WITHIN THE WETLAND AND ADJACENT TO ALIGNMENT, OR IN STAGING AREA OUTSIDE THE WETLAND AND WALKED IN.
11. LOWER–IN PIPE. PRIOR TO BACKFILLING TRENCH, IF REQUIRED, TRENCH PLUGS SHALL BE INSTALLED AS REQUIRED. BACKFILL TRENCH.
12. RESTORE GRADE TO NEAR PRE–CONSTRUCTION TOPOGRAPHY, REPLACE TOPSOIL AND INSTALL PERMANENT EROSION CONTROL.
13. IF UTILIZED, REMOVE TIMBER MATS OR PREFABRICATED MATS FROM WETLANDS UPON COMPLETION.

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"DRY" WETLAND CROSSING METHOD

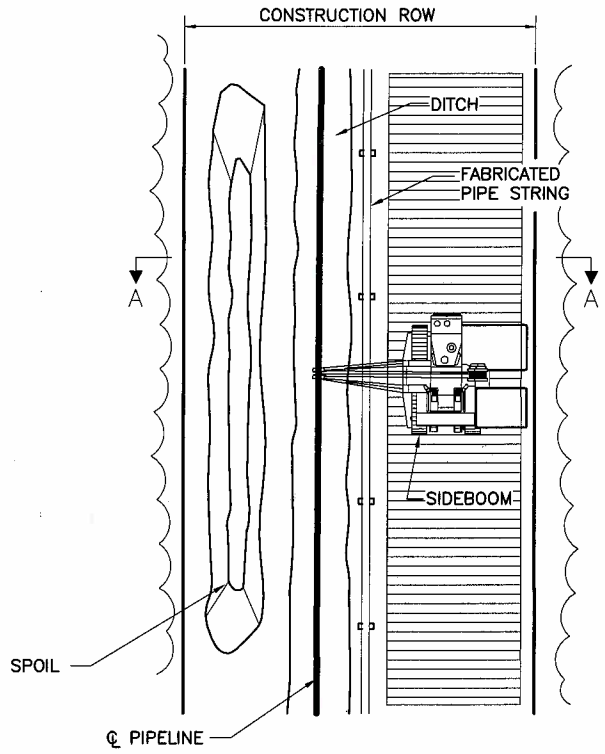
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DETAIL 8

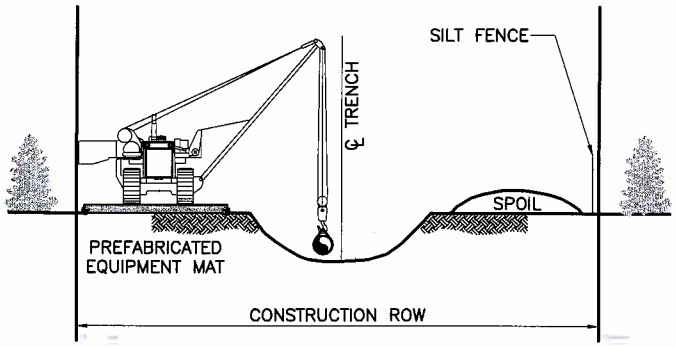
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PLAN VIEW



SECTION "A–A"

CONSTRUCTION PROCEDURES:

1. FLAG WETLAND BOUNDARIES PRIOR TO CLEARING.
2. NO REFUELING OF MOBILE EQUIPMENT IS ALLOWED WITHIN 100 FEET OF WETLAND. PLACE "NO FUELING" SIGN POSTS APPROXIMIATLY 100 FEET BACK FROM WETLAND BOUNDARY. REFUEL STATIONARY EQUIPMENT AS PER KEYSTONE'S SPILL PREVENTION PROCEDURES.
3. INSTALL TEMPORARY SLOPE BREAKER UPSLOPE WITHIN 100 FEET OF WETLAND BOUNDARY IF DIRECTED BY KEYSTONE.
4. INSTALL TIMBER MATS/RIP–RAP THROUGH ENTIRE WETLAND AREA. EQUIPMENT NECESSARY FOR RIGHT–OF–WAY CLEARING MAY MAKE ONE (1) PASS THROUGH THE WETLAND BEFORE MATS ARE INSTALLED.
5. AVOID ADJACENT WETLANDS. INSTALL SEDIMENT BARRIERS (STRAW BALES AND/OR SILT FENCE) AT DOWN SLOPE EDGE OF RIGHT–OF–WAY AND ALONG WETLAND EDGE AS REQUIRED.
6. RESTRICT ROOT GRUBBING TO ONLY THAT AREA OVER THE DITCHLINE AND DITCH SPOIL AREAS AND REMOVE FROM WETLAND FOR DISPOSAL.
7. TOPSOIL STRIPPING SHALL NOT BE REQUIRED IN SATURATED SOIL CONDITIONS.
8. LEAVE HARD PLUGS AT THE EDGE OF WETLAND UNTIL JUST PRIOR TO TRENCHING.
9. PIPE SECTION MAY BE FABRICATED WITHIN THE WETLAND AND ADJACENT TO ALIGNMENT, OR IN STAGING AREA OUTSIDE THE WETLAND AND WALKED IN.
10. TRENCH THROUGH WETLANDS.
11. LOWER–IN PIPE, INSTALL TRENCH PLUGS AT WETLAND EDGES AS REQUIRED AND BACKFILL IMMEDIATELY.
12. REMOVE TIMBER MATS OR PREFABRICATED MATS FROM WETLANDS UPON COMPLETION.
13. RESTORE GRADE TO NEAR PRE–CONSTRUCTION TOPOGRAPHY, REPLACE TOPSOIL AND INSTALL PERMANENT EROSION CONTROL.

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STANDARD WETLAND CROSSING METHOD

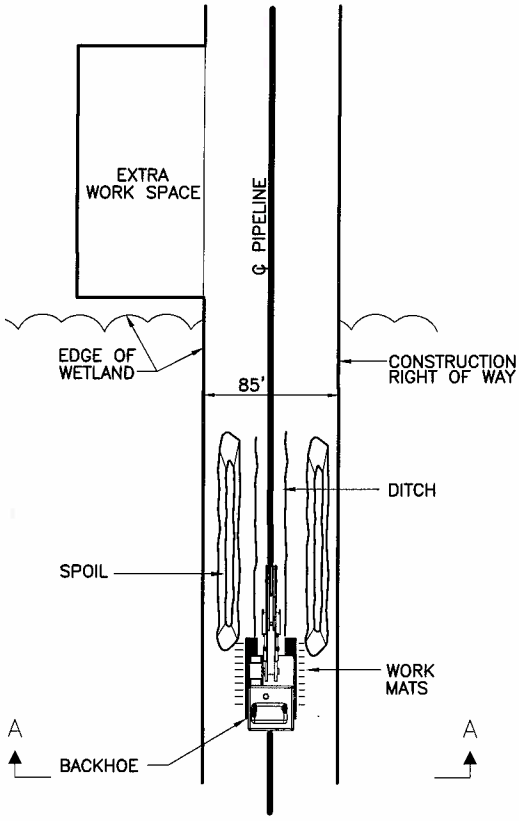
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DETAIL 9

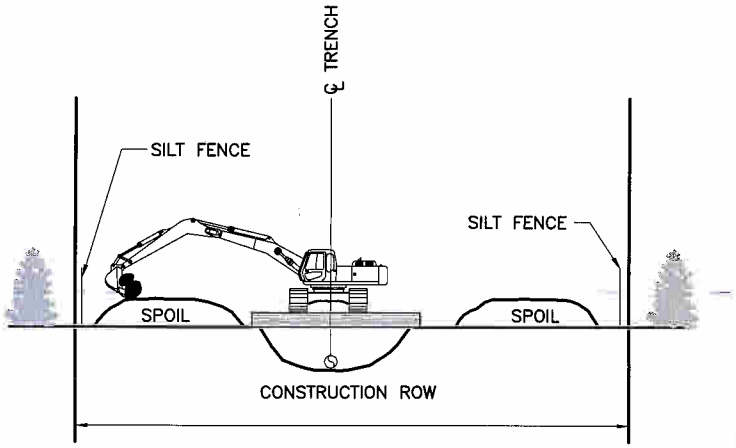
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PLAN VIEW



SECTION "A–A"

CONSTRUCTION PROCEDURES:

1. FLAG WETLAND BOUNDARIES PRIOR TO CLEARING.
2. NO REFUELING OF MOBILE EQUIPMENT IS ALLOWED WITHIN APPROXIMATELY 100 FEET OF WETLAND. PLACE "NO FUELING" SIGN POSTS 100 FEET BACK FROM WETLAND BOUNDARY. REFUEL STATIONARY EQUIPMENT AS PER KEYSTONE'S SPILL PREVENTION PROCEDURES.
3. INSTALL TEMPORARY SLOPE BREAKER UPSLOPE WITHIN 100 FEET OF WETLAND BOUNDARY AS DIRECTED BY KEYSTONE.
4. RESTRICT ROOT GRUBBING TO ONLY THE AREA OVER THE DITCHLINE.
5. TOPSOIL STRIPPING SHALL NOT BE REQUIRED IN SATURATED SOIL CONDITIONS.
6. UTILIZE AMPHIBIOUS EXCAVATORS (PONTOON MOUNTED BACKHOES) OR TRACKED BACKHOES SUPPORTED BY FABRICATED TIMBER MATS OR FLOATS TO EXCAVATE TRENCH. IF FABRICATED TIMBER MATS ARE USED FOR STABILIZATION, THE BACKHOE SHALL GRADUALLY MOVE ACROSS THE WETLAND BY MOVING THE MAT FROM IMMEDIATELY BEHIND TO IMMEDIATELY IN FRONT OF THE BACKHOE'S PATH.
7. AVOID ADJACENT WETLANDS. INSTALL SEDIMENT BARRIERS (STRAW BALES AND/OR SILT FENCE) AT EDGE OF RIGHT–OF–WAY AND ALONG WETLAND EDGE IF PRACTICAL.
8. FABRICATE PIPE IN STAGING AREA OUTSIDE THE WETLAND IN THE EXTRA WORK SPACE AS INDICATED ON THE CONSTRUCTION DRAWINGS.
9. LEAVE HARD PLUGS AT THE EDGE OF THE WETLAND UNTIL JUST PRIOR TO PIPE PLACEMENT.
10. FLOAT PIPE IN PLACE, LOWER–IN, INSTALL TRENCH PLUGS AT WETLAND EDGES WHERE REQUIRED AND BACKFILL IMMEDIATELY.
11. REMOVE TIMBER MATS OR PREFABRICATED MATS OF NON–NATIVE MATERIAL FROM WETLANDS UPON COMPLETION.
12. RESTORE GRADE TO NEAR PRE–CONSTRUCTION TOPOGRAPHY AND INSTALL PERMANENT EROSION CONTROL.

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PUSH/PULL WETLAND CROSSING METHOD

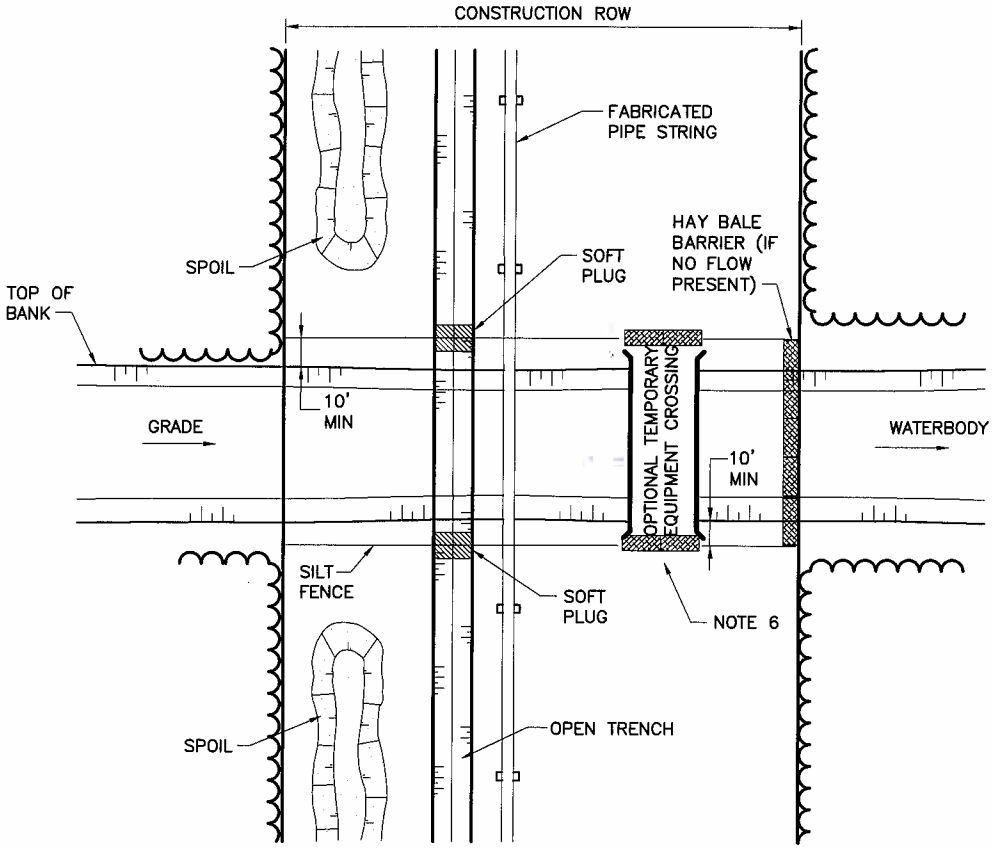
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DETAIL 10

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PLAN VIEW

CONSTRUCTION PROCEDURES:

1. METHOD APPLIES TO CROSSINGS WHERE NO FLOWING WATER IS PRESENT AT THE TIME OF CROSSING OR AS OTHERWISE SHOWN ON THE CONSTRUCTION DRAWINGS.
2. CONTRACTOR MAY "MAINLINE THROUGH" THE CROSSING OR UP TO BOTH SIDES OF THE CROSSING; STRING, WELD, COAT AND WEIGHT (IF NECESSARY), USING THE MAINLINE CREW WITH THE PIPE SKIDDED OVER THE CROSSING.
3. NO REFUELING OF MOBILE EQUIPMENT WITHIN APPROXIMATELY 100 FEET OF DRY CHANNEL. REFUEL STATIONARY EQUIPMENT AS PER KEYSTONE'S SPILL PREVENTION PROCEDURES.
4. INSTALLATION OF TEMPORARY EQUIPMENT CROSSING IS OPTIONAL AT THE DISCRETION OF KEYSTONE.
5. IN AGRICULTURAL LAND, STRIP TOPSOIL FROM SPOIL STORAGE AREA. STOCKPILE TOPSOIL AND SPOIL SEPARATELY. TOPSOIL AND SPOIL WILL NOT BE STOCKPILED IN THE CROSSING CHANNEL AND WILL BE PLACED A MINIMUM OF 10 FEET FROM CROSSING BANKS WITHIN THE CONSTRUCTION RIGHT OF WAY.
6. CONSTRUCT SEDIMENT BARRIERS ACROSS THE ENTIRE CONSTRUCTION RIGHT OF WAY FOLLOWING CLEARING AND GRADING AND MAINTAIN UNTIL CONSTRUCTION OF THE CROSSING. EROSION CONTROL MEASURES SHALL BE REINSTALLED IMMEDIATELY FOLLOWING BACKFILLING OF TRENCH AND STABILIZATION OF BANKS. BARRIERS MAY BE TEMPORARILY REMOVED TO ALLOW CONSTRUCTION ACTIVITIES BUT MUST BE REPLACED BY THE END OF EACH WORK DAY.
7. IN-STREAM SPOIL TO BE STORED OUT OF THE STREAM CHANNEL A MINIMUM OF 10 FEET FROM HIGH BANK AND WITHIN THE CONSTRUCTION RIGHT OF WAY.
8. BACKFILL WITH NATIVE MATERIAL.
9. RESTORE CROSSING CHANNEL TO APPROXIMATE PRE-CONSTRUCTION PROFILE AND SUBSTRATE.
10. RESTORE CROSSING BANKS TO APPROXIMATE ORIGINAL CONDITION AND STABILIZE WITH EROSION CONTROL.

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NON-FLOWING WATER BODY CROSSING METHOD

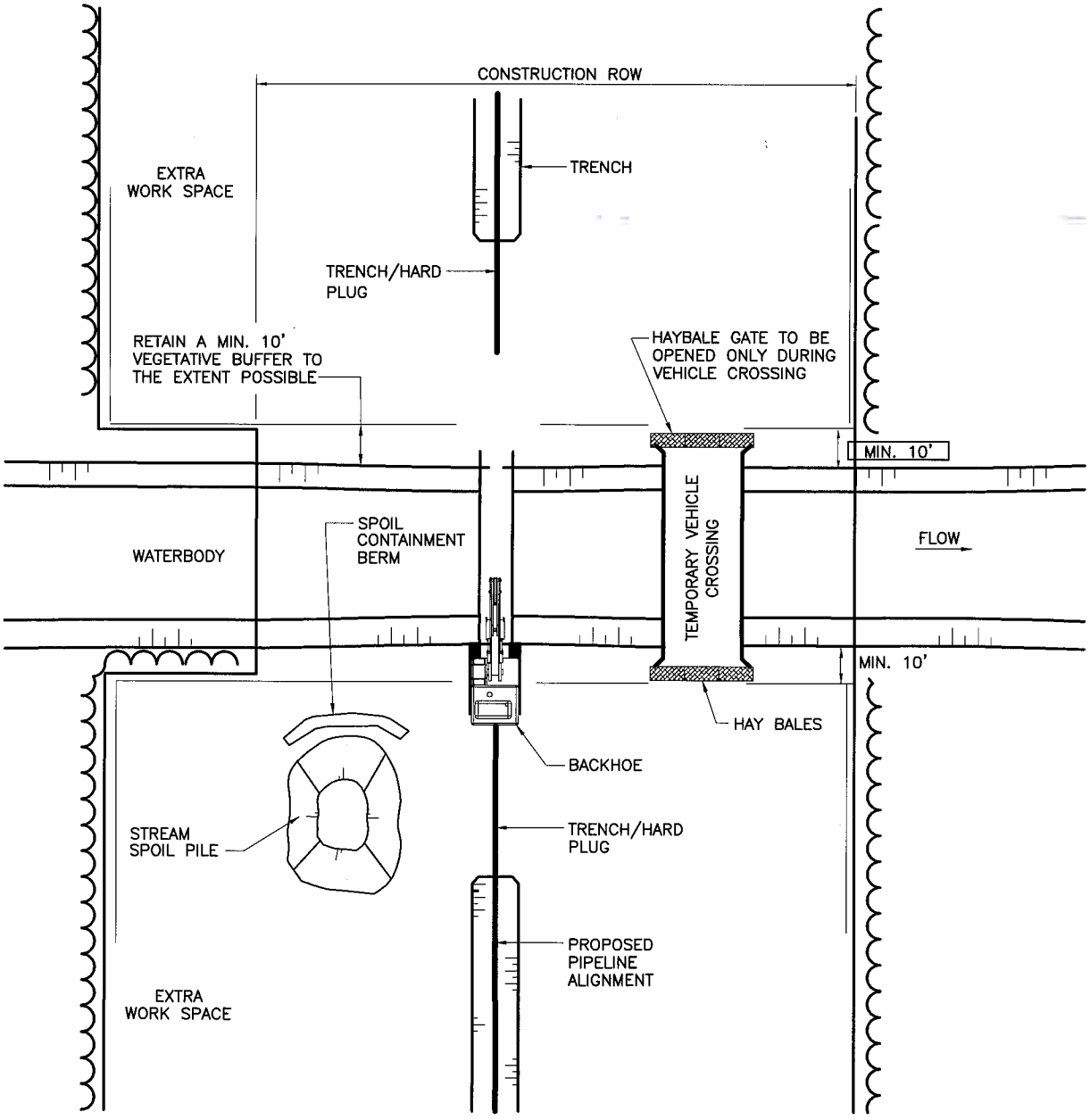
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DETAIL 11

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SEE DETAIL 12a FOR
CONSTRUCTION PROCEDURE



PLAN VIEW

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TYPICAL FLOWING WATERBODY CROSSING METHOD

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DETAIL 12

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CONSTRUCTION PROCEDURES:

1. RIGHT-OF-WAY BOUNDARIES AND WORK SPACE LIMITS SHALL BE CLEARLY DELINEATED. STAGING FOR MAKEUP SHALL BE LOCATED A MINIMUM OF 10 FEET FROM WATERBODY.

2. CLEARING LIMITS WILL BE CLEARLY DELINEATED AND A 10 FOOT VEGETATIVE BUFFER STRIP BETWEEN DISTURBED AREA AND THE WATERBODY SHALL BE MAINTAINED TO THE EXTENT POSSIBLE. ALL CLEARING SHALL BE MINIMIZED TO THE EXTENT POSSIBLE AND TO ONLY THAT NECESSARY FOR CONSTRUCTION. WOODY VEGETATION SHALL BE CUT AT GROUND LEVEL AND THE STUMPS/ROOTS LEFT IN PLACE TO THE EXTENT POSSIBLE.

3. TOPSOIL SHALL BE STRIPPED FROM THE DITCH LINE IN ALL WETLANDS RIPARIAN.

4. CONTRACTOR SHALL INSTALL SIGNS APPROXIMATELY 100 FEET MINIMUM FROM EACH WATERBODY AND WETLAND TO IDENTIFY THE HAZARDOUS MATERIALS EXCLUSION AREA.

5. EROSION AND SEDIMENT CONTROL

   A. CONTRACTOR SHALL SUPPLY, INSTALL AND MAINTAIN SEDIMENT CONTROL STRUCTURES, AS DEPICTED OR ALONG DOWN GRADIENT SIDES OF WORK AREAS AND STAGING AREAS SUCH THAT NO HEAVILY SILT LADEN WATER ENTERS WATERBODY OR WETLAND.

   B. NO HEAVILY SILT LADEN WATER SHALL BE DISCHARGED DIRECTLY OR INDIRECTLY INTO THE WATERBODY. ALL EROSION AND SEDIMENT CONTROL STRUCTURE LOCATIONS AS DEPICTED ARE APPROXIMATE AND MAY BE ADJUSTED AS DIRECTED BY THE COMPANY INSPECTOR TO SUIT ACTUAL SITE CONDITIONS. SILT FENCE OR STRAW BALE INSTALLATIONS SHALL INCLUDE REMOVABLE SECTIONS TO FACILITATE ACCESS DURING CONSTRUCTION.

   C. SEDIMENT LADEN WATER FROM TRENCH DEWATERING SHALL BE DISCHARGED TO A WELL VEGETATED UPLAND AREA, INTO A STRAW BALE DEWATERING STRUCTURE OR GEOTEXTILE FILTER BAG. SEDIMENT CONTROL STRUCTURES MUST BE IN PLACE AT ALL TIMES ACROSS THE DISTURBED CONSTRUCTION RIGHT OF WAY EXCEPT DURING EXCAVATION/INSTALLATION OF THE CROSSING PIPE.

   D. SOFT DITCH PLUGS MUST REMAIN IN PLACE AT CONVENIENT LOCATIONS TO SEPARATE MAINLINE DITCH FROM THE WATERBODY CROSSING UNTIL THE WATER CROSSING IS INSTALLED AND BACKFILLED.

   E. TRENCH BREAKERS ARE TO BE INSTALLED AT THE SAME SPACING AND IMMEDIATELY UPSLOPE OF PERMANENT SLOPE BREAKERS, OR AS DIRECTED BY THE COMPANY.

6. CONTRACTOR SHALL MAINTAIN HARD PLUGS IN THE DITCH AT THE WATERBODY UNTIL JUST PRIOR TO PIPE INSTALLATION. CONTRACTOR SHALL EXCAVATE TRENCH AND INSTALL PIPE AS EXPEDIENTLY AS PRACTICAL TO REDUCE THE DURATION OF WORK ACTIVITIES IN THE WATERBODY BED.

7. CONTRACTOR SHALL PLACE TRENCH SPOIL ONLY IN CERTIFICATED WORK SPACE AND A MINIMUM OF 10 FEET FROM THE WATERBODY BANKS TO PREVENT ENTRY OF SPOIL INTO THE WATERBODY. SPOIL SHALL BE CONTAINED AS NECESSARY USING EITHER A STRAW BALE BARRIER OR AN EARTH/ROCK BERM.

8. CONTRACTOR SHALL RESTORE THE WATERBODY AND BANKS TO APPROXIMATE PRECONSTRUCTION CONTOURS, UNLESS OTHERWISE APPROVED BY THE COMPANY. CONTRACTOR SHALL INSTALL PERMANENT EROSION AND SEDIMENT CONTROL STRUCTURES AS INDICATED. ANY MATERIALS PLACED IN THE WATERBODY TO FACILITATE CONSTRUCTION SHALL BE REMOVED DURING RESTORATION. BANKS SHALL BE STABILIZED AND TEMPORARY SEDIMENT BARRIERS INSTALLED AS SOON AS POSSIBLE AFTER CROSSING, BUT WITHIN 24 HOURS OF COMPLETING THE CROSSING. MAINTAIN A SILT FENCE OR STRAW BALE BARRIER ALONG THE WATERBODY AND WETLAND BOUNDARIES UNTIL VEGETATION IS ESTABLISHED IN ADJACENT DISTURBED AREAS.

9. VEHICLE CROSSING CAN BE CONSTRUCTED USING EITHER A FLUME CROSSING OR A TEMPORARY BRIDGE. VEHICLE CROSSING ONLY REQUIRED IF STREAM SUPPORTS A STATE DESIGNATED FISHERY.

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TYPICAL FLOWING WATERBODY CROSSING METHOD

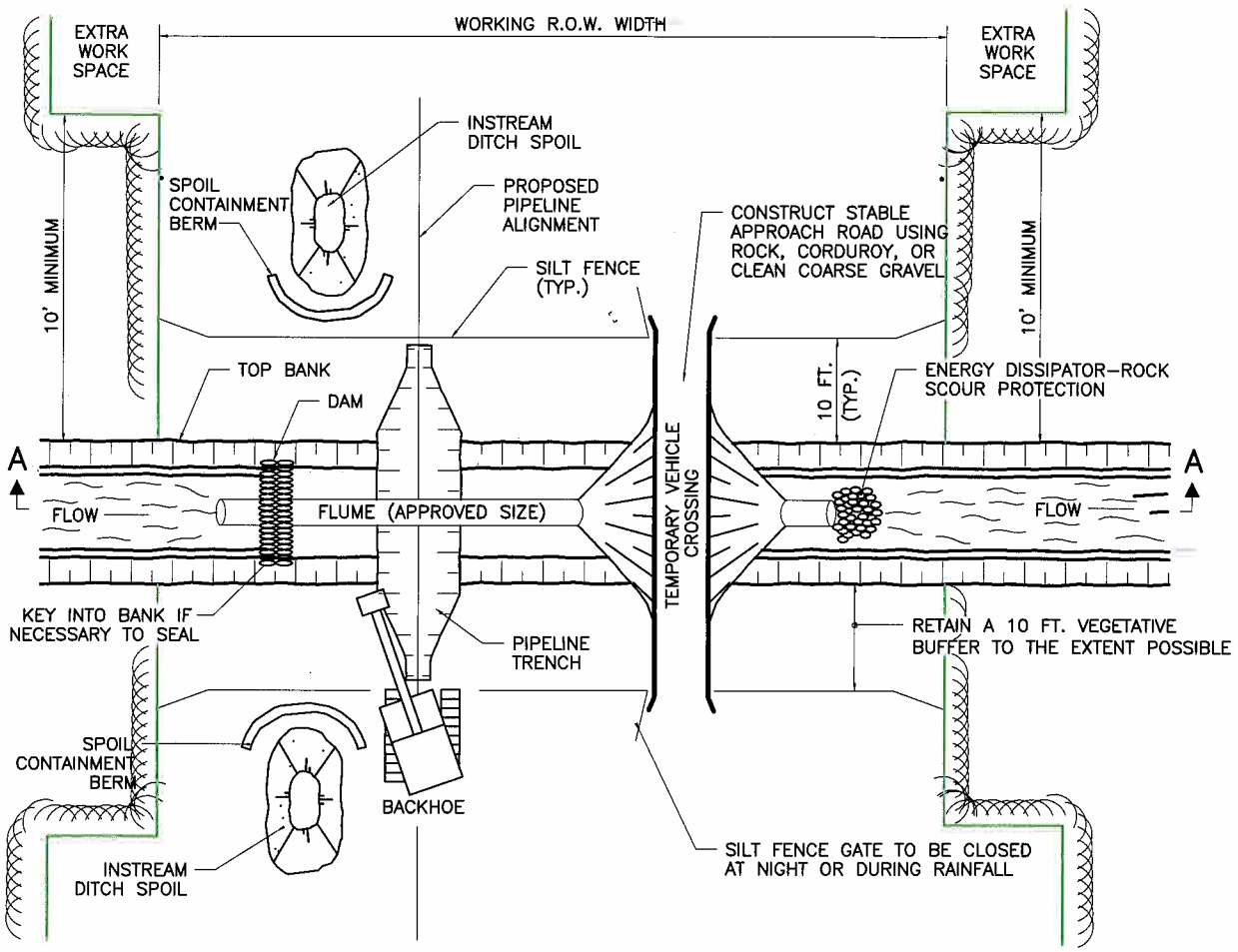
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DETAIL 12a

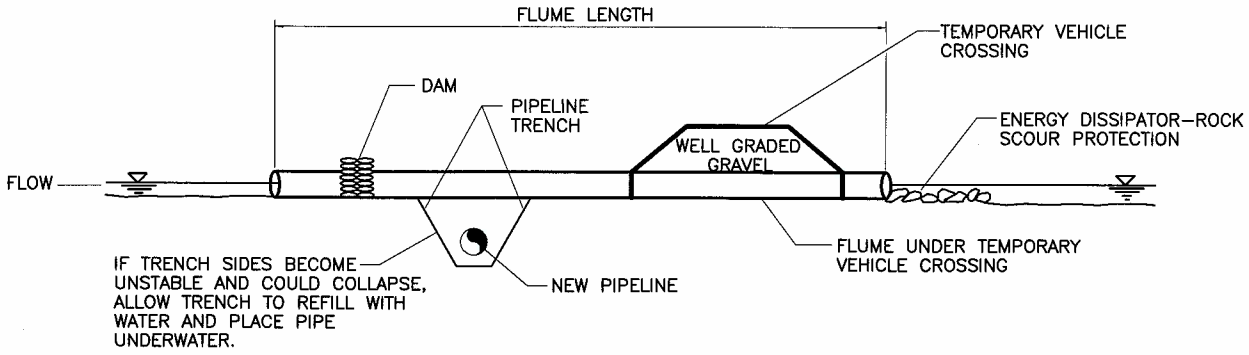
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PLAN VIEW



SECTION 'A–A'

NOTES:
1. PIPELINE PLACEMENT WITHIN RIGHT–OF–WAY CONCEPTUAL ONLY.
2. SEE DETAIL 13a FOR CONSTRUCTION PROCEDURES.

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TYPICAL DRY FLUME CROSSING METHOD

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DETAIL 13

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CONSTRUCTION PROCEDURES:

1. MARK OUT AND MAINTAIN LIMITS OF AUTHORIZED WORK AREAS WITH FENCING OR FLAGGING TAPE TO AVOID UNNECESSARY DISTURBANCE OF VEGETATION. ENSURE EQUIPMENT OPERATORS WORKING ON THE CROSSING HAVE BEEN BRIEFED ABOUT THIS PLAN AND THE MEASURES NEEDED TO PROTECT WATER QUALITY.

2. ALL NECESSARY EQUIPMENT AND MATERIALS TO BUILD THE FLUME MUST BE ON SITE OR READILY AVAILABLE PRIOR TO COMMENCING IN-WATER WORK.

3. TO THE EXTENT POSSIBLE, MAINTAIN A MINIMUM 10 FT. VEGETATIVE BUFFER STRIP BETWEEN DISTURBED AREAS AND THE WATERCOURSE. INSTALL AND MAINTAIN A SILT FENCE OR STRAW BALE BARRIER UPSLOPE OF THE BUFFER STRIP ON EACH SIDE OF THE WATERCOURSE.

4. CONTRACTOR SHALL SUPPLY, INSTALL AND MAINTAIN SEDIMENT CONTROL STRUCTURES, AS DEPICTED OR ALONG DOWN GRADIENT SIDES OF WORK AREAS AND STAGING AREAS SUCH THAT NO HEAVILY SILT LADEN WATER ENTERS STREAM.
   a. NO HEAVILY SILT LADEN WATER SHALL BE DISCHARGED DIRECTLY INTO THE STREAM.
   b. EROSION AND SEDIMENT CONTROL STRUCTURE LOCATIONS AS DEPICTED ARE APPROXIMATE AND MAY BE ADJUSTED AS DIRECTED BY THE COMPANY INSPECTOR TO ACTUAL SITE CONDITIONS.
   c. SILT FENCE OR STRAW BALE INSTALLATIONS SHALL INCLUDE REMOVABLE SECTIONS TO FACILITATE ACCESS DURING CONSTRUCTION. UTILIZE STRAW BALE BARRIERS ONLY IN LIEU OF A SILT FENCE WHERE FREQUENT ACCESS IS REQUIRED.
   d. SEDIMENT LADEN WATER FROM TRENCH DEWATERING SHALL BE DISCHARGED TO A WELL VEGETATED UPLAND AREA INTO A STRAW BALE DEWATERING STRUCTURE OR GEOTEXTILE FILTER BAG.
   e. SEDIMENT CONTROL STRUCTURES MUST BE IN PLACE AT ALL TIMES ACROSS THE DISTURBED PORTIONS OF THE RIGHT-OF-WAY EXCEPT DURING EXCAVATION/INSTALLATION OF THE CROSSING PIPE.
   f. SOFT DITCH PLUGS MUST REMAIN IN PLACE AT CONVENIENT LOCATIONS TO SEPARATE MAINLINE DITCH FROM THE RIVER CROSSING UNTIL THE RIVER CROSSING IS INSTALLED AND BACKFILLED.

5. PIPE SHALL BE STRUNG AND WELDED FOR READY INSTALLATION PRIOR TO WATERCOURSE TRENCHING.

6. FLUME CAPACITY DURING DRY CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE 1.5 TIMES THE FLOW MEASURED AT THE TIME OF CONSTRUCTION PROVIDED THAT THE FLUMES WILL BE IN PLACE NOT MORE THAN 96 HOURS AND NO PRECIPITATION IS FORECAST. FLUME CAPACITY FOR VEHICLE ACCESS SHALL BE SUFFICIENT TO PASS THE 2 YEAR DESIGN FLOW OR THE FLOW REASONABLY EXPECTED TO OCCUR DURING THE INSTALLATION. EXCESS FLUMES REQUIRED FOR LONGER TERM ACCESS SHALL BE CAPPED DURING DRY CROSSING PROCEDURES.

7. ENSURE THAT THE DAMS AND VEHICLE-CROSSING ARE LOCATED FAR ENOUGH APART TO ALLOW FOR A WIDE EXCAVATION. FLUMES ARE TO BE SET WITH 10 PERCENT OF THEIR DIAMETER BELOW STREAMBED LEVEL WHERE SOIL CONDITIONS PERMIT (OTHERWISE INSTALLED AT STREAM GRADE AND SLOPE).

8. PLACE IMPERVIOUS DAMS AT EACH END OF THE FLUME, UPSTREAM FIRST, THEN DOWNSTREAM. ACCEPTABLE ALTERNATIVES INCLUDE GRAVEL WITH RIP-RAP PROTECTION, SAND BAGS, STEEL PLATE AND ROCKFILL. DURING INSTALLATION, INSTALL AN IMPERVIOUS MEMBRANE, IF NECESSARY, TO LIMIT LEAKAGE, DAMS MAY NEED KEYING INTO THE BANK AND STREAMBED.

9. EXCAVATE TRENCH THROUGH PLUGS AND UNDER FLUME FROM BOTH SIDES. WORK IS TO BE COMPLETED AS QUICKLY AS POSSIBLE.
   a. LOWER IN PIPE BY PASSING UNDER FLUME AND BACKFILL IMMEDIATELY WITH SPOIL MATERIAL.
   b. IT IS NOT NECESSARY TO DEWATER THE IN-STREAM TRENCH, HOWEVER, DISPLACED WATER SHALL BE PUMPED TO A STABLE UPLAND AREA TO AVOID OVERTOPPING OF DAMS DURING PIPE PLACEMENT.
   c. IF THE SPOIL MATERIAL IS NOT SUITABLE, USE IMPORTED CLEAN GRANULAR MATERIAL.
   d. IF BLASTING IS REQUIRED, USE CONTROLLED BLASTING TECHNIQUES TO PREVENT DAMAGE TO THE FLOW CONVEYANCE SYSTEM. ALTERNATIVELY, BLASTING MAY BE ACCOMPLISHED PRIOR TO FLUME INSTALLATION BY DRILLING THROUGH THE OVERBURDEN.

10. EXCAVATED MATERIAL MUST NOT BE STOCKPILED WITHIN 10 FT. OF THE WATERCOURSE. THIS MATERIAL SHALL BE CONTAINED TO PREVENT SATURATED SOIL FROM FLOWING BACK INTO THE WATERCOURSE.

11. DEWATERING OF THE ONLAND TRENCH SHOULD OCCUR IN A STABLE VEGETATED AREA A MINIMUM OF 50 FT. FROM ANY WATERBODY. THE PUMP DISCHARGE SHOULD BE DIRECTED ONTO A STABLE SPILL PAD CONSTRUCTED OF ROCKFILL OR TIMBERS TO PREVENT LOCALIZED EROSION. THE DISCHARGE WATER SHOULD ALSO BE FORCED INTO SHEET FLOW IMMEDIATELY BEYOND THE SPILL PAD BY USING STRAW BALES AND THE NATURAL TOPOGRAPHY.

12. FLUMES SHOULD BE REMOVED AS SOON AS POSSIBLE, WHEN NO LONGER REQUIRED FOR PIPE LAYING OR FOR ROAD ACCESS, IN THE FOLLOWING MANNER:
   a. REMOVE THE VEHICLE CROSSING RAMP. BANKS ARE TO BE RESTORED TO A STABLE ANGLE AND PROTECTED WITH EROSION RESISTANT MATERIAL COMPATIBLE WITH THE FLOW CONDITIONS (E.G., EROSION CONTROL BLANKETS, CRIBBING, ROCK RIP-RAP, ETC.) TO THE MAXIMUM EXTENT POSSIBLE BEFORE REMOVING THE DAMS.
   b. REMOVE DOWNSTREAM DAM.
   c. REMOVE UPSTREAM DAM.
   d. REMOVE FLUME.
   e. COMPLETE BANK TRIMMING AND EROSION PROTECTION. IF SANDBAGS ARE USED FOR THE DAMS, PLACE AND REMOVE BY HAND TO AVOID EQUIPMENT BREAKING BAGS.

13. RESTORE THE STREAM BED AND BANKS TO APPROXIMATE PRE-CONSTRUCTION CONTOURS, BUT NOT TO EXCEED 2 HORIZONTAL TO 1 VERTICAL.
   a. INSTALL PERMANENT EROSION AND SEDIMENT CONTROL STRUCTURES AS INDICATED ON A SITE SPECIFIC BASIS. IN THE ABSENCE OF SITE SPECIFIC INFORMATION, A FLEXIBLE CHANNEL LINER SUCH AS NAG C125 OR C350 WHICH IS CAPABLE OF WITHSTANDING ANTICIPATED FLOW SHALL BE INSTALLED. ALTERNATIVELY, ROCK RIP-RAP SHALL BE INSTALLED.
   b. ANY MATERIALS PLACED IN THE STREAM TO FACILITATE CONSTRUCTION SHALL BE REMOVED DURING RESTORATION. BANKS SHALL BE STABILIZED AND TEMPORARY SEDIMENT BARRIERS INSTALLED AS SOON AS POSSIBLE AFTER CROSSING, BUT WITHIN 24 HOURS OF COMPLETING THE CROSSING.
   c. MAINTAIN A SILT FENCE OR STRAW BALE BARRIER ALONG THE WATER COURSE UNTIL VEGETATION IS ESTABLISHED IN ADJACENT DISTURBED AREAS.

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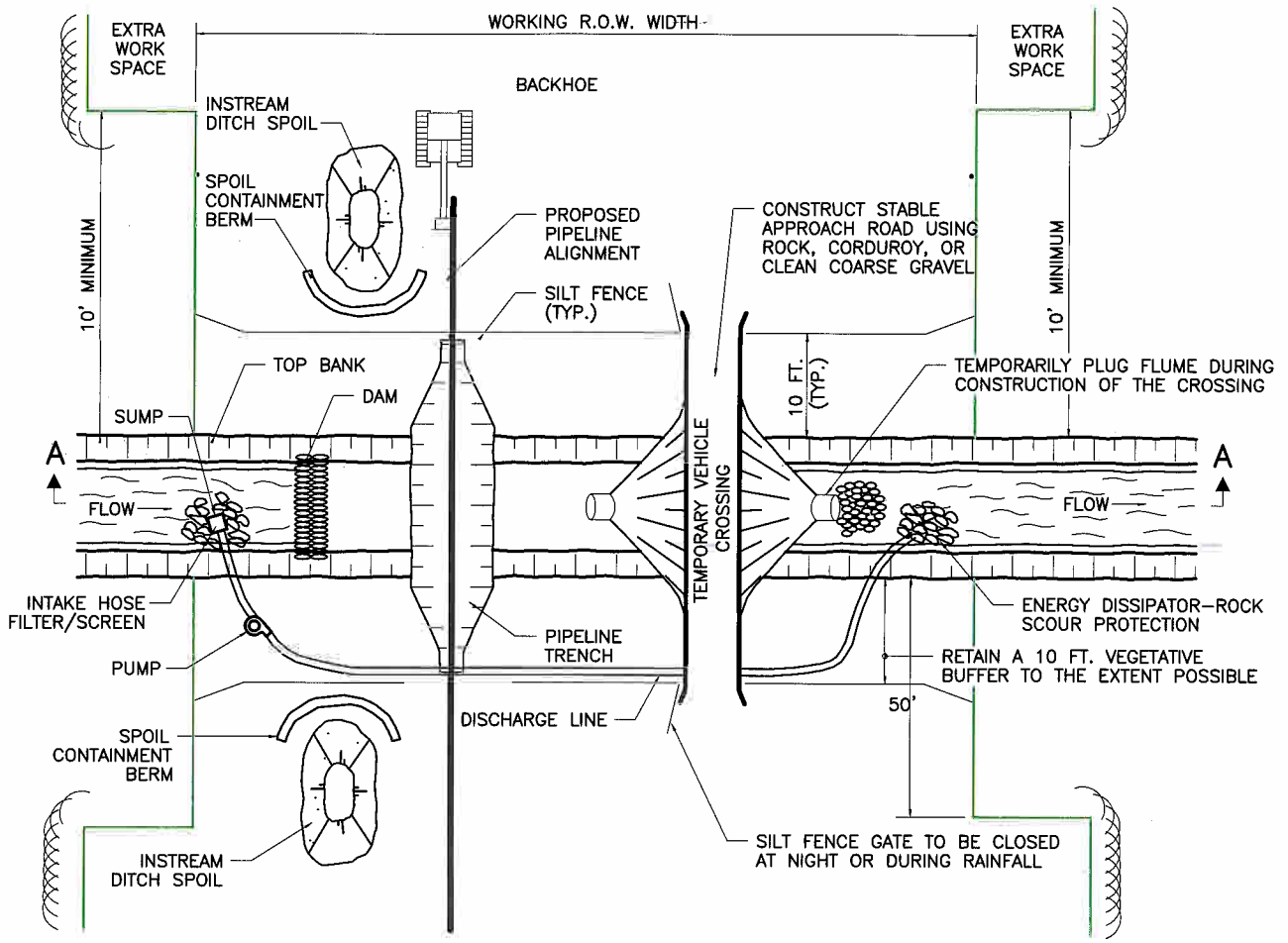
TYPICAL DRY FLUME CROSSING METHOD

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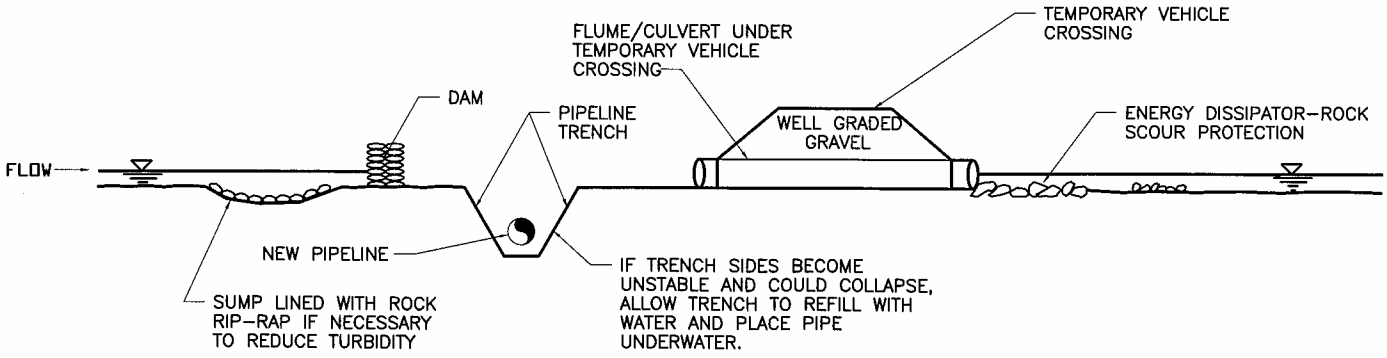
DETAIL 13a

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PLAN VIEW



SECTION 'A-A'

NOTES:
1. PIPELINE PLACEMENT WITHIN RIGHT-OF-WAY CONCEPTUAL ONLY.
2. SEE DETAIL 14a FOR CONSTRUCTION PROCEDURE

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TYPICAL DAM AND PUMP CROSSING

PROJECT: 50388E

DETAIL 14

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CONSTRUCTION PROCEDURES:

1. WHERE NECESSARY, OBTAIN PRIOR APPROVAL BEFORE USING THE DAM AND PUMP METHOD.
2. IF THERE IS ANY FLOW IN THE WATERCOURSE, INSTALL PUMPS TO MAINTAIN STREAMFLOW AROUND THE BLOCKED OFF SECTIONS OF CHANNEL. THE PUMP IS TO HAVE 1.5 TIMES THE PUMPING CAPACITY OF ANTICIPATED FLOW. A SECOND STANDBY PUMP OF EQUAL CAPACITY IS TO BE READILY AVAILABLE AT ALL TIMES. AN ENERGY DISSIPATOR IS TO BE BUILT TO ACCEPT PUMP DISCHARGE WITHOUT STREAMBED OR STREAMBANK EROSION. IF THE CROSSING IS PROLONGED BEYOND ONE DAY THE OPERATION NEEDS TO BE MONITORED OVERNIGHT.
3. SCHEDULE INSTREAM ACTIVITY FOR LOW FLOW PERIODS IF POSSIBLE
4. MARK OUT AND MAINTAIN LIMITS OF AUTHORIZED WORK AREAS WITH FENCING OR FLAGGING TAPE TO AVOID UNNECESSARY DISTURBANCE OF VEGETATION. ENSURE EQUIPMENT OPERATORS WORKING ON THE CROSSING HAVE BEEN BRIEFED ABOUT THIS PLAN AND THE MEASURES NEEDED TO PROTECT WATER QUALITY. INSTALL PRE-WORK SEDIMENT CONTROL MEASURES AS SPECIFIED IN THE PLAN. ALL NECESSARY EQUIPMENT AND MATERIALS TO BUILD THE DAMS AND TO PUMP WATER MUST BE ON SITE OR READILY AVAILABLE PRIOR TO COMMENCING IN-WATER CONSTRUCTION. PIPE SHOULD BE STRUNG, WELDED AND COATED AND READY FOR INSTALLATION PRIOR TO WATERCOURSE TRENCHING.
5. CONTRACTOR SHALL SUPPLY, INSTALL AND MAINTAIN SEDIMENT CONTROL STRUCTURES, AS DEPICTED AND ALONG DOWN GRADIENT SIDES OF WORK AREAS AND STAGING AREAS SUCH THAT NO HEAVILY SILT LADEN WATER ENTERS STREAM.
   a. NO HEAVILY SILT LADEN WATER SHALL BE DISCHARGED DIRECTLY INTO THE STREAM.
   b. EROSION AND SEDIMENT CONTROL STRUCTURE LOCATIONS AS DEPICTED ARE APPROXIMATE AND MAY BE ADJUSTED AS DIRECTED BY THE COMPANY INSPECTOR TO ACTUAL SITE CONDITIONS.
   c. SILT FENCE OR STRAW BALE INSTALLATIONS SHALL INCLUDE REMOVABLE SECTIONS TO FACILITATE ACCESS DURING CONSTRUCTION. UTILIZE STRAW BALE BARRIERS ONLY IN LIEU OF A SILT FENCE WHERE FREQUENT ACCESS IS REQUIRED.
   d. SEDIMENT LADEN WATER FROM TRENCH DEWATERING SHALL BE DISCHARGED TO A WELL VEGETATED UPLAND AREA, INTO A STRAW BALE DEWATERING STRUCTURE OR GEOTEXTILE FILTER BAG.
   e. SEDIMENT CONTROL STRUCTURES MUST BE IN PLACE AT ALL TIMES ACROSS THE DISTURBED PORTIONS OF THE RIGHT-OF-WAY EXCEPT DURING EXCAVATION/INSTALLATION OF THE CROSSING PIPE.
   f. SOFT DITCH PLUGS MUST REMAIN IN PLACE AT CONVENIENT LOCATIONS TO SEPARATE MAINLINE DITCH FROM THE RIVER CROSSING UNTIL THE RIVER CROSSING IS INSTALLED AND BACKFILLED.
6. TO THE EXTENT POSSIBLE, MAINTAIN A MINIMUM 10 FEET VEGETATIVE BUFFER STRIP BETWEEN DISTURBED AREAS AND THE WATERCOURSE. INSTALL AND MAINTAIN A SILT FENCE UPSLOPE OF THE BUFFER STRIP ON EACH SIDE OF THE WATERCOURSE. THE SILT FENCE SHOULD INCORPORATE REMOVABLE "GATES" AS REQUIRED TO ALLOW ACCESS WHILE MAINTAINING EASE OF REPLACEMENT FOR OVERNIGHT OR DURING PERIODS OF RAINFALL.
7. CONSTRUCT A TEMPORARY SUMP UPSTREAM OF THE DAM AND LINE WITH ROCKFILL IF A NATURAL POOL DOES NOT EXIST. INSTALL THE PUMP OR PUMP INTAKE IN THE POOL OR SUMP. DISCHARGE WATER ONTO AN ENERGY DISSIPATOR DOWNSTREAM OF THE WORK AREA.
8. EXCAVATED MATERIAL MUST NOT BE STOCKPILED WITHIN 10 FT. OF THE WATERCOURSE. THIS MATERIAL MUST BE CONTAINED WITHIN BERM CONTAINMENT, WITH SECONDARY SILT FENCE PROTECTION TO PREVENT SATURATED SOIL FROM FLOWING BACK INTO THE WATERCOURSE.
9. CHEMICALS, FUELS, LUBRICATING OILS SHALL NOT BE STORED AND EQUIPMENT REFUELED WITHIN 100 FT. OF THE WATERBODY. PUMPS ARE TO BE REFUELED AS PER THE SPCC PLANS.
10. STAGING AREAS ARE TO BE LOCATED AT LEAST 10 FT. FROM THE WATER'S EDGE (WHERE TOPOGRAPHIC CONDITIONS PERMIT) AND SHALL BE THE MINIMUM SIZE NEEDED.
11. DAMS ARE TO BE MADE OF STEEL PLATE, INFLATABLE PLASTIC DAM, SAND BAGS, COBBLES, WELL GRADED COARSE GRAVEL FILL, OR ROCK FILL. DAMS MAY NEED KEYING INTO THE BANKS AND STREAMBED. ENSURE THAT THE DAM AND VEHICLE CROSSING ARE LOCATED FAR ENOUGH APART TO ALLOW FOR A WIDE EXCAVATION. CAP FLUMES USED UNDER VEHICLE CROSSING DURING DRY CROSSING.
12. DEWATER AREA BETWEEN DAMS IF POSSIBLE. DEWATERING SHOULD OCCUR IN A STABLE VEGETATIVE AREA A MINIMUM OF 50 FT. FROM ANY WATERBODY. THE PUMP DISCHARGE SHOULD BE DISCHARGED ONTO A STABLE SPILL PAD CONSTRUCTED OF ROCKFILL SANDBAGS, OR TIMBERS TO PREVENT LOCALIZED EROSION. THE DISCHARGE WATER SHOULD ALSO BE FORCED INTO SHEET FLOW IMMEDIATELY BEYOND THE SPILL PAD BY USING STRAW BALES AND THE NATURAL TOPOGRAPHY DISCHARGED WATER SHALL NOT BE ALLOWED TO FLOW INTO ANY WATERCOURSE OR WETLAND. IF IT IS NOT POSSIBLE TO DEWATER THE EXCAVATION DUE TO SOILS WITH A HIGH HYDRAULIC CONDUCTIVITY, THE EXCAVATION AND PIPE PLACEMENT IS TO BE CARRIED OUT IN THE STANDING WATER. PUMP ANY DISPLACED WATER AS DESCRIBED ABOVE TO PREVENT OVERTOPPING OF DAMS.
13. EXCAVATE TRENCH THROUGH PLUGS AND STREAMBED FROM BOTH SIDES, RE-POSITIONING DISCHARGE HOSE AS NECESSARY. LOWER THE PIPE IN THE TRENCH AND BACKFILL IMMEDIATELY. DURING THIS OPERATION WORK IS TO BE COMPLETED AS QUICKLY AS POSSIBLE.
14. CONTRACTOR SHALL RESTORE THE STREAM BED AND BANKS TO APPROXIMATE PRE-CONSTRUCTION CONTOURS, BUT NOT TO EXCEED 2 HORIZONTAL TO 1 VERTICAL.
   a. CONTRACTOR SHALL INSTALL PERMANENT EROSION AND SEDIMENT CONTROL STRUCTURES AS INDICATED ON A SITE SPECIFIC BASIS. IN THE ABSENCE OF SITE SPECIFIC INFORMATION, A FLEXIBLE CHANNEL LINER SUCH AS NAG C125 OR C350 WHICH IS CAPABLE OF WITHSTANDING ANTICIPATED FLOW SHALL BE INSTALLED. ALTERNATIVELY, ROCK RIP-RAP SHALL BE INSTALLED.
   b. ANY MATERIALS PLACED IN THE STREAM TO FACILITATE CONSTRUCTION SHALL BE REMOVED DURING RESTORATION. BANKS SHALL BE STABILIZED AND TEMPORARY SEDIMENT BARRIERS INSTALLED AS SOON AS POSSIBLE AFTER CROSSING, BUT WITHIN 24 HOURS OF COMPLETING THE CROSSING.
   c. MAINTAIN A SILT FENCE OR STRAW BALE BARRIER ALONG THE WATER COURSE UNTIL VEGETATION IS ESTABLISHED IN ADJACENT DISTURBED AREAS.
15. WHEN THE STREAMBED HAS BEEN RESTORED, THE CREEK BANKS ARE TO BE CONTOURED TO A STABLE ANGLE AND PROTECTED WITH EROSION RESISTANT MATERIAL COMPATIBLE WITH FLOW VELOCITY BETWEEN DAMS (E.G., EROSION CONTROL BLANKETS, CRIBBING, ROCK RIP-RAP, ETC.). THE DAMS ARE TO BE REMOVED DOWNSTREAM FIRST. KEEP PUMP RUNNING UNTIL NORMAL FLOW IS RESUMED. COMPLETE BANK TRIMMING AND EROSION PROTECTION. IF SANDBAGS ARE USED FOR THE DAMS, PLACE AND REMOVE BY HAND TO AVOID EQUIPMENT BREAKING BAGS.

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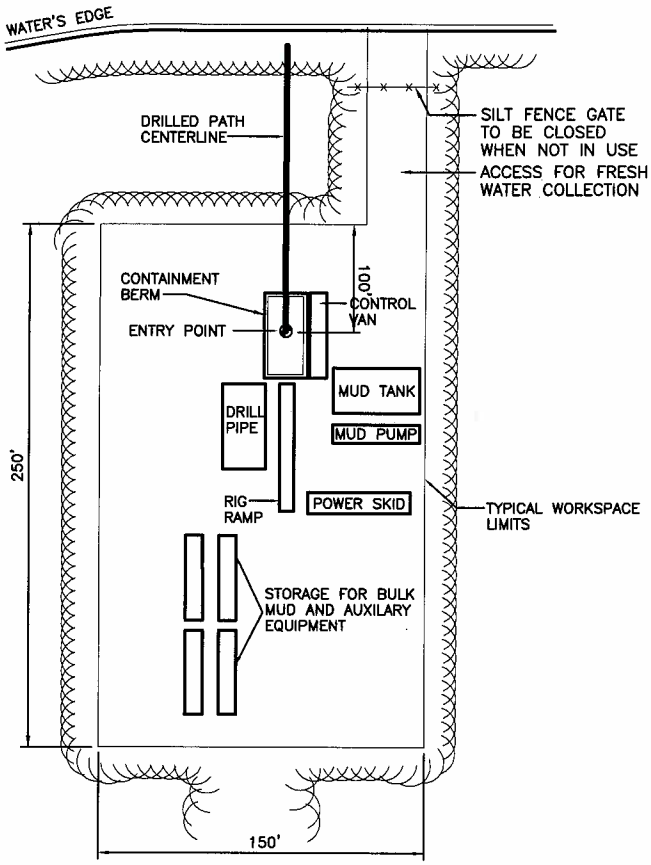
TYPICAL DAM AND PUMP CROSSING

PROJECT: 50388E

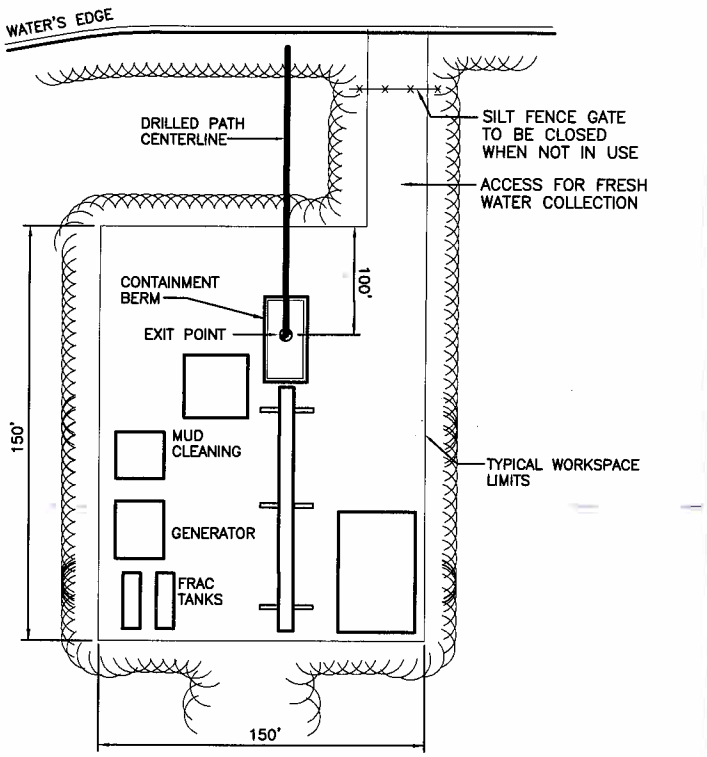
DETAIL 14a

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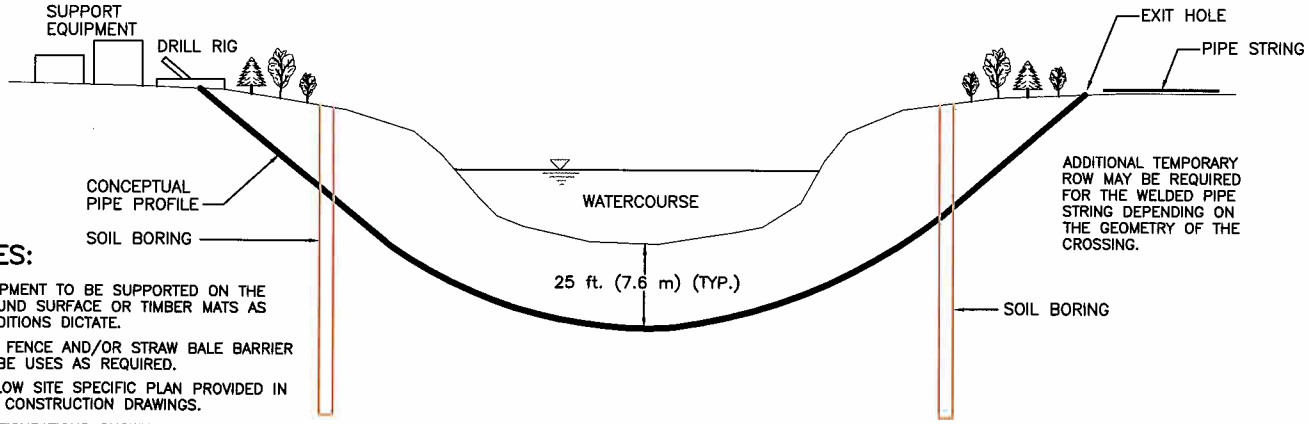
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SITE PLAN
ENTER SIDE



SITE PLAN
EXIT SIDE



PROFILE

NOTES:

1. EQUIPMENT TO BE SUPPORTED ON THE GROUND SURFACE OR TIMBER MATS AS CONDITIONS DICTATE.
2. SILT FENCE AND/OR STRAW BALE BARRIER TO BE USES AS REQUIRED.
3. FOLLOW SITE SPECIFIC PLAN PROVIDED IN THE CONSTRUCTION DRAWINGS.
4. CONFIGURATIONS SHOWN ARE TYPICAL AND SHALL BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS

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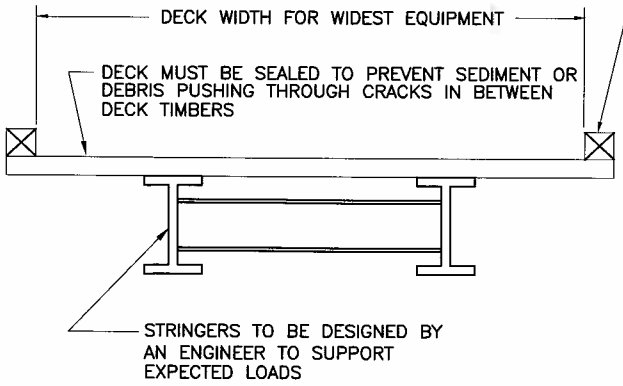
TYPICAL HORIZONTAL DRILL (HDD) SITE PLAN & PROFILE

PROJECT: 50388E

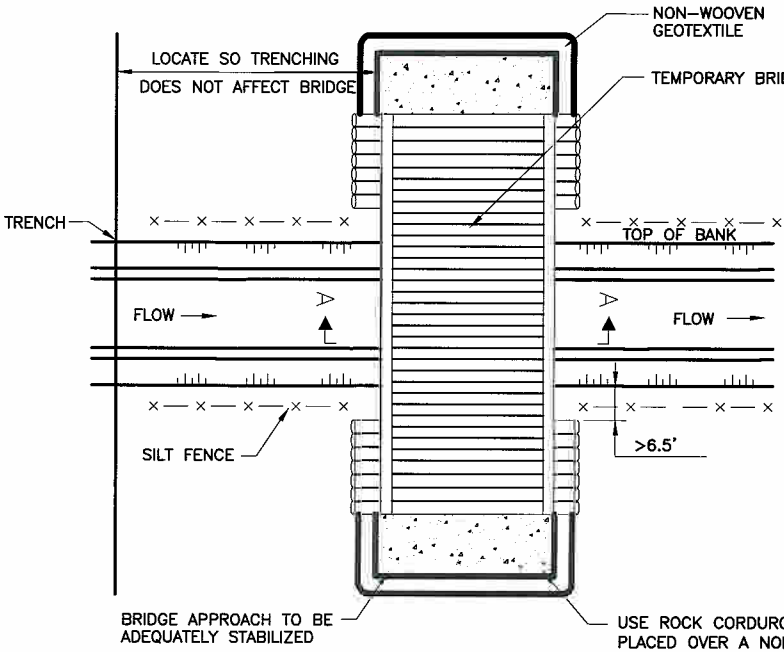
DETAIL 15

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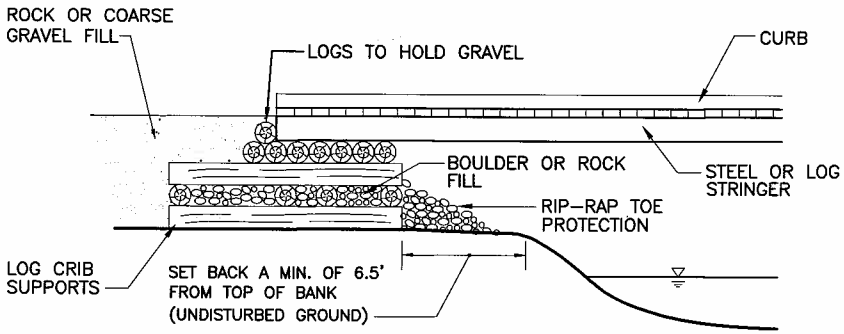
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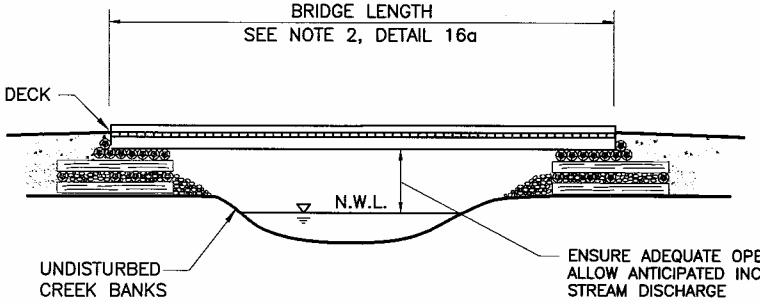
SECTION A–A



PLAN



TYPICAL TEMPORARY CRIB ABUTMENT



BRIDGE PROFILE

NOTES:

1. SEE DETAIL 16a FOR CONSTRUCTION PROCEDURES

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TYPICAL TEMPORARY BRIDGE CROSSING

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DETAIL 16

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CONSTRUCTION PROCEDURES:

IN GENERAL TERMS, THE FOLLOWING IS A SEQUENCE OF CONSTRUCTION PROCEDURES THAT ARE RECOMMENDED TO BE FOLLOWED FOR TEMPORARY BRIDGE CROSSINGS:

1. A PORTABLE BRIDGE, FLEXI–FLOAT, OR FLUMED VEHICLE CROSSING MAY BE SUBSTITUTED FOR THE TEMPORARY BRIDGE. IT IS IMPORTANT THAT THE SIZE OF THE TOTAL OPENING BE SELECTED SO THE STRUCTURE CAN SAFELY PASS FLOOD FLOWS THAT CAN REASONABLY BE EXPECTED TO OCCUR DURING THE LIFE OF THE CROSSING.

2. DETERMINE BRIDGE LENGTH REQUIRED AND FOLLOW EITHER METHOD A) OR B) FOR DETERMINING THE OPENING SIZE. IF A) IS FOLLOWED, A MINIMUM 6.5 ft. SETBACK FROM TOP OF BANK MUST BE PRESERVED AS A "NO DISTURBANCE AREA." IF ABUTMENTS OR PIERS IN THE STREAMBED ARE REQUIRED, METHOD B) IS TO BE FOLLOWED.

3. INSTALL THE BRIDGE IN A MANNER THAT WILL MINIMIZE SEDIMENT ENTERING THE WATER. STRINGERS MUST BE DESIGNED TO SUPPORT THE LOADS EXPECTED ON THE BRIDGE. CURBS MUST BE INSTALLED ALONG THE EDGE OF THE DECK TO CONTAIN SEDIMENT AND DEBRIS ON THE BRIDGE. FASTENERS CONNECTING COMPONENTS MUST BE STRONG ENOUGH TO HOLD THEM IN POSITION DURING THE LIFE OF THE BRIDGE. CRIBS ARE TO BE FILLED WITH ROCK OR COBBLE. RIP–RAP EROSION PROTECTION IS TO BE PLACED AROUND THE CRIBS AND ON ANY FILL SLOPES PROJECTING INTO THE WATERBODY.

4. ROAD APPROACHES LEADING TO THE BRIDGE MUST BE RAISED AND STABLE SO EQUIPMENT LOADS ARE SUPPORTED A SUFFICIENT DISTANCE BACK FROM THE WATER TO REDUCE SEDIMENT AND DEBRIS ENTERING THE WATERBODY FROM EQUIPMENT TRACKS. THIS MAY REQUIRE USING MATERIALS SUCH AS GRAVEL, ROCK OR CORDUROY. DO NOT USE SOIL TO CONSTRUCT OR STABILIZE EQUIPMENT BRIDGES. IF CUTS ARE NEEDED TO OBTAIN A SATISFACTORY GRADE, THEY ARE TO BE DUG WITH SIDE DITCHES AND STABLE SLOPES. EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE INSTALLED TO KEEP SEDIMENT ON LAND (E.G., SILT FENCING, FILTER CLOTH, RIP–RAP, SEED AND MULCH, ETC.)

5. MAINTAIN A SILT FENCE ON EACH SIDE OF THE WATERBODY EXTENDING A MINIMUM OF 10 ft. BEYOND THE WIDTH OF DISTURBANCE UNTIL VEGETATION HAS BEEN ESTABLISHED IN UPSLOPE AREAS.

6. PERIODICALLY CHECK BRIDGE INSTALLATION AND REMOVE ANY BUILD–UP OF SEDIMENT OR DEBRIS ON THE BRIDGE. DISPOSE OF THIS MATERIAL IN A LOW LYING AREA AT LEAST 100 ft. FROM THE WATERBODY.

7. REMOVE TEMPORARY CROSSINGS AS SOON AS POSSIBLE AFTER FINAL CLEAN–UP. MATERIALS PLACED ALONG THE WATERBODY SHOULD BE COMPLETELY REMOVED DURING FINAL CLEAN–UP. REMOVAL SHOULD NOT NOT OCCUR OUTSIDE THE CONSTRUCTION WINDOWS.
   SURPLUS GRAVEL IS TO BE SPREAD ON THE RIGHT–OF WAY AS GRAVEL SHEETING, IF GRADATION IS SUITABLE, OR MOVED AT LEAST 100 ft. FROM TOP OF BANK FOR DISPOSAL. BRIDGE MATERIALS ARE TO BE REMOVED FROM THE CROSSING AREA. THE WATERBODY BED AND BANKS ARE TO BE RESTORED TO A STABLE ANGLE AND PROTECTED WITH EROSION RESISTANT MATERIAL COMPATIBLE WITH THE EXPECTED FLOW CONDITIONS.

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TYPICAL TEMPORARY BRIDGE CROSSING

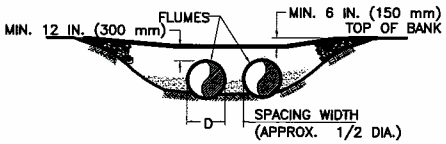
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DETAIL 16a

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SECTION 'A–A'

CONSTRUCTION PROCEDURES:

THE FOLLOWING IS A SEQUENCE OF CONSTRUCTION AND MITIGATION MEASURES TO BE FOLLOWED AT ALL TEMPORARY FLUME VEHICLE CROSSINGS.

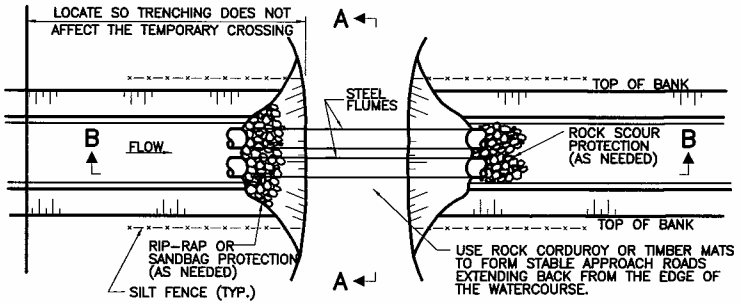
1. A PORTABLE FLEXI–FLOAT, OR TEMPORARY BRIDGE MAY BE SUBSTITUTED FOR THE TEMPORARY FLUME CROSSING.

2. THE LENGTH OF THE FLUME SHALL BE SUFFICIENT TO SPAN THE ENTIRE AREA REQUIRED FOR VEHICULAR ACCESS, EXTENDING 4 FT. BEYOND TOE OF FILL MATERIAL, SO TRENCHING WILL NOT AFFECT THE ROAD CROSSING. A LONGER PIPE IS TO BE USED, IF NEEDED, TO MAINTAIN STABLE SIDE SLOPES. FLUME CAPACITY TO BE BASED ON THE 2–YEAR DESIGN FLOW OR MAXIMUM FLOW ANTICIPATED TO OCCUR DURING INSTALLATION, AS SPECIFIED IN CONSTRUCTION DOCUMENTS.

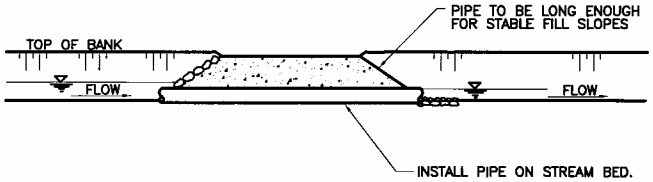
3. WHERE PRACTICAL, BACKFILL AROUND THE PIPES AT THE ROAD WITH CLEAN, COARSE ROCK FILL MATERIAL. IF SCOUR IS POSSIBLE, RIP–RAP IS TO BE PLACED ON THE STREAM BED DOWN–STREAM OF THE PIPE OUTLET EXTENDING A MINIMUM OF TWO PIPE DIAMETERS. ALTERNATIVELY, TIMBER EQUIPMENT MATS, SAND BAGS OR TIMBER CORDUROY MAY BE USED TO FORM THE TRAVEL SURFACE.

4. TO REDUCE MUD ENTERING THE WATER FROM EQUIPMENT TRACKS, THE APPROACH ROAD LEADING TO THE CULVERT CROSSING MUST BE RAISED AND STABLE SO EQUIPMENT LOADS ARE SUPPORTED A SUFFICIENT DISTANCE BACK FROM THE WATER. IF CUTS ARE NEEDED TO OBTAIN A SATISFACTORY GRADE, THEY ARE TO BE DUG WITH SIDE DITCHES AND STABLE SLOPES. EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE INSTALLED TO LIMIT THE POTENTIAL FOR SEDIMENT TO ENTER THE WATERBED (E.G., CHECK DAMS, SILT FENCE, RIP–RAP, SEED AND MULCH, SEDIMENT TRAPS, ETC.).

5. PERIODICALLY CHECK THE TEMPORARY CROSSING INSTALLATION AND REMOVE ANY BUILD–UP OF SEDIMENT OR DEBRIS ON THE BRIDGE. DISPOSE OF THIS MATERIAL AT LEAST 100 FT. FROM THE WATERCOURSE AND ABOVE THE HIGH WATER LEVEL.



PLAN VIEW



SECTION 'B–B'

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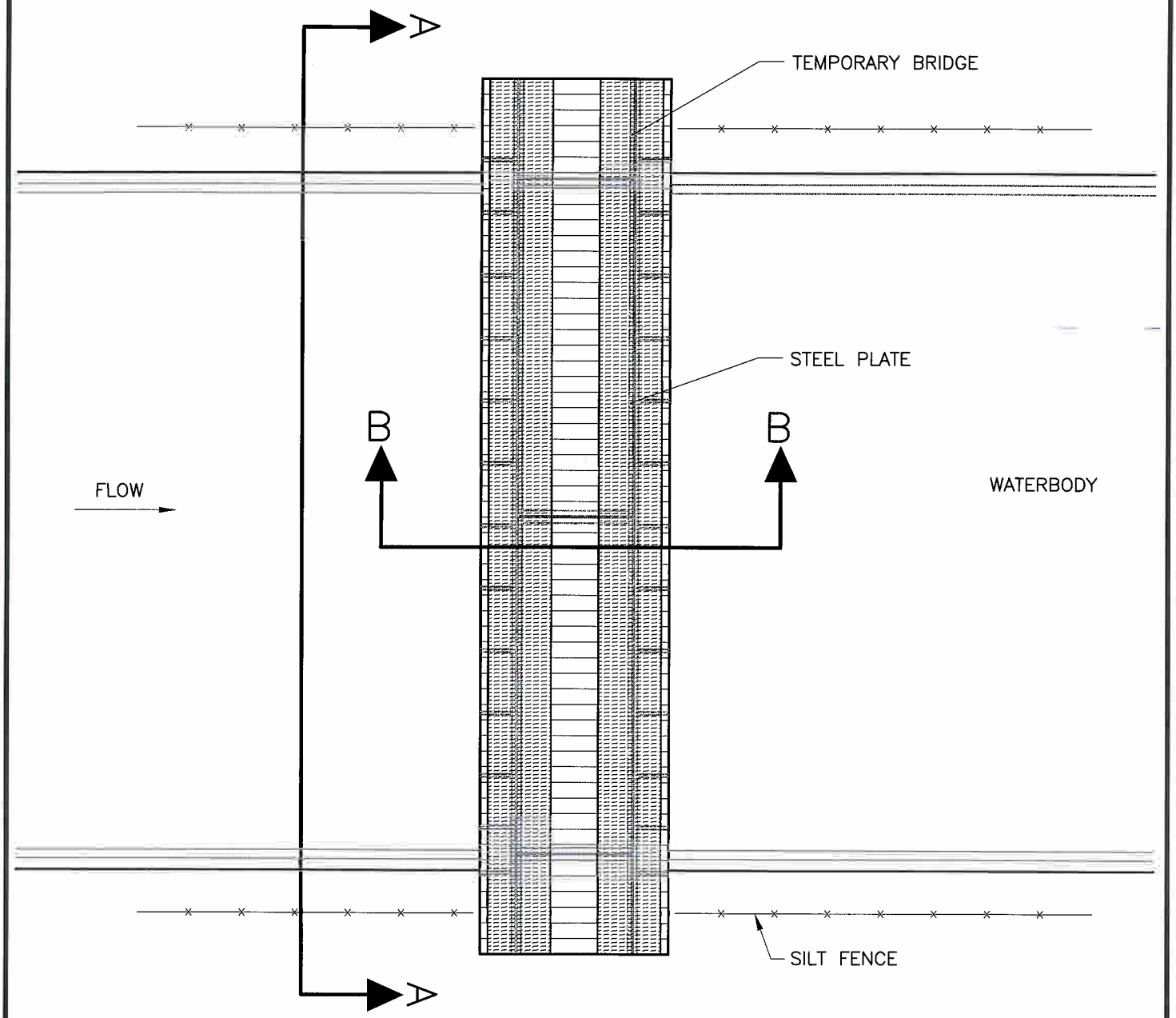
TYPICAL FLUME BRIDGE CROSSING

PROJECT: 50388E

DETAIL 17

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NOTES:

1. SEE DETAIL 18a FOR CONSTRUCTION PROCEDURES

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TYPICAL RAILCAR BRIDGE CROSSING

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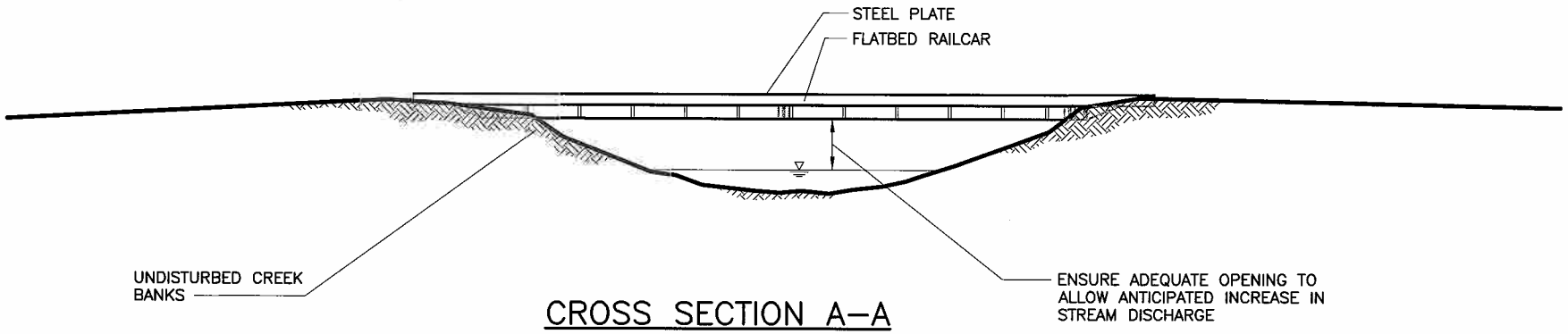
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DETAIL 18

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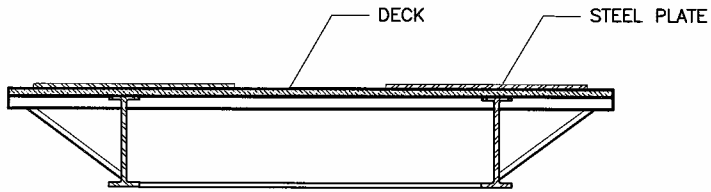
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CROSS SECTION A–A

CONSTRUCTION PROCEDURES:

1. THIS TYPICAL DRAWING PROVIDES FOR A RAILCAR BRIDGE EQUIPMENT CROSSING.
2. BRIDGE SHOULD BE A MINIMUM OF 12 FEET LONGER THAN BANK TO BANK WIDTH.
3. BEST MANAGEMENT PRACTICES UTILIZING EROSION CONTROL DEVICES, SUCH AS HAY BALES AND SILT FENCE ARE REQUIRED TO PREVENT SEDIMENTATION OF THE STREAM. EROSION PROTECTION SHALL BE PLACED ON THE STREAM BANKS.
4. DURING FINAL CLEAN–UP, REMOVE TEMPORARY EQUIPMENT CROSSINGS AS SOON AS POSSIBLE. INSTALLED MATERIALS, SUCH AS HAY BALES AND SILT FENCE MUST BE REMOVED AND DISPOSED IN ACCORDANCE WITH STATE AND LOCAL REGULATIONS AND REQUIREMENTS. THE STREAM BED, BANKS AND AREAS AFFECTED BY CONSTRUCTION OF THE TEMPORARY EQUIPMENT CROSSING SHOULD BE RESTORED TO A STABLE CONDITION. IF REQUIRED TO PREVENT TRANSPORT OF SEDIMENTATION TO THE STREAM, SILT FENCE SHOULD BE INSTALLED AT THE TOP OF THE BANKS.



CROSS SECTION B–B

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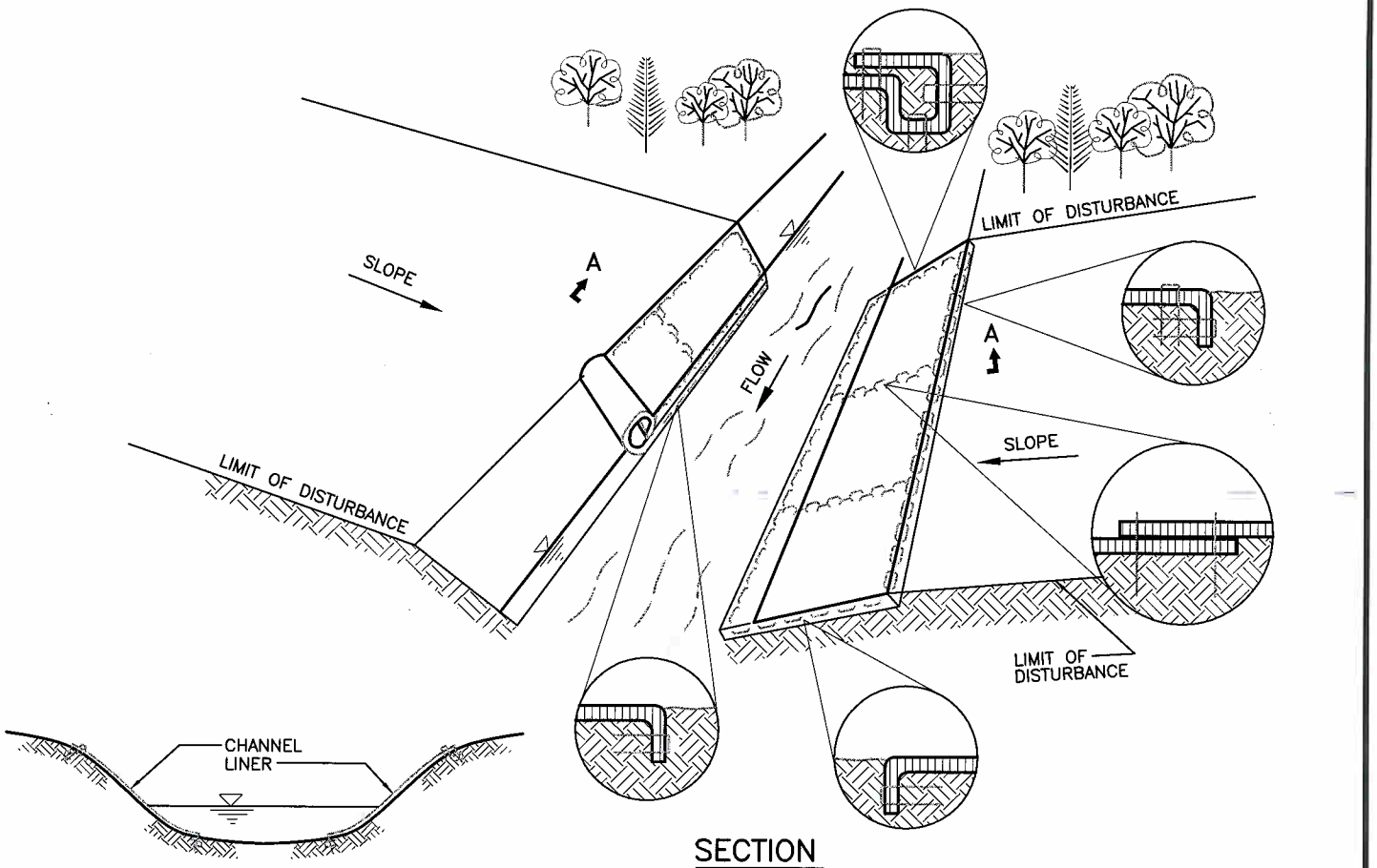
TYPICAL RAILCAR BRIDGE CROSSING

PROJECT: 50388E

DETAIL 18a

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SECTION

SECTION A–A

NOTES:

1. INSTALL AND ANCHOR LINERS FOLLOWING MANUFACTURER'S INSTRUCTIONS.
2. PREPARE SOIL BEFORE INSTALLING CHANNEL LINER, INLCUDING THE APPLICATION OF FERTILIZER AND SEED. CHANNEL LINERS SHOULD EXTEND COMPLETELY ACROSS DISTURBED BANK AREAS TO PROTECT ERODIBLE SURFACES.
3. BEGIN AT THE END OF THE CHANNEL BY ANCHORING THE LINER IN A TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
4. ROLL LINER IN DIRECTION OF WATER FLOW.
5. INSTALL LINERS END–OVER–END (SHINGLE STYLE) WITH OVERLAP USEING A DOUBLE ROW OF STAGGERED STAPLES 4 in. (100 mm) APART TO SECURE LINER.
6. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 ft. (9 TO 12 m) INTERVALS. USE A ROW OF STAPLES 4 in. (100 mm) BELOW THE FIRST ROW IN A STAGGERED PATTERN.
7. INSTALL CHANNEL LINER TO THE TOP OF THE DEFINED CHANNEL SECTION. TWO OR MORE ROWS OF BLANKETS MAY BE NECESSARY, THESE LINERS MUST BE OVERLAPPED 4 in. (100 mm) AND STAPLED.
8. THE CHANNEL LINER SHOULD EXTEND TO THE BASE OF THE CHANNEL AND STAPLED. FOR CHANNELS WITH VERY LITTLE OR NO FLOW. EXTEND A MIN. OF 1 ft. (300 mm) BELOW THE LOW WATER LEVEL AND STAPLE IN PLACE.
9. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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FLEXIBLE CHANNEL LINER INSTALLATION

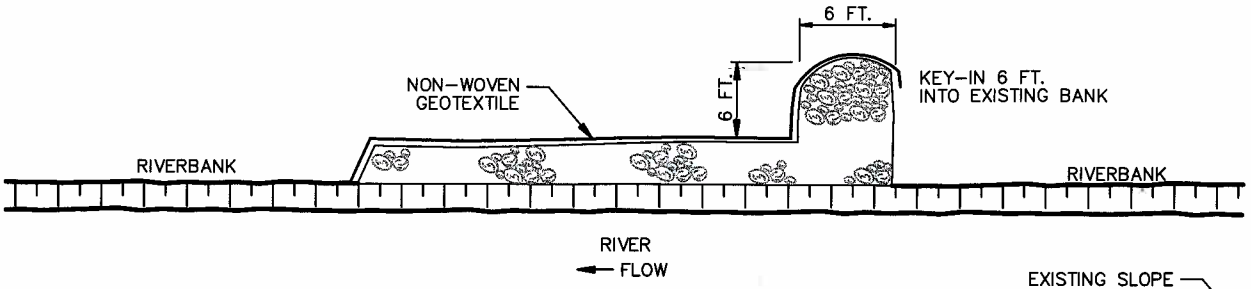
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DETAIL 19

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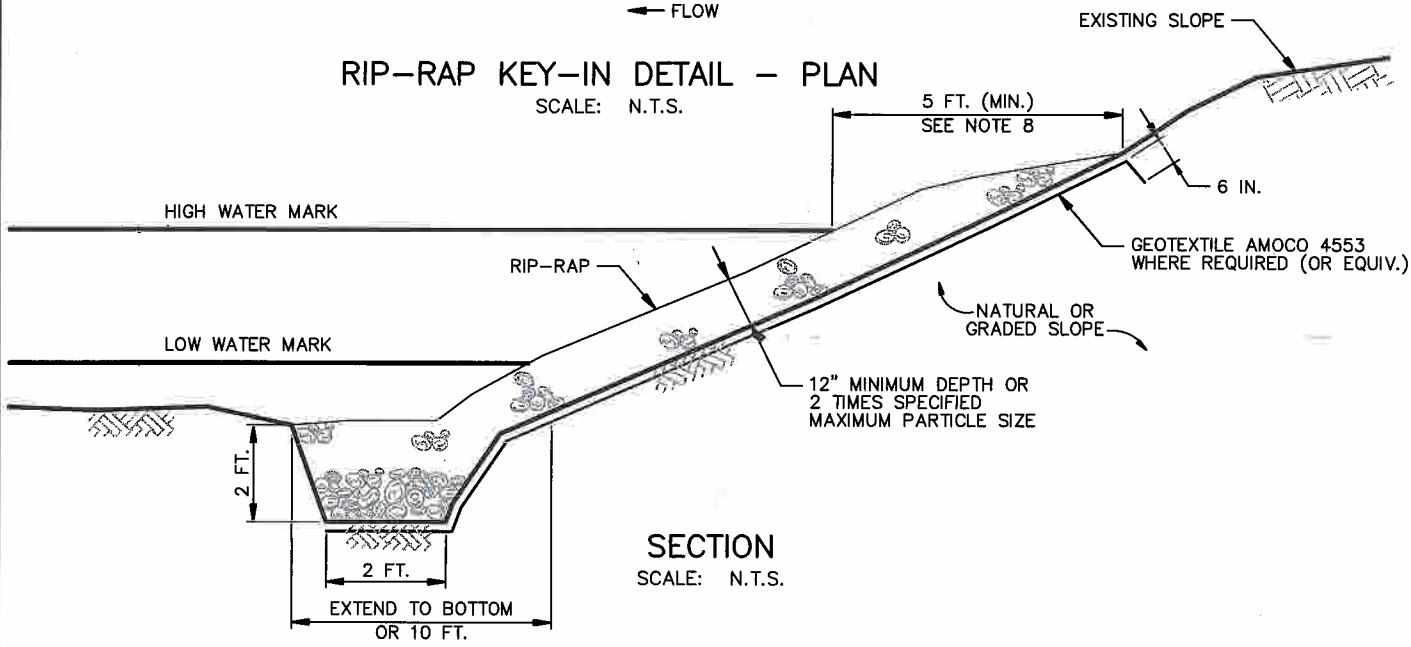
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RIP-RAP KEY-IN DETAIL - PLAN

SCALE: N.T.S.



SECTION

SCALE: N.T.S.

NOTES:

1. REMOVE ALL STUMPS, ORGANIC MATERIAL, AND PREPARE BANKS TO A STABLE CONFIGURATION TO A MAXIMUM SLOPE OF 2 HORIZONTAL TO 1 VERTICAL.
2. CONSTRUCT TOE TRENCH TO KEY IN BOTTOM OF RIP-RAP PROTECTION.
3. INSTALL FILTER CLOTH (GEOTEXTILE), SUCH AS AMOCO 4553 OR EQUIVALENT, UNDER ROCK WHERE SPECIFIED OR AS DIRECTED BY THE COMPANY. ADJOINING EDGES OF CLOTH SHALL OVERLAP A MINIMUM OF 12"
4. ROCK UTILIZED FOR RIP-RAP SHALL CONSIST OF SOUND, DURABLE ROCK, AND RESISTANT TO WEATHERING. INDIVIDUAL PIECES SHOULD BE ANGULAR, BLOCK SHAPED, AND HAVE A MINIMUM SPECIFIC GRAVITY OF 2.2.
5. INSTALL RIP-RAP TO A THICKNESS OF APPROXIMATELY 2 TIMES THE MAXIMUM EQUIVALENT DIAMETER OF THE RIP-RAP. EACH LOAD SHOULD BE WELL GRADED. A WELL GRADED MIXTURE IS COMPOSED 60% (MINIMUM) OF LARGER SIZES WITH 40% OF SMALLER SIZES TO FILL THE VOIDS.
6. SIZE OF RIP-RAP IS DEPENDENT UPON THE PREDICTED FLOW CONDITIONS.
7. KEY IN THE EDGES OF THE RIP-RAP AND FILTER CLOTH TO NATURAL GROUND CONTOURS SO THAT UNDERMINING DOES NOT OCCUR.
8. RIP-RAP IS TO BE INSTALLED TO 2 FT. ABOVE THE NORMAL HIGH WATER MARK OR 5 FT. ALONG THE SLOPE, WHICHEVER IS LESS.
9. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE TO SUIT ACTUAL SITE CONDITIONS.

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TYPICAL ROCK RIP-RAP

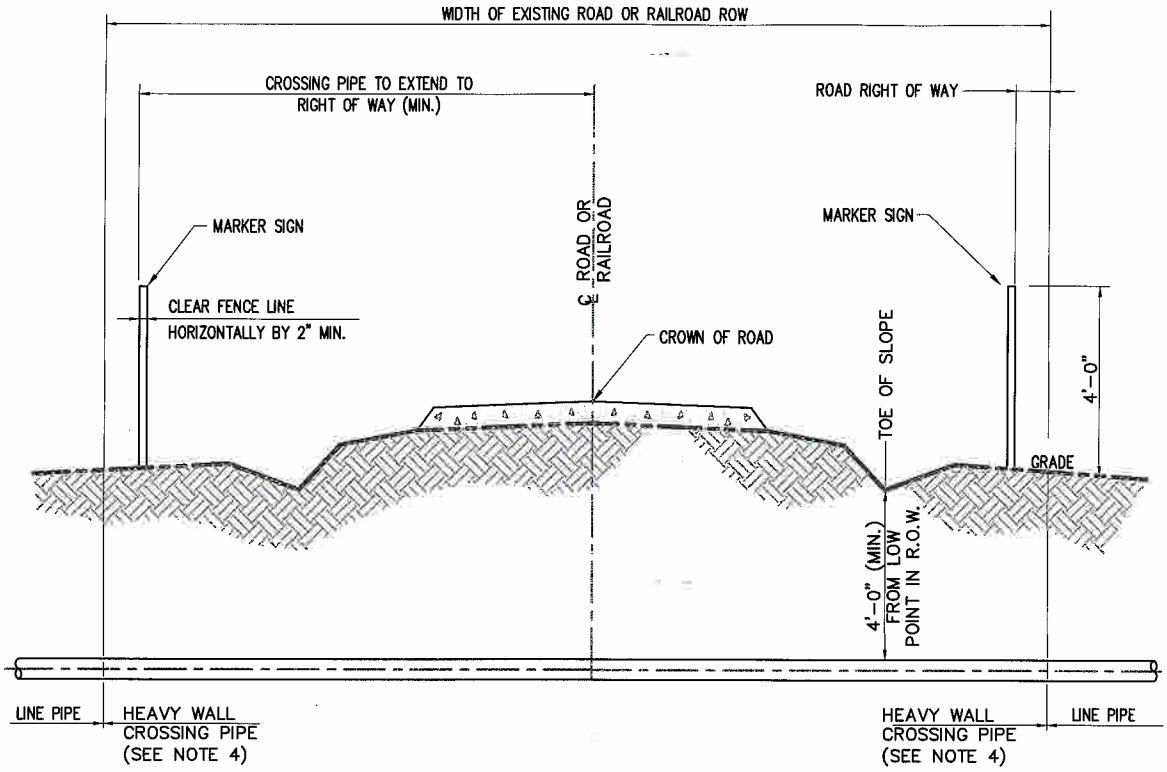
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DETAIL 20

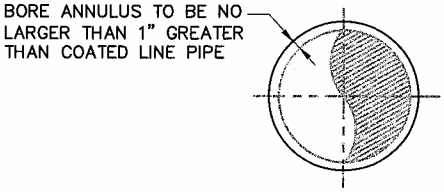
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TYPICAL UNCASED ROAD CROSSING BORED



NOTES:

1. CROSSINGS SHALL BE IN ACCORDANCE WITH APPLICABLE PERMIT.
2. ROAD CROSSING PIPE SHALL EXTEND AT MINIMUM TO RIGHT OF WAY LINE UNLESS OTHERWISE SPECIFIED.
3. THE TYPE AND MINIMUM REQUIRED LENGTH OF PIPE FOR CROSSINGS OF ROADS SHALL BE AS SPECIFIED ON ALIGNMENT SHEETS.
4. PIPE FOR BORED CROSSINGS TO INCLUDE ABRASION-RESISTANT (ARB) COATING.
5. PIPELINE MARKER & TEST STATIONS TO BE INSTALLED ON ROW LINE NEXT TO FENCE IF POSSIBLE.
6. THE CROSSING PIPE SHALL BE STRAIGHT WITH NO VERTICAL OR HORIZONTAL BENDS WITHIN ROAD RIGHT OF WAY.

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TYPICAL UNCASED ROAD CROSSING BORE DETAIL

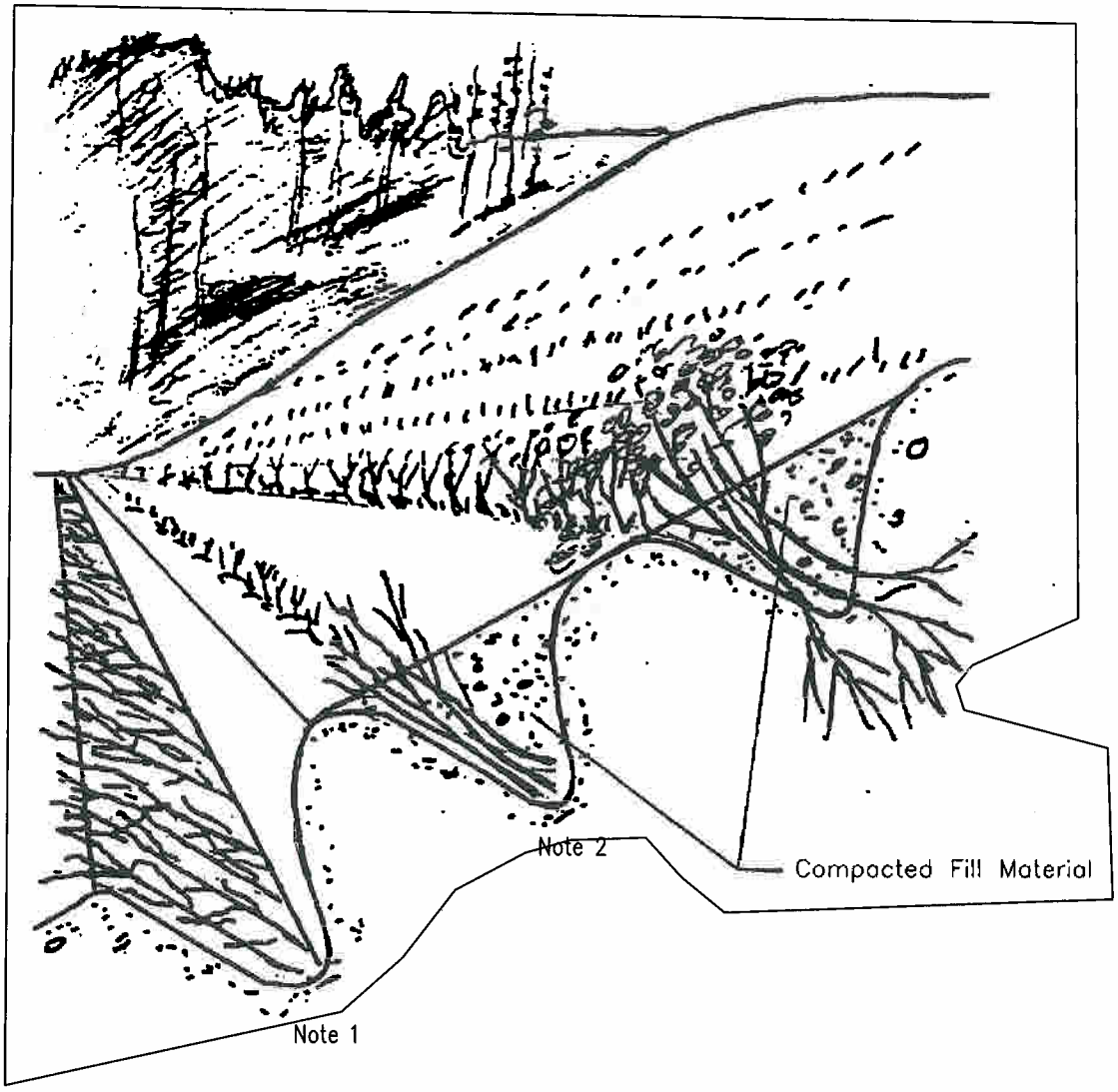
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DETAIL 21

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NOTES:

1. CUT TRENCH ACROSS SLOPE. FILL WITH DORMANT WOODY PLANT MATERIAL.
2. FILL IS PLACED ON TOP OF BRANCH LAYER AND COMPACTED.
3. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT SITE CONDITIONS.

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STREAMBANK RECLAMATION-BRUSH LAYER IN CROSS CUT SLOPE

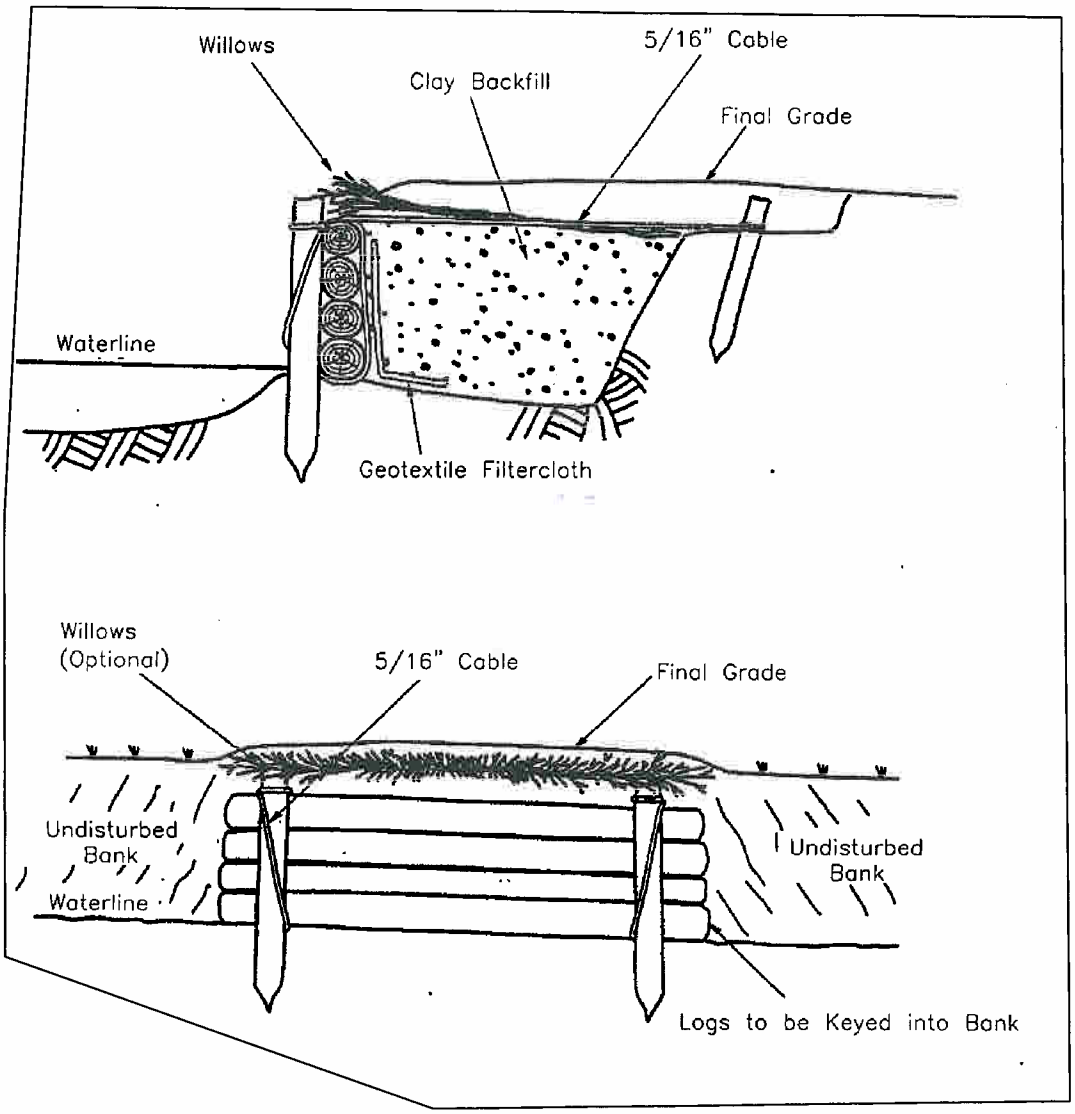
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DETAIL 22

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NOTES:

1. LOG WALLS TO BE CONSTRUCTED USING CONIFEROUS MATERIAL.
2. NATURE BACKFILL OR LOOSE GRADE MATERIAL SHOULD BE USED AS FILL MATERIAL.
3. ANCHOR PILINGS OR DEADMAN ANCHORS TO BE USED TO SECURE CABLE IN BANK.
4. NON-WOVEN FILTER CLOTH (NYLEX C34 OR EQUIVALENT) TO BE USED TO LINE LOG WALL.
5. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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STREAMBANK RECLAMATION-LOGWALL

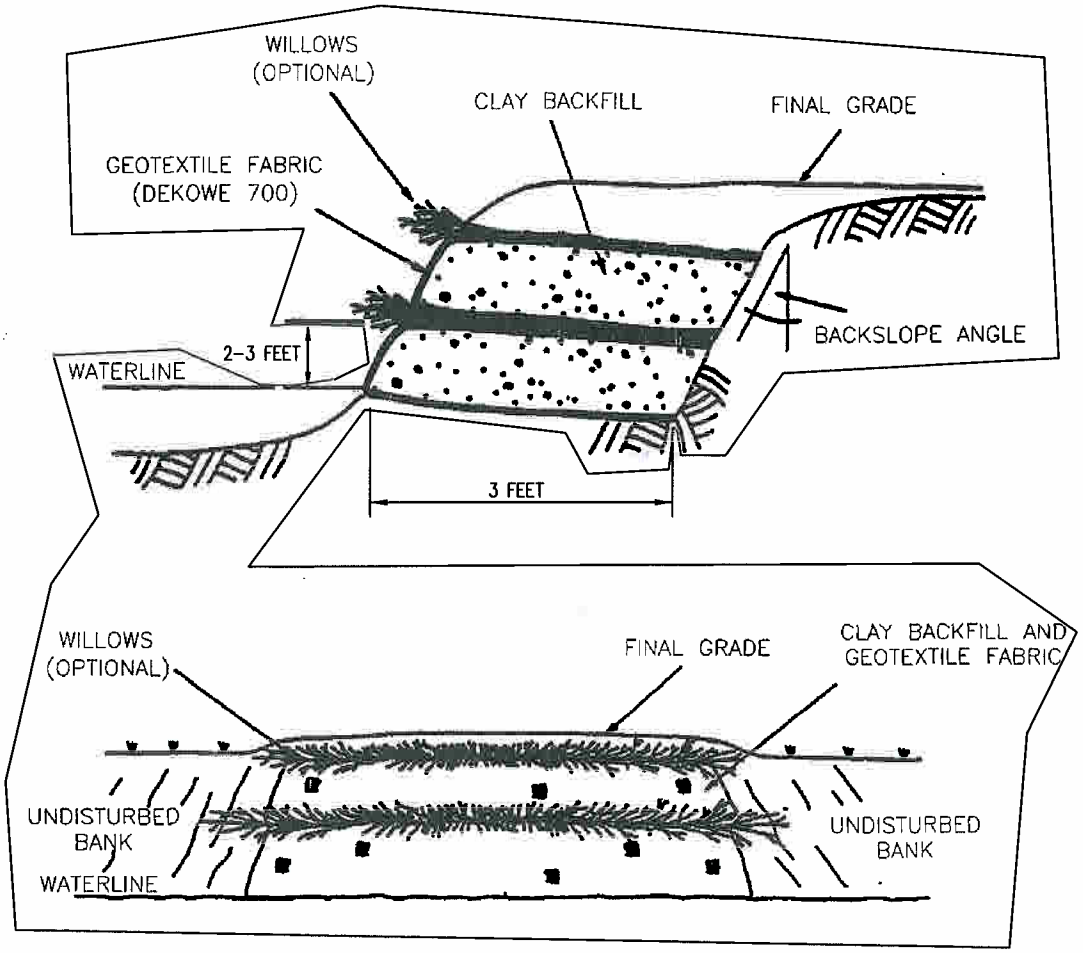
PROJECT: 50388E

DETAIL 23

DRAWING NUMBER	DRAWN BY	CHECKED BY	APPROVED BY
K-00-P-7000-301	NY	GC	LAG

LAST PLOT DATE: Tue, 04 Apr 2006 - 3:33pm

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NOTES:

1. NATURE BACKFILL OR LOOSE GRADE MATERIAL SHOULD BE USED TO MINIMIZE AIR SPACES. THIS ALLOWS PROPER SOIL FABRIC CONTACT, WHICH MINIMIZES STEELING AND SCOURING DURING RUNOFF AND ENSURES SURVIVAL OF THE WILLOW CUTTINGS.
2. PLYWOOD FORMS (8X2 FEET) MAY BE REQUIRED TO HELP RECONSTRUCT STEEP OR VERTICAL BANKS.
3. GRID LAYERS SHOULD NOT EXCEED 3 FEET IN HEIGHT WITH A MINIMUM OF 3 FEET SET IN BANK.
4. WILLOWS SHOULD BE HARVESTED AS CLOSE TO INSTALLATION AS POSSIBLE, PREFERABLY THE PREVIOUS DAY BUT NO MORE THAN 2 DAYS EARLY.
5. WILLOWS SHOULD BE 0.5 TO 1 INCH IN DIAMETER AND 2 TO 3 FEET LONG WITH NO MORE THAN 10 INCHES LEFT EXPOSED.
6. PLANTING RATE SHOULD BE APPROXIMATELY 1 STEM PER 6 INCHES.
7. INSTALLATION TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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STREAMBANK RECLAMATION-VEGETATED GEOTEXTILE INSTALLATION

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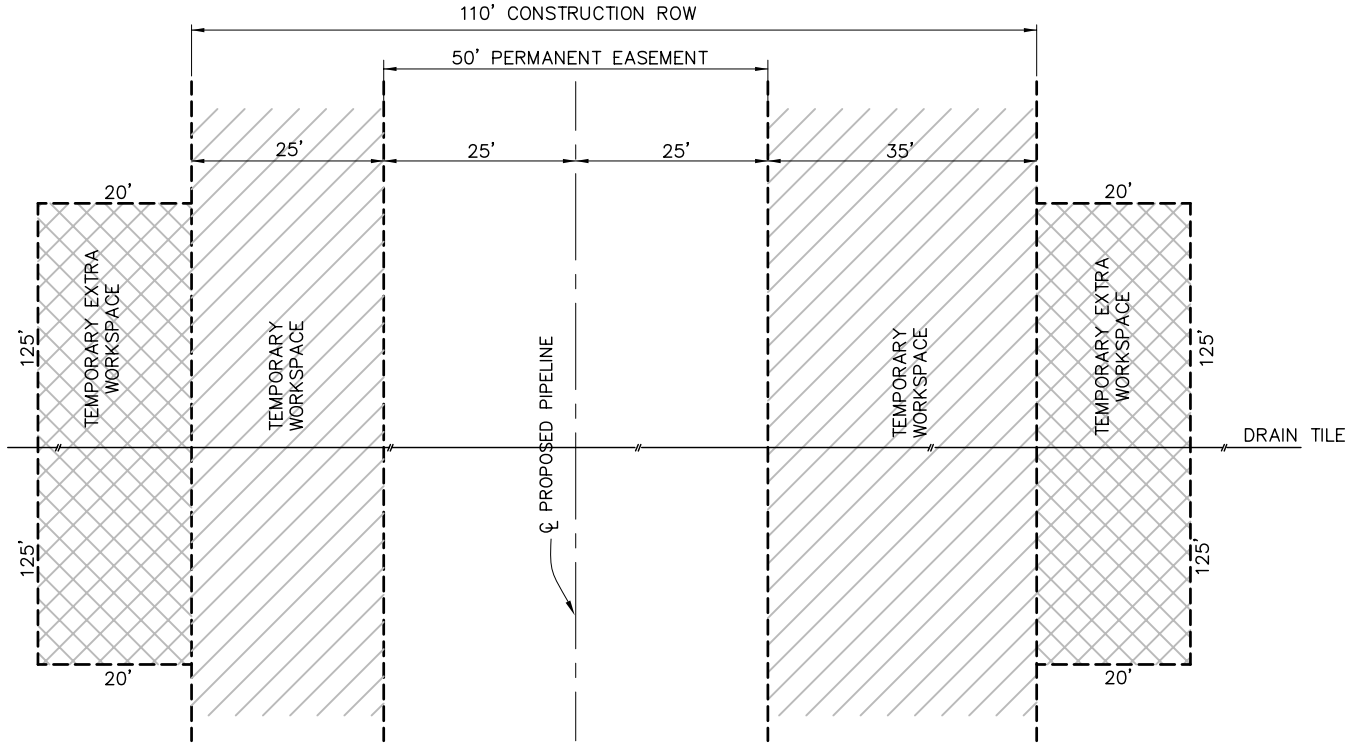
PROJECT: 50388E

DETAIL 24

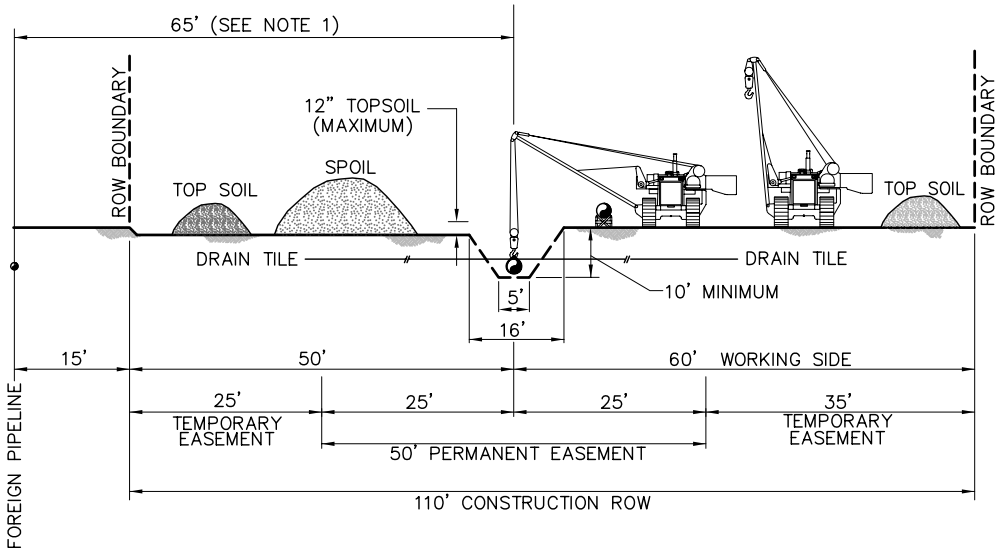
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PLAN



ELEVATION

N.T.S.

NOTES:

1. THE OFFSET FROM A FOREIGN PIPELINE, WHERE APPLICABLE, WILL BE 40' FOR MOST LOCATION. BUT MAY BE INCREASED OR DECREASED DEPENDING ON THE SITE SPECIFIC CONSTRUCTION REQUIREMENTS.
2. THE MINIMUM CLEARANCE BETWEEN THE TOP OF PIPE AND THE BOTTOM OF DRAIN TILE WILL BE 12 INCHES.
3. INSTALLATION SPECIFICATIONS TO BE MODIFIED BY KEYSTONE AS NECESSARY TO SUIT ACTUAL SITE CONDITIONS.

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KEYSTONE PIPELINE PROJECT

TYPICAL ROW LAYOUT/SOIL HANDLING 110' CONST. R.O.W. 50' ESMT. DRAIN TILE CROSSING

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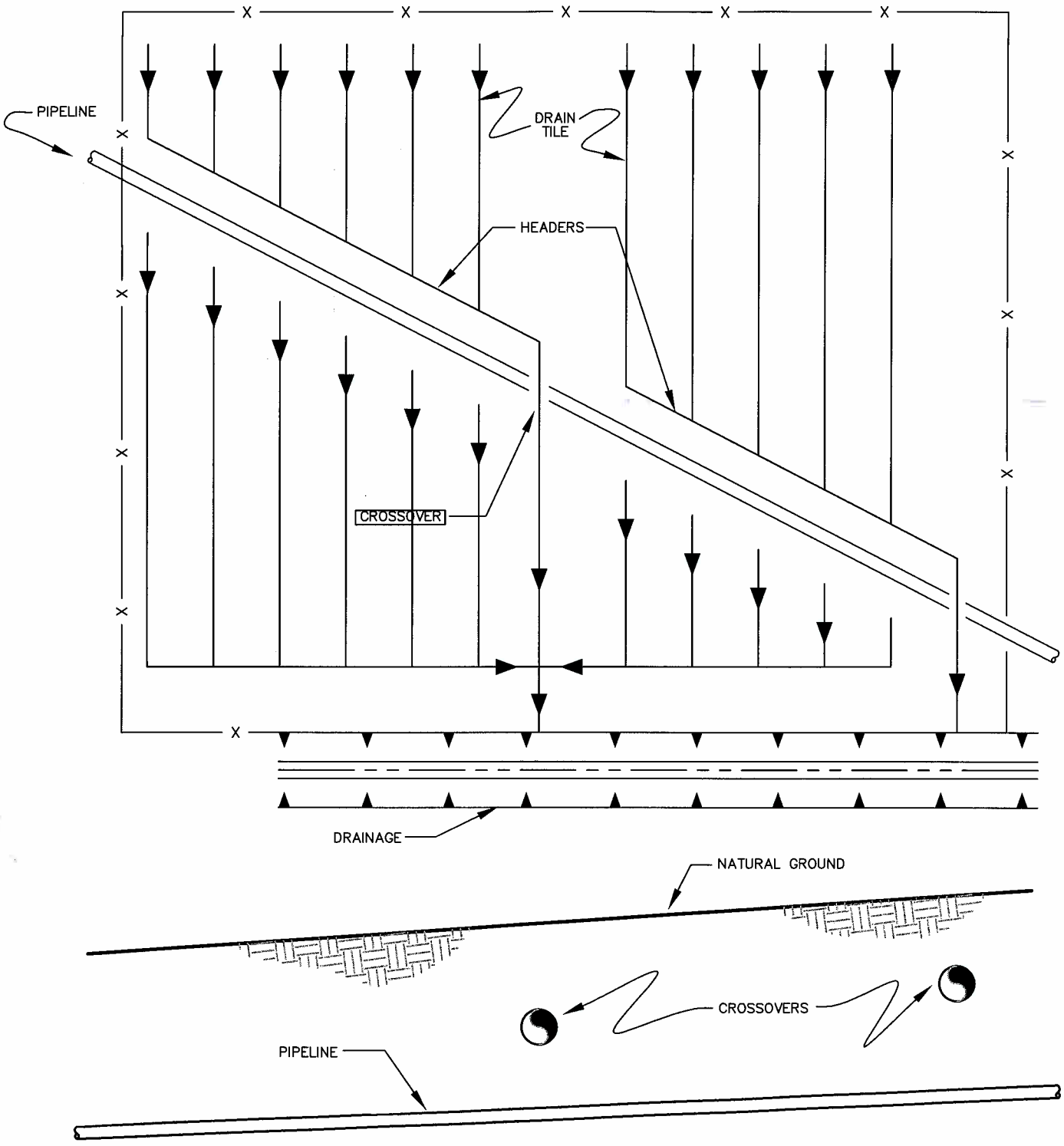
DETAIL 25

DRAWING NUMBER	DRAWN BY	CHECKED BY	APPROVED BY
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LAST PLOT DATE: Wed, 05 Apr 2006 - 3:38pm

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HEADER / MAIN CROSSOVERS OF PIPELINE



PROFILE

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HEADER / MAIN CROSSOVERS OF PIPELINE

PROJECT: 50388E

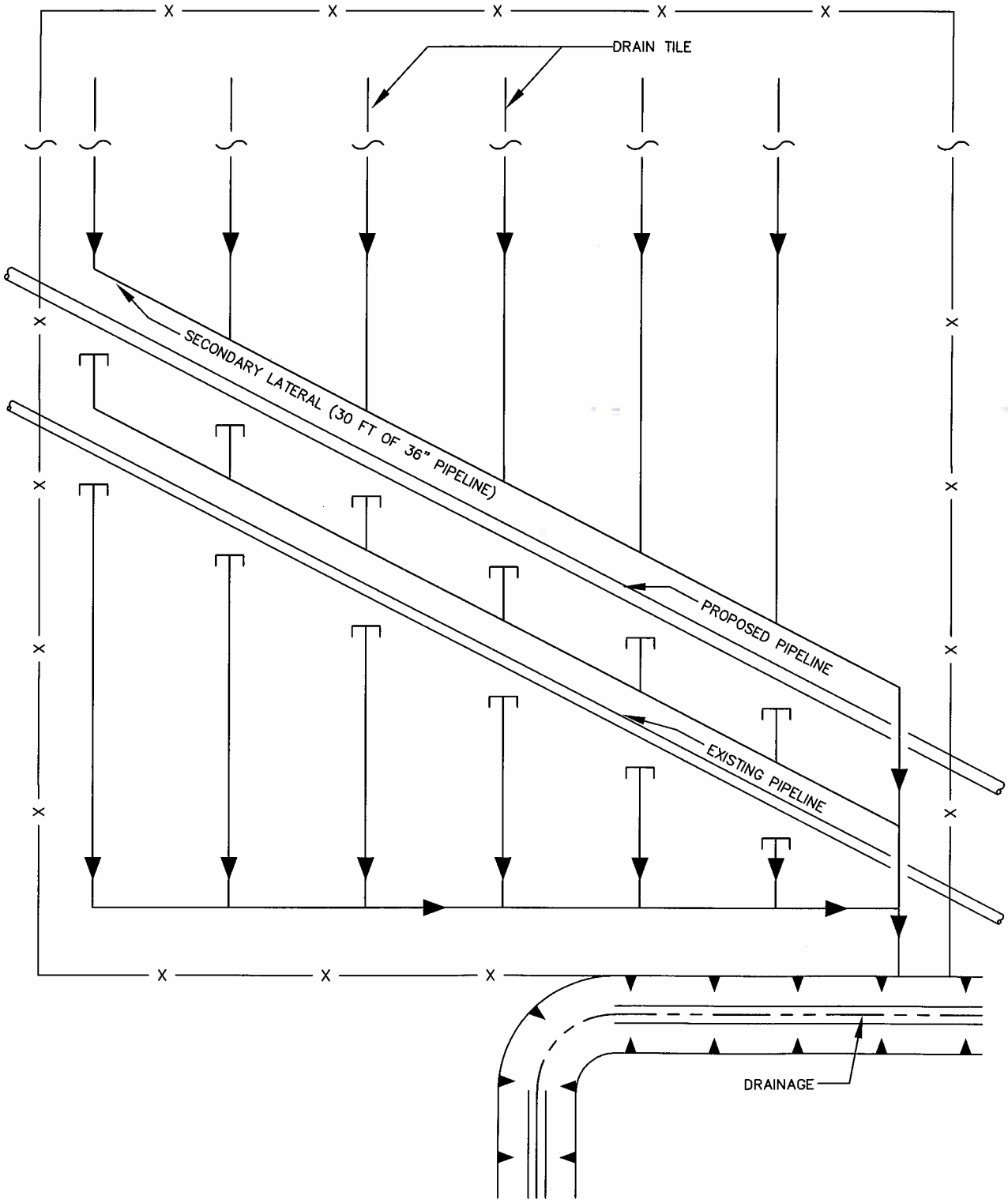
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LAST PLOT DATE: Tue, 04 Apr 2006 - 3:43pm

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RELOCATE / REPLACE DRAINAGE HEADER / MAIN



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HEADER / MAIN CROSSOVERS OF PIPELINE

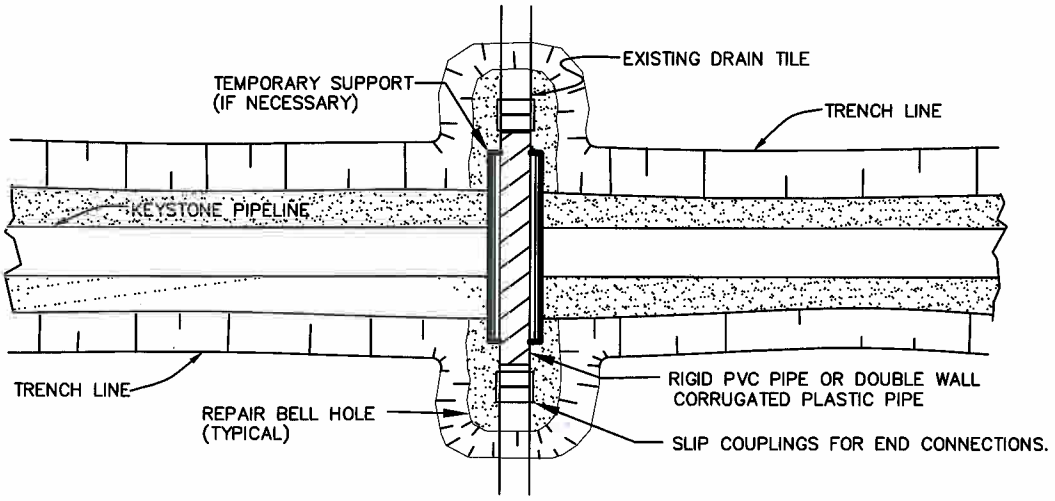
PROJECT: 50388E

DETAIL 27

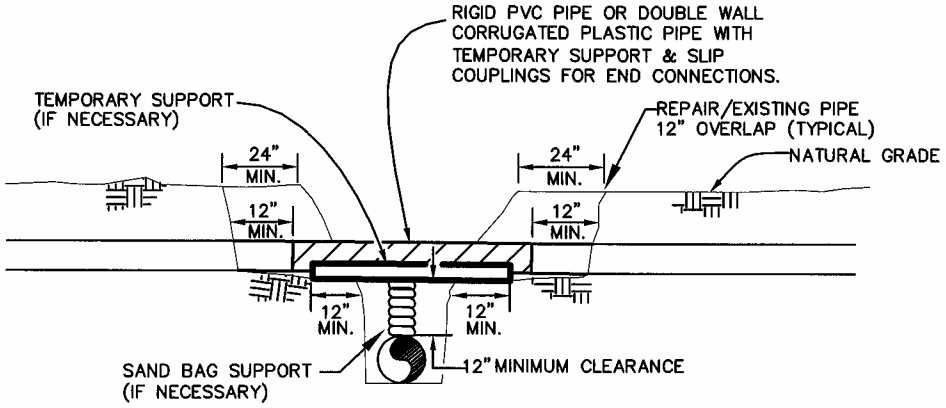
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PLAN



CROSS SECTION

NOTES:

1. IMMEDIATELY REPAIR TILE IF WATER IS FLOWING THROUGH TILE AT TIME OF TRENCHING.
2. SCREEN ALL EXPOSED ENDS OF TILE LINES.

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KEYSTONE PIPELINE PROJECT

DRAINAGE AND IRRIGATION
TEMPORARY DRAIN TILE
REPAIR

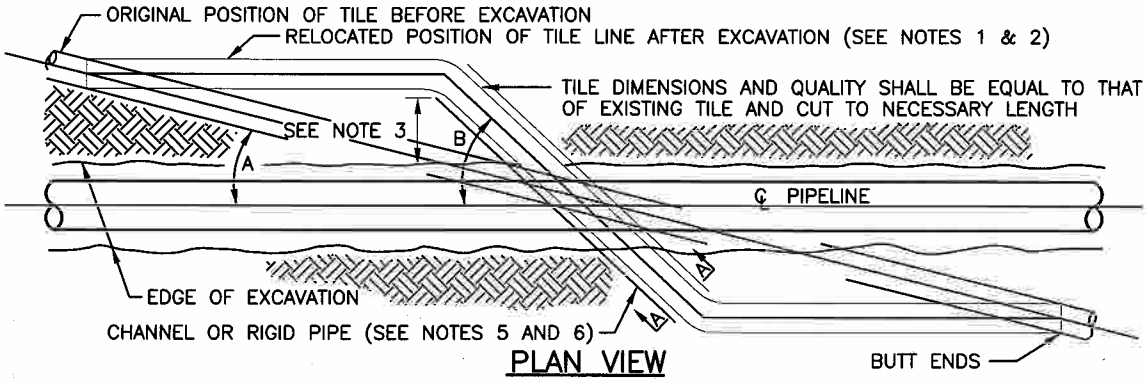
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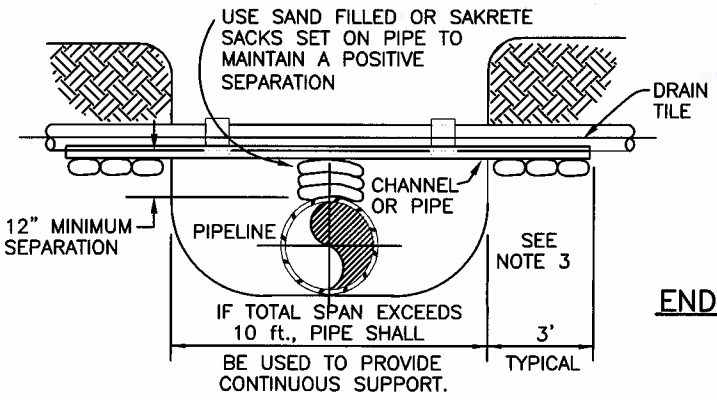
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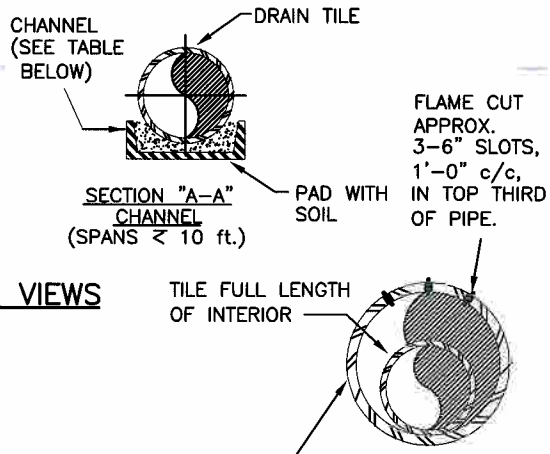
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PLAN VIEW





END VIEWS

NOTES

1. TILE REPAIR SHALL MAINTAIN ORIGINAL ALIGNMENT AND GRADIENT WHEN ANGLE "A", BETWEEN PIPELINE AND ORIGINAL TILE, IS MORE THAN 20° UNLESS OTHERWISE DIRECTED BY KEYSTONE REPRESENTATIVE.
2. WHEN ANGLE A IS LESS THAN 20°, UNLESS OTHERWISE DIRECTED BY COMPANY, ANGLE "B" SHALL BE 45° FOR USUAL WIDTHS OF TRENCH. FOR EXTRA WIDTHS IT MAY BE GREATER AS DIRECTED BY KEYSTONE REPRESENTATIVE.
3. 3'–0" MINIMUM LENGTH OF CHANNEL OR RIGID PIPE SHALL BE SUPPORTED BY UNDISTURBED SOIL, OR IF CROSSING IS NOT AT RIGHT ANGLES TO GAS PIPELINE, EQUIVALENT LENGTH PERPENDICULAR TO TRENCH. SHIM WITH SAKRETE, SAND BAGS OR CONCRETE BLOCKS TO UNDISTURBED SOIL FOR SUPPORT AND DRAINAGE GRADIENT MAINTENANCE (TYPICAL BOTH SIDES).
4. DRAINAGE TILE SHALL BE REPLACED SO THAT ITS FORMER GRADIENT AND ALIGNMENT ARE RESTORED.
5. DIAMETER OF RIGID PIPE SHALL BE OF ADEQUATE SIZE TO ALLOW FOR THE INSTALLATION OF THE TILE FOR THE FULL LENGTH OF THE RIGID PIPE.
6. OTHER METHODS OF SUPPORTING DRAIN TILE MAY BE USED IF THE ALTERNATE PROPOSED IS EQUIVALENT IN STRENGTH TO THE CHANNEL/PIPE SECTIONS SHOWN AND IF APPROVED BY THE KEYSTONE REPRESENTATIVE IN ADVANCE. SITE SPECIFIC ALTERNATE SUPPORT SYSTEM TO BE DEVELOPED BY KEYSTONE REPRESENTATIVE AND FURNISHED TO CONTRACTOR FOR SPANS IN EXCESS OF 20 FEET, TILE GREATER THAN 10" DIAMETER, AND FOR "HEADER" SYSTEMS.
7. ALL MATERIAL TO BE FURNISHED BY CONTRACTOR.
8. PRIOR TO REPAIRING TILE, CONTRACTOR SHALL PROBE INTO THE EXISTING TILE TO THE FULL WIDTH OF THE RIGHT OF WAY TO DETERMINE IF ADDITIONAL DAMAGE HAS OCCURRED. ALL DAMAGED/DISTURBED TILE SHALL BE REPAIRED AS NEAR AS PRACTICABLE TO ITS ORIGINAL OR BETTER CONDITION.
9. "NIGHT CAP" OPEN ENDS OF PIPE AND/OR DRAIN TILES IF REPAIRS ARE NOT COMPLETED BY END OF WORK DAY.

MINIMUM SUPPORT TABLE			
TILE SIZE	CHANNEL SIZE	PIPE SIZE	
3"	4" ● 5.4 #/ft.	4"	STD. WT
4"–5"	5" ● 6.7 #/ft.	6"	STD. WT
6"–9"	7" ● 9.8 #/ft.	8"–10"	STD. WT
10"	10" ● 15.3 #/ft.	12"	STD. WT

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DRAINAGE AND IRRIGATION PERMANENT DRAIN TILE REPAIR

PROJECT: 50388E

DETAIL 29

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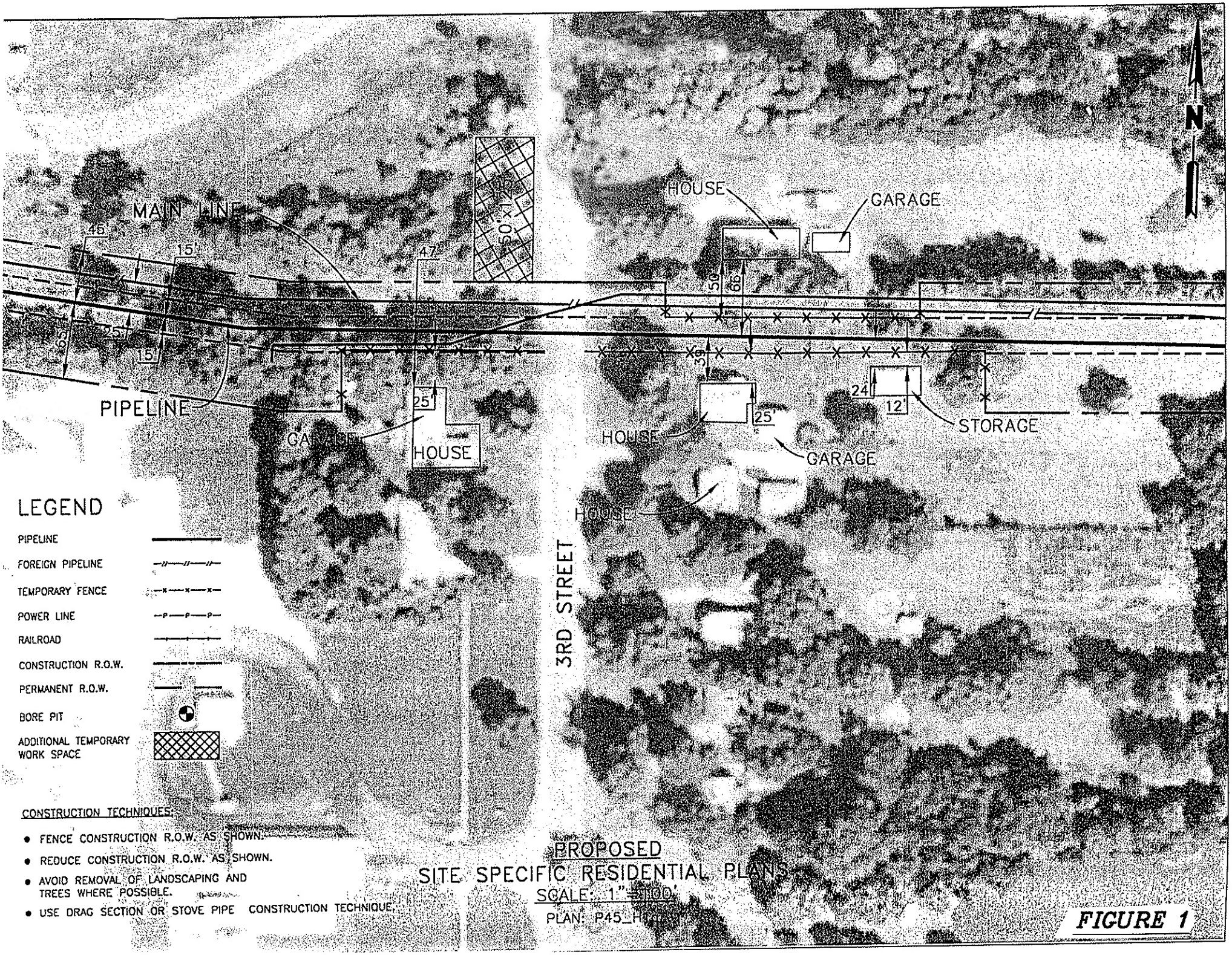

MAIN LINE
45'
15'
47'
50' x 50'
HOUSE
GARAGE
50'
66'
65'
25'
15'
39'
24'
12'
PIPELINE
25'
GARAGE
HOUSE
HOUSE
25'
GARAGE
STORAGE
HOUSE
3RD STREET
N
LEGEND
PIPELINE
FOREIGN PIPELINE
TEMPORARY FENCE
POWER LINE
RAILROAD
CONSTRUCTION R.O.W.
PERMANENT R.O.W.
BORE PIT
ADDITIONAL TEMPORARY WORK SPACE
CONSTRUCTION TECHNIQUES:
• FENCE CONSTRUCTION R.O.W. AS SHOWN.
• REDUCE CONSTRUCTION R.O.W. AS SHOWN.
• AVOID REMOVAL OF LANDSCAPING AND TREES WHERE POSSIBLE.
• USE DRAG SECTION OR STOVE PIPE CONSTRUCTION TECHNIQUE.
PROPOSED
SITE SPECIFIC RESIDENTIAL PLANS
SCALE: 1" = 100'
PLAN: P45_H

FIGURE 1

Appendix D

Hydrostatic Test Plan

KEYSTONE PIPELINE PROJECT

DRAFT
HYDROSTATIC TEST PLAN



November 15, 2007
Rev. 2

1.0 INTRODUCTION

2.0 HYDROSTATIC TESTING
- **2.1 Test Water Source and Discharge Locations**
- **2.2 Filling the Mainline Pipeline**
- **2.3 Small Hydrostatic Test Sections**
- **2.4 Dewatering the Pipeline**

ATTACHMENT A HYDROSTATIC TEST SOURCES AND ALTERNATE SOURCE LOCATIONS

1.0 INTRODUCTION

This Hydrostatic Test Plan provides an overview of the methods and guidelines for conducting hydrostatic testing operations for the Keystone Pipeline Project (Keystone). Once the pipeline is constructed, in order to assure compliance with U.S. Department of Transportation regulations, Keystone must pressure test the pipeline in accordance with CFR Part 192 requirements. The hydrostatic test contractor is required to comply with the environmental requirements of this plan and all federal and state permits and approvals, including the Project's Biological Assessment (BA). Special requirements associated with hydrostatic test water withdrawals to protect sensitive species and habitats are included below.

The project's Construction Mitigation and Reclamation Plan provides additional mitigation measures and erosion and sediment control methods that will be implemented during construction to minimize potential impacts during construction, hydrostatic testing, and reclamation of the Keystone Pipeline Project.

2.0 HYDROSTATIC TESTING

2.1 Test Water Source and Discharge Locations

Keystone plans to withdraw water from a number of surface water sources along the project route to hydrostatically test the pipeline in sections following construction. Primary and alternate hydrostatic test water sources are included in Attachment A. Keystone will obtain all appropriate permits and authorizations for water withdrawals. Water withdrawn from a source will be returned directly to the same source or nearby (within the same watershed) at the completion of testing operations. During hydrostatic test water withdrawals, the Contractor will maintain adequate flow rates in the waterbody to protect aquatic life and provide for downstream uses, in compliance with regulatory and permit requirements. In the event that primary test water sources do not contain adequate flow rates to support the hydrostatic test water withdrawal without affecting downstream uses and resources, the alternate water sources identified in Attachment A may be used. In some cases, the alternate water source may replace more than one primary water source.

In waterbodies where sensitive species are located, Keystone will generally avoid withdrawal of hydrostatic test water until after August 1, unless specific approval is obtained in advance from the appropriate regulatory or resource agency(ies). Small withdrawals associated with horizontal directional drills may take place before August 1. In these cases, the withdrawal rates will be minor and the pump intakes will be screened with fine mesh to avoid entrainment or impingement of fish or debris.

In areas where zebra mussels are known to occur, all equipment used during the hydrostatic test withdrawal and discharge will be thoroughly cleaned before being used at subsequent hydrostatic test locations to prevent the transfer of zebra mussels or veligers to new locations.

2.2 Filling the Mainline Pipeline

In order to obtain water from the surface waterbody, a fill pump will be placed at the waterbody's edge and connected to a hydrostatic test fill line (approximately 6- to 10-inch diameter steel pipe or hose) placed along the ground and attached to the hydrostatic test header. If there is not an adequate depression in the river bottom, it may be necessary to dig a small sump to allow the pump intake to be fully submerged. The intake of the pump will be screened to prevent entrainment of debris and fish. The fill pump will be placed in a plastic-lined bermed or metal containment to prevent spills or leaks from reaching the ground or the waterbody. The fill pumps will be continuously monitored during operation.

Keystone anticipates that water will be withdrawn at an average rate of 3000 gallons per minute through a 6- to 10-inch pipe or hose. Water withdrawal rates will be monitored to avoid significant impacts to downstream water users, resources and streamflow. The screen around the intake will be fabricated to provide an adequate surface area of fine meshed screen to reduce the approach velocity to prevent impingement or entrainment of small fish. For example, to achieve an approach velocity of less than 0.11 m/s for a withdrawal rate of 3000 gallons per minute, a #60 wedge wire screen with a mesh opening of 0.10 inches and an open area of 63% would require at least 30 square feet of screen surface area to prevent impingement or entrainment of fish with a subcarangiform swimming mode. The contractor will utilize a screen around the pump intake with a larger surface area than indicated in this example. Keystone will regularly inspect the water intake screen for entrained fish and will contact the FWS immediately if federally listed aquatic species (e.g., fish or mussels) are found impinged on the screen.

Water withdrawn for hydrostatic testing will be in the pipeline for fewer than 30 days before being discharged back to (or near) the location where it was withdrawn.

Additional protective measures that will be implemented during hydrostatic test water filling and discharge operations include the following:

- Keystone will obtain water samples for analysis from each source before filling the pipeline. In addition, water samples will be taken prior to discharge of the water, as required by state and federal permit requirements.
- Staging/work areas for filling the pipeline with water will be located a minimum of 100 feet from the waterbody or wetland boundary if topographic conditions permit. The Contractor will install temporary sediment filter devices adjacent to all streams to prevent sediments from leaving the construction site.
- The intake hose and screen will be kept off the bottom of the waterbody.
- Refueling of construction equipment will be conducted a minimum distance of 100 feet from the stream or a wetland.
- Pumps used for hydrostatic testing within 100 feet of any waterbody or wetland will be operated and refueled within secondary containment as detailed in the Project's Spill Prevention, Control and Countermeasure Plan. The fill pumps will be set on a catch pan or plastic lined secondary

containment berm of sufficient dimensions to prevent any leaking fuel or lubricants from entering the water source.

2.3 Small Hydrostatic Test Sections

Selected river crossing pipe sections may be specified to be pre-tested for a minimum of 1 hour. Water for pre-testing of a river crossing section may be hauled or taken from the respective river if it is an approved water withdrawal source. Intakes for the small test sections will be screened with fine mesh, and the intake rate/volume will be quite low to prevent entrainment of fish or debris on the screen. Since the volume of water utilized in these pre-test sections of pipeline will be relatively small, the water will be discharged overland along the construction right-of-way and allowed to soak into the ground. Erosion and sediment control measures will be installed to prevent sedimentation from the discharge.

2.4 Dewatering the Pipeline

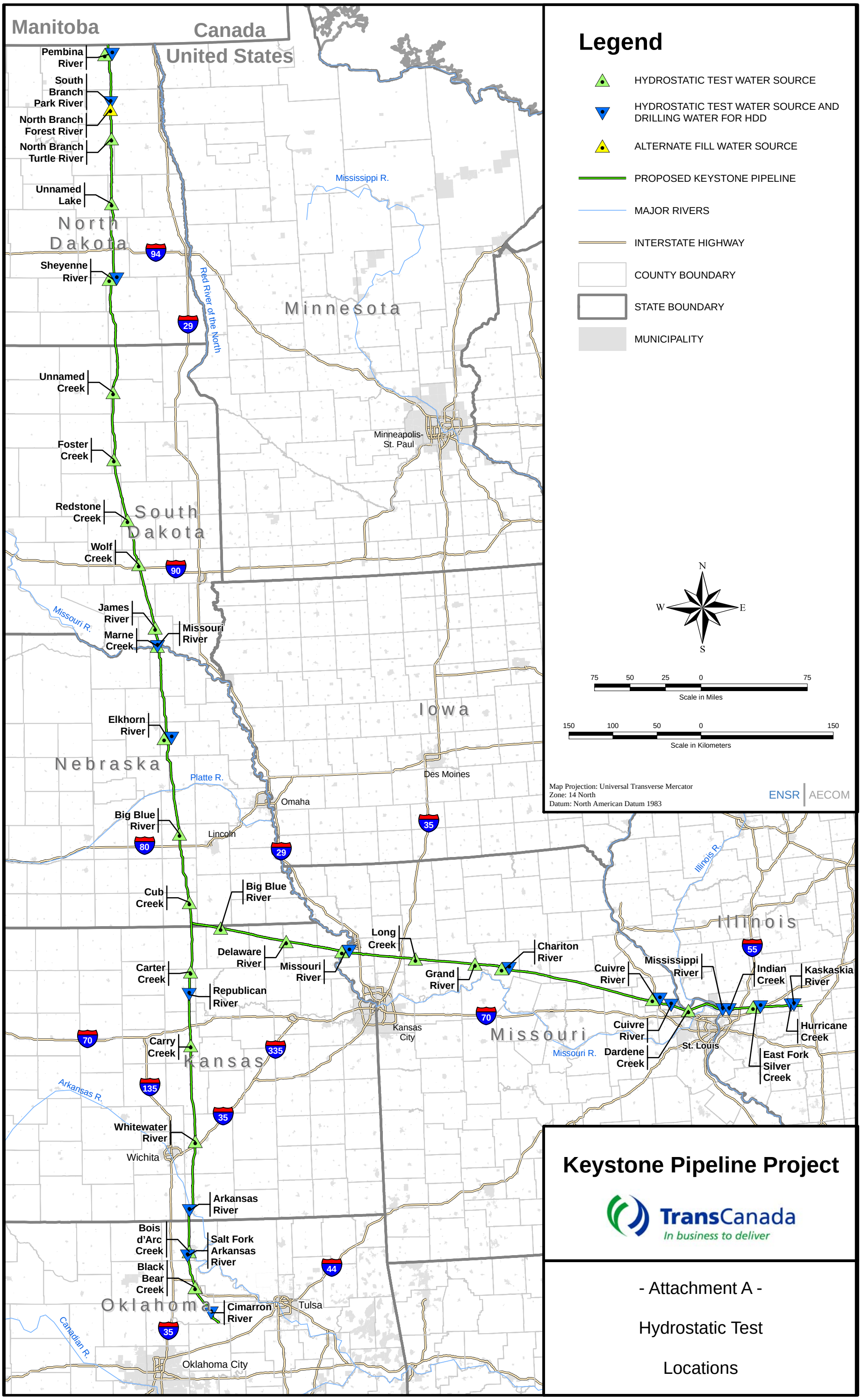
Once hydrostatic testing is complete, the hydrostatic test water will be returned to the same waterbody source – or to the same general vicinity – from where it was withdrawn. Discharge piping (approximately 6- to 10-inch diameter steel pipe) and an energy dissipater (usually a welded steel baffling device) would be transported to the river's edge using equipment. The equipment will keep the energy dissipater in place during the discharge and then remove the piping and dissipater once dewatering is complete. Additional best management practices, such as the use of plastic sheeting or other material to prevent scour, will be used as necessary to prevent excessive sedimentation during dewatering.

The pipeline is constructed of all new materials and there will be no additives in the hydrostatic test water. Therefore, the project does not anticipate exceeding water quality standards. Typically, hydrostatic test water will pick up some iron oxide (rust) from the new pipe and may give the discharge water a slight red color. The energy dissipater mentioned above is designed to prevent scouring and erosion at the point of discharge.

The discharge operation will be monitored and water samples will be taken prior to the beginning of the discharge to ensure that it complies with project and permit requirements. If required by state permits, additional water quality testing will be conducted during discharge, in accordance with permit conditions.

ATTACHMENT A

HYDROSTATIC TEST WATER SOURCES


Manitoba
Canada
United States
Pembina River
South Branch Park River
North Branch Forest River
North Branch Turtle River
Unnamed Lake
North Dakota
Sheyenne River
Red River of the North
Mississippi R.
Minnesota
Unnamed Creek
Foster Creek
Redstone Creek
South Dakota
Wolf Creek
Missouri R.
James River
Marne Creek
Missouri River
Elkhorn River
Nebraska
Platte R.
Big Blue River
Lincoln
Omaha
Des Moines
Iowa
Cub Creek
Big Blue River
Long Creek
Delaware River
Missouri River
Carter Creek
Republican River
Grand River
Chariton River
Cuivre River
Mississippi River
Indian Creek
Kaskaskia River
Illinois
Illinois R.
Kansas City
Missouri
St. Louis
Missouri R.
Dardene Creek
Hurricane Creek
East Fork Silver Creek
Carry Creek
Kansas
Arkansas R.
Whitewater River
Wichita
Arkansas River
Bois d'Arc Creek
Salt Fork Arkansas River
Black Bear Creek
Oklahoma
Cimarron River
Tulsa
Canadian R.
Oklahoma City
Legend
HYDROSTATIC TEST WATER SOURCE
HYDROSTATIC TEST WATER SOURCE AND DRILLING WATER FOR HDD
ALTERNATE FILL WATER SOURCE
PROPOSED KEYSTONE PIPELINE
MAJOR RIVERS
INTERSTATE HIGHWAY
COUNTY BOUNDARY
STATE BOUNDARY
MUNICIPALITY
N
W
E
S
75 50 25 0 75
Scale in Miles
150 100 50 0 150
Scale in Kilometers
Map Projection: Universal Transverse Mercator
Zone: 14 North
Datum: North American Datum 1983
ENSR | AECOM
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- Attachment A -
Hydrostatic Test
Locations

PRIMARY FILL WATER SOURCES – MAINLINE

PRIMARY WATER SOURCE	LEGAL DESCRIPTION	COUNTY	STATE	ESTIMATED VOLUME (gallons)
Pembina River	S/W 1/4 T163N R56W Sec 31	Pembina	North Dakota	12,561,669
South Branch Park River	N/E 1/4 T157N R57W Sec 24	Walsh	North Dakota	160,000
N. Branch Turtle River	N/W 1/4 T153N R57W Sec 25	Nelson	North Dakota	3,982,422
Unnamed Lake	S/W 1/4 T145N R57W Sec 9	Steele	North Dakota	7,629,929
Sheyenne River	N/W 1/4 T136N R58W Sec 12	Ransom	North Dakota	16,427,319
Unnamed Creek	N/E 1/4 T123N R59W Sec 20	Day	South Dakota	8,325,553
Foster Creek	N/W 1/4 T115N R59W Sec 17	Clark	South Dakota	6,801,790
Redstone Creek	N/W 1/4 T108N R58W Sec 23	Miner	South Dakota	8,102,798
Wolf Creek	N/W 1/4 T103N R57W Sec 25	Hanson	South Dakota	10,968,244
James River	N/E 1/4 T95N R56W Sec 13	Yankton	South Dakota	6,165,037
Marne Creek (Missouri River)	Not Available	Yankton	South Dakota	12,708,894
Elkhorn River	S/E 1/4 T23N R1E Sec 36	Stanton	Nebraska	8,679,834
Platte River	S/W 1/4 T16N R2E Sec 3	Colfax	Nebraska	350,000
Big Blue River	S/W 1/4 T11N R3E Sec 6	Seward	Nebraska	12,633,723
Cub Creek	N/E 1/4 T3N R4E Sec 7	Jefferson	Nebraska	4,094,688
Big Blue River	S/E 1/4 T1S R7E Sec 11	Marshall	Kansas	9,159,234
Delaware River	N/W 1/4 T3S R15E Sec 4	Brown	Kansas	9,529,108
Missouri River	N/E 1/4 T4S R22E Sec 20	Doniphan	Kansas	9,824,818
Long Creek	N/W 1/4 T55N R28W Sec 16	Caldwell	Missouri	9,109,531
Grand River	S/E 1/4 T54N R21W Sec 17	Carroll	Missouri	6,606,710
Chariton River	S/W 1/4 T53N R18W Sec 1	Chariton	Missouri	7,745,268
Cuivre River	N/W 1/4 T49N R1E Sec 29	Lincoln	Missouri	17,305,675
Cuivre River	ML-MO-LI-4801 (Tract)	Lincoln	Missouri	200,000
Dardene Creek	S/E 1/4 T47N R4E Sec 3	St. Charles	Missouri	4,665,184
Mississippi River	N/E 1/4 T47N R8E Sec 9	St. Charles	Missouri	300,000
E Fork Silver Creek	S/W 1/4 T4N R5W Sec 4	Madison	Illinois	10,563,376
Mississippi River Levee	N/W 1/4 T4N R9W Sec 4	Madison	Illinois	150,000
Indian Creek (For Hwy 255)	N/E 1/4 T4N R8W Sec 7	Madison	Illinois	150,000
East Fork Silver Creek	S/W 1/4 T4N R5W Sec 4	Madison	Illinois	150,000
Hurricane Creek	S/W 1/4 T4N R1W Sec 8	Fayette	Illinois	150,000
Kaskaskia River	S/W 1/4 T4N R1W Sec 10	Fayette	Illinois	150,000

ALTERNATE FILL WATER SOURCES – MAINLINE

PRIMARY WATER SOURCE	LEGAL DESCRIPTION	COUNTY	STATE	ESTIMATED VOLUME (gallons)
North Branch Forest River	S/E 1/4 T156N R57W Sec 11	Walsh	North Dakota	15,421,700

PRIMARY FILL WATER SOURCES – CUSHING EXTENSION

PRIMARY WATER SOURCE	LEGAL DESCRIPTION	COUNTY	STATE	ESTIMATED VOLUME (gallons)
Carter Creek	N/E 1/4 T6S R4E Sec 18	Clay	Kansas	18,285,731
Republican River	N/W 1/4 T9S R3E Sec 1	Clay	Kansas	200,000
Carry Creek	S/E 1/4 T14S R3E Sec 36	Dickinson	Kansas	10,229,359
Whitewater River	N/E 1/4 T26S R4E Sec 8	Butler	Kansas	27,639,705
Arkansas River	S/E 1/4 T34S R3E sec 16	Cowley	Kansas	250,000
Bois d Arc Creek	S/W 1/4 T26N R2E Sec 32	Kay	Oklahoma	6,015,740
Salt Fork Arkansas River	S/W 1/4 T25N R2E Sec 30	Kay	Oklahoma	250,000
Black Bear Creek	S/E 1/4 T21N R2E Sec 2	Noble	Oklahoma	16,059,641
Cimarron River	Not Available	Payne	Oklahoma	300,000

Appendix E

Environmental Fate and Risk Associated with Crude Oil

Environmental Fate and Risk Associated with Crude Oil

1.0 Overview

This report reviews the environmental fate, consequences, and potential impacts of a crude oil spill from the Keystone Pipeline. The composition, environmental fate and transport of crude oils released to the environment is discussed. Existing toxicological data on the effects of major crude oil constituents on aquatic species are presented and the calculated frequency of crude oil spills are reviewed and evaluated. In addition, ecologically sensitive High Consequence Areas (HCAs) that are crossed by the pipeline are quantified by state and the probability of a spill in these HCA areas also is predicted.

2.0 Environmental Consequences

2.1 Crude Oil in the Environment

2.1.1 Crude Oil Composition

The composition of crude oil varies widely, depending on the source and processing. Crude oils are complex mixtures of hundreds of organic (and a few inorganic) compounds. These compounds differ in their solubility, toxicity, persistence, and other properties that profoundly affect their impact on the environment. The effects of a specific crude oil cannot be thoroughly understood without taking its composition into account.

Crude oil transported by the Keystone Pipeline Project is derived from the Alberta oil sands region. The oil extracted from the sands is called bitumen, which is highly viscous. In order for the bitumen to be transported by pipeline, it is either mixed with diluent and is transported as diluted bitumen or upgraded to synthetic crude oil. The precise composition of the crude oils will vary by shipper and is considered proprietary information by the shippers (e.g., ConocoPhillips). For the purposes of this analysis, two product types of crude oil will be transported: synthetic crude and diluted bitumen. In general, the pipeline will contain batches of these two products and 10 percent of batches will be synthetic crude and 90 percent of batches will be diluted bitumen.

The primary classes of compounds found in crude oil are alkanes (hydrocarbon chains), cycloalkanes (hydrocarbons containing saturated carbon rings), and aromatics (hydrocarbons with unsaturated carbon rings). Most crude oils are more than 95 percent carbon and hydrogen, with small amounts of sulfur, nitrogen, oxygen, and traces of other elements. Crude oils contain lightweight straight-chained alkanes (e.g., hexane, heptane), cycloalkanes (e.g., cyclyohexane), aromatics (e.g., benzene, toluene), cycloalkanes, and heavy aromatic hydrocarbons (e.g., polycyclic aromatic hydrocarbons [PAHs], asphaltines). Straight-chained alkanes are more easily degraded in the environment than branched alkanes. Cycloalkanes are extremely resistant to biodegradation. Aromatics (i.e., benzene, toluene, ethylbenzene, xylenes [BTEX compounds]) pose the most potential for environmental concern. Because of their lower molecular weight, they are more soluble in water than alkanes and cycloalkanes.

2.1.2 Environmental Fate and Transport

Accidental releases of crude oil can occur during transport by pipeline. Once released into the terrestrial environment, the crude oil will pool in low-lying areas. Some lighter volatile constituents of the crude oil will evaporate into air, while other constituents will bind or leach into soils, or dissolve into water. Hydrocarbons that volatilize into the atmosphere are broken down by sunlight into smaller compounds. This process, referred to as photodegradation, occurs rapidly in air and the rate of photodegradation increases as molecular weight increases. If released onto soil, a portion of the crude oil will penetrate the soil as a result of the effects of

gravity and capillary action. The rate of penetration will depend on the nature of the soil. Since crude oil is more viscous than water, crude oils penetrate soils less quickly. When released into water, the crude oil will float to the surface where it can evaporate. With time, water soluble fractions within the crude oil will begin to dissolve, and eventually as the crude oil composition becomes more dense as lightweight hydrocarbons evaporate and if the oil is not cleaned up, some material may descend to the bottom through sedimentation processes.

The spread of crude oil across water increases with wind and current speed and increasing temperature. Most crude oils spread across surface waters at a rate of 100 to 300 meters per hour. Surface ice will greatly reduce the spreading rate of oil across a waterbody. Spreading reduces the bulk quantity of crude oil present in the vicinity of the spill but increases the spatial area within which adverse effects may occur. Thus, crude oil in flowing waterbodies, as opposed to contained waterbodies, will be less concentrated in any given location, but may cause impacts, albeit reduced in intensity, over a much larger area. Spreading and thinning of spilled crude oil also increases the surface area of the slick, thus enhancing surface dependent fate processes such as evaporation, degradation, and dissolution.

Dispersion of crude oil increases with increasing surface turbulence. The dispersion of crude oil into water may serve to increase the surface area of crude oil susceptible to dissolution and degradation processes and thereby limit the potential for physical impacts.

Evaporation will be the primary mechanism of loss for low molecular weight constituents and light oil products. As lighter components evaporate, remaining crude oil becomes denser and more viscous. Evaporation thus tends to reduce crude oil toxicity but enhances crude oil persistence. Bulk evaporation of Alberta crude oil accounted for an almost 50 percent reduction in volume over a 12-day period (Shiu et al. 1988). Evaporation increases with increased spreading of a slick, increased temperature, and increased wind and wave action.

Dissolution of crude oil in water is not a significant process controlling the crude oil's fate in the environment, since most components of oils are relatively insoluble (Neff and Anderson 1981). Moreover, overall solubility of crude oils tend to be less than their constituents since solubility is limited to the partitioning between oil and water interface and individual compounds are often more soluble in oil than in water, thus they tend to remain in the oil. Nevertheless, dissolution is one of the primary processes affecting the toxic effects of a spill, especially in confined waterbodies. Dissolution increases with decreasing molecular weight, increasing temperature, decreasing salinity, and increasing concentrations of dissolved organic matter. Greater photodegradation also tends to enhance the solubility of crude oil in water.

Heavy molecular weight hydrocarbons will bind to suspended particulates and this process can be significant in highly turbid or eutrophic waters. Organic particles (e.g., biogenic material) tend to be more effective at sorbing oils than inorganic particles (e.g., clays). Sorption processes and sedimentation reduce the quantity of heavy hydrocarbons present in the water column and available to aquatic organisms. However, these processes also render hydrocarbons less susceptible to degradation. Sedimented oil tends to be highly persistent and can cause shoreline impacts.

Photodegradation of crude oil increases with greater solar intensity. It can be a significant factor controlling the disappearance of a slick, especially of lighter oil constituents; but it will be less important during cloudy days and winter months. Photodegraded crude oil constituents tend to be more soluble and more toxic than parent compounds. Extensive photodegradation, like dissolution, may thus increase the biological impacts of a spill event.

In the immediate aftermath of a crude oil spill, natural biodegradation of crude oil will not tend to be a significant process controlling the fate of spilled crude oil in waterbodies previously unexposed to oil. Microbial populations must become established before biodegradation can proceed at any appreciable rate. Also, prior to weathering (i.e., evaporation and dissolution of light-end constituents), oils may be toxic to the very organisms responsible for biodegradation and high molecular weight constituents tend to be resistant to

biodegradation. Biodegradation is nutrient and oxygen demanding and may be precluded in nutrient-poor aquatic systems. It also may deplete oxygen reserves in closed waterbodies, causing adverse secondary effects to aquatic organisms.

With time, however, microorganisms capable of consuming crude oil generally increase in number and the biodegradation process naturally remediates the previously contaminated soil. The biodegradation process is enhanced as the surface area of spilled oil increases (e.g., by dispersion or spreading). Biodegradation has been shown to be an effective method of remediating soils and sediments contaminated by crude oil.

Overall, the environmental fate of released crude oil is controlled by many confounding factors and persistence is difficult to predict with great accuracy. Major factors affecting the environmental fate include spill volume, type of crude oil, dispersal rate of the crude oil, terrain, receiving media, and weather. Once released, the physical environment largely dictates the environmental persistence of the spilled material. Along the Keystone Pipeline route, the primary habitats of concern include low gradient streams, rivers, and small intermittent ponds. Wetlands also occur along the proposed pipeline route. Estimates of the length of time materials could persist at potentially acute concentrations vary depending on the size of spill and environmental conditions. In warm summer months, the acutely toxic volatile component of crude oil will evaporate quickly, and a relatively small release into a high gradient stream would be expected to rapidly dissipate. In contrast, crude oil released into a small stream in winter could become trapped under pockets of ice and persist longer.

2.2 Environmental Risk

The environmental risk posed by a crude oil pipeline is a function of 1) the probability of an accidental release, 2) the probability of a release reaching an environmental receptor (e.g., waterbody, fish), 3) the concentration of the contamination once it reaches the receptor, and 4) the hazard posed by that concentration of crude oil to the receptor. Based on spill probabilities and estimated spill volumes, this risk assessment determines the probability of exposure to environmental receptors and the probable impacts based on a range of potential concentrations.

An evaluation of the potential impacts resulting from the accidental release of crude oil into the environment is discussed by environmental resource below.

2.2.1 Soils

Because pipelines are buried, soil absorption of spilled crude oil could occur, thus impacting the soils. Subsurface releases to soil tend to disperse slowly and are generally located within a contiguous and discrete area. Effects to soils can be quite slow to develop, allowing time for emergency response and cleanup actions to mitigate effects to potential receptors.

In the event of a spill, a portion of the released materials would enter the surrounding soil and disperse both vertically and horizontally in the soil. The extent of dispersal would depend on a number of factors, including size and rate of release, topography of the release site, vegetative cover, soil moisture, bulk density and soil porosity. High rates of release from the buried pipeline would result in a greater likelihood that released materials would reach the ground surface.

The majority of crude oil from an underground pipeline spill would likely reside in the less consolidated soil (lower soil bulk density) within the pipeline trench. If a release were to occur in sandy soils, it is likely that the horizontal and vertical extent of the contamination would be greater than in areas containing more organic soils. Crude oil released into soils would likely become visible to aerial surveillance due to product on the soils surface or discoloration of vegetation. If present, soil moisture and moisture from precipitation would increase the dispersion and migration of crude oil.

The vast majority of the Keystone Pipeline is located in relatively flat terrain. In these flat locations, the oil would disperse horizontally within the pipeline trench with a smaller portion of the spilled oil moving into the surrounding, more consolidated soil. If the spill were to occur on a steep slope, crude oil would likely pool primarily within the trench behind trench breakers. If sufficient volume existed, the crude oil would breach the soil's surface as it extended over the top of the trench breaker. Once on the soil's surface, the release would be more apparent to leak surveillance patrols.

Both on the surface and in the subsurface, rapid attenuation of light, volatile constituents (due to volatilization) would quickly reduce the total volume of product, while heavier constituents would be more persistent. Except in cases of high rate and high total volume releases, and environmental settings characterized by steep topography or fractured bedrock,soil impacts would be confined to a relatively small, contiguous, and easily defined area. This would facilitate cleanup and remediation. Within a relatively short time, lateral migration would generally stabilize and downward vertical migration could begin to occur.

Keystone would be responsible for cleanup of contaminated soils. Once remedial cleanup levels were achieved in the soils, no adverse or long-term impacts would be expected.

2.2.2 Vegetation and Soil Ecosystems

Crude oil released to the soil's surface could potentially produce localized effects on plant populations. Terrestrial plants are much less sensitive to crude oil than aquatic species. The lowest toxicity threshold for terrestrial plants found in the USEPA ECOTOX database (USEPA 2001) was 18.2 ppm for benzene, higher than the 7.4 ppm threshold for aquatic species and the 0.005 ppm threshold for human drinking water. Similarly, available data from the USEPA database indicate that earthworms also are less sensitive than aquatic species (toxicity threshold was greater than 1,000 ppm). If concentrations were sufficiently high, crude oil in the root zone could harm individual plants and organisms.

Release of crude oil could result in the contamination of soils (see Soils section above). Keystone would be responsible for cleanup of contaminated soils. Once remedial cleanup levels were achieved in the soils, no adverse or long-term impacts to vegetation would be expected.

2.2.3 Wildlife

Spilled crude oil can affect organisms directly and indirectly. Direct effects include physical processes, such as oiling of feathers and fur, and toxicological effects, which can cause sickness or death. Indirect effects are less conspicuous and include habitat impacts, nutrient cycling disruptions, and alterations in ecosystem relationships. The magnitude of effects varies with multiple factors, the most significant of which include the amount of material released, the size of the spill dispersal area, the type of crude oil spilled, the species assemblage present, climate, and the spill response tactics employed.

Wildlife, especially birds and shoreline mammals, are typically among the most visibly affected organisms in any crude oil spill. Effects of crude oil can be differentiated into physical (mechanical) and toxicological (chemical) effects. Physical effects result from the actual coating of animals with crude oil, causing reductions in thermal insulative capacity and buoyancy of plumage (feathers) and pelage (fur).

Crude oil released to the environment may cause adverse biological effects on birds and mammals via inhalation or ingestion exposure. Ingestion of crude oil may occur when animals consume oil-contaminated food, drink oil-contaminated water, or orally consume crude oil during preening and grooming behaviors.

Potential adverse effects could result from direct acute exposure. Acute toxic effects include drying of the skin, irritation of mucous membranes, diarrhea, narcotic effects, and possible death. While releases of crude oil may have an immediate and direct effect on wildlife populations, the potential for physical and toxicological effects attenuates with time as the volume of material diminishes, leaving behind more persistent, less volatile, and

less water-soluble compounds. Although many of these remaining compounds are toxic and potentially carcinogenic, they do not readily disperse in the environment and their bioavailability is low, and therefore, the potential for impacts from those persistent compounds is low.

Unlike aquatic organisms that frequently cannot avoid spills in their habitats, the behavioral responses of terrestrial wildlife may help reduce potential adverse effects. Many birds and mammals are mobile and generally will avoid oil-impacted areas and contaminated food (Sharp 1990; Stubblefield et al. 1995). In a few cases, such as cave-dwelling species, organisms that are obligate users of contaminated habitat may be exposed. However, most terrestrial species have alternative, unimpacted habitat available, as will often be the case with localized spills (in contrast to large-scale oil spills in marine systems), therefore, mortality of these species would be limited (Stubblefield et al. 1995).

Indirect environmental effects of spills can include reduction of suitable habitat or food supply. Primary producers (e.g., algae and plants) may experience an initial decrease in primary productivity due to physical effects and acute toxicity of the spill. However, these effects tend to be short-lived and a decreased food supply is not considered to be a major chronic stressor to herbivorous organisms after a spill. If mortality occurs to local invertebrate and wildlife populations, the ability of the population to recover will depend upon the size of the impact area and the ability of surrounding populations to repopulate the area.

2.2.4 Surface Water Resources

Crude oil could enter surface water resources if the pipeline is breached or leaks occur. As part of project planning and in recognition of the environmental sensitivity of waterbodies, the Keystone Pipeline routing process attempted to minimize the number of waterbodies crossed. Furthermore, valves have been strategically located along the Keystone Pipeline to help reduce the amount of crude oil that could potentially spill into waterbodies, if such an event were to occur. The location of valves, spill containment measures, and implementing actions in the Keystone Emergency Response Plan would mitigate adverse effects to surface water.

2.2.4.1 Aquatic Resources

The USDOT, in cooperation with federal and state agencies, has identified surface water resources that are particularly vulnerable to contamination. These surface water resources are designated as High Consequence Areas (HCAs). Broadly, this report evaluated impacts to downstream aquatic resources by comparing projected surface water benzene concentrations with an ecological benchmark for benzene. The rationale for selecting benzene as the ecological benchmark is based on its combined solubility and toxicity, as discussed below. Rather than evaluate the risk to each waterbody crossed by the Keystone Pipeline, this risk assessment evaluated categories of streams, based on the magnitude of streamflow and stream width. **Table 1** summarizes the stream categories used for the assessment and identifies several representative streams within these categories.

Table 1 Stream Categories

	Streamflow (cubic feet per second; cfs)	**Stream Width (feet)**	**Representative Streams**
Low Flow Stream	10 – 100	<50	Shell Creek, Mill Creek
Lower Moderate Flow Stream	100 – 1,000	50 – 500	Pembina Creek, James River, Sheyenne River, Cuivre River
Upper Moderate Flow Stream	1,000 – 10,000	500 – 1,000	Platte River, Chariton River, Missouri River
High Flow Stream	>10,000	1,000 – 2,500	Mississippi River

The concentration of crude oil constituents in an actual spill would vary both temporally and spatially in surface water, however, localized toxicity could occur from virtually any size of crude oil spill. **Table 2** summarizes the acute toxicity values (USEPA AQUIRE database 2000) of various crude oil hydrocarbons to a broad range of freshwater species. Acute toxicity refers to the death or complete immobility of an organism within a short period of exposure. The LC_{50} is the concentration of a compound necessary to cause 50 percent mortality in laboratory test organisms. For aquatic biota, most acute LC_{50}s for monoaromatics range between 10 and 100 ppm. LC_{50}s for the polyaromatic naphthalene were generally between 1 and 10 ppm, while LC_{50} values for anthracene were generally less than 1 ppm.

Table 2 Acute Toxicity of Aromatic Hydrocarbons to Freshwater Organisms

Species	Toxicity Values (ppm)				
	Benzene	**Toluene**	**Xylene**	**Naphthalene**	**Anthracene**
Carp *(Cyprinus carpio)*	40.4	---	780	---	---
Channel catfish *(Kctalurus)*	---[1]	240	---	---	---
Clarias catfish *(Clarias* sp.*)*	425	26	---	---	---
Coho salmon *(Oncorhyncus kisutch)*	100	---	---	2.6	---
Fathead minnow *(Pimephales)*	---	36	25	4.9	25
Goldfish *(Carassius auratus)*	34.4	23	24	---	---
Guppy *(Poecilia reticulate)*	56.8	41	---	---	---
Largemouth bass *(Micropterus)*	---	---	---	0.59	---
Medaka *(Oryzias sp.)*	82.3	54	---	---	---
Mosquitofish *(Gambusia affinis)*	---	1,200	---	150	---
Rainbow trout *(Oncorhyncus mykis)*	7.4	8.9	8.2	3.4	---
Zebrafish *(Therapon iarbua)*	---	25	20	---	---
Rotifer *(Brachionus calyciflorus)*	>1,000	110	250	---	---
Midge *(Chironomus attenuatus)*	---	---	---	15	---
Midge *(Chironomus tentans)*	---	---	---	2.8	---
Zooplankton *(Daphnia magna)*	30	41	---	6.3	0.43
Zooplankton *(Daphnia pulex)*	111	---	---	9.2	---
Zooplankton *(Diaptomus forbesi)*	---	450	100	68	---
Amphipod *(Gammarus lacustris)*	---	---	0.35	---	---
Amphipod *(Gammarus minus)*	---	---	---	3.9	---
Snail *(Physa gyrina)*	---	---	---	5.0	---
Insect *(Somatochloa cingulata)*	---	---	---	1.0	---
Chlorella vulgaris	---	230	---	25	---
Microcystis aeruginosa	---	---	---	0.85	---
Nitzschia palea	---	---	---	2.8	---
Scenedesmus subspicatus	---	130	---	---	---
Selenastrum capricornutum	70	25	72	7.5	---

[1]Indicates no value was available in the database.

Note: Data summarize conventional acute toxicity endpoints from USEPA's ECOTOX database. When several results were available for a given species, the geometric mean of the reported LC50 values was calculated.

Table 2 shows fish are among the most sensitive aquatic biota, while aquatic invertebrates generally have intermediate sensitivities, and algae and bacteria tend to be the least sensitive. Nevertheless, even when major fish kills have occurred as a result of oil spills, population recovery has been observed, and long-term changes in fish abundance have not been reported. Benthic (bottom-dwelling) aquatic invertebrates tend to be more sensitive than algae, but are equally or less sensitive than fish. Planktonic (floating) species tend to be more sensitive than most benthic insects, crustaceans, and molluscs.

In aquatic environments, toxicity is a function of the concentration of a compound necessary to cause toxic effects combined with the compound's water solubility. For example, a compound may be highly toxic, but if it is not very soluble in water then its toxicity to aquatic biota is relatively low. The toxicity of crude oil is dependent of the toxicity of its constituents. As an example, **Table 3** summarizes the toxicity of various crude oil hydrocarbons to the zooplankton, *Daphnia magna*. The relative toxicity of decane is much lower than for benzene or ethylbenzene because of the comparatively low solubility of decane. Most investigators have concluded that the acute toxicity of crude oil is related to the concentrations of relatively lightweight aromatic constituents, particularly benzene.

Table 3 Acute Toxicity of Crude Oil Hydrocarbons to *Daphnia magna*

Compound	48-hr LC_{50} (ppm)	Optimum Solubility (ppm)	Relative Toxicity
Hexane	3.9	9.5	2.4
Octane	0.37	0.66	1.8
Decane	0.028	0.052	1.9
Cyclohexane	3.8	55	14.5
methyl cyclohexane	1.5	14	9.3
Benzene	9.2	1,800	195.6
Toluene	11.5	515	44.8
Ethylbenzene	2.1	152	72.4
p-xylene	8.5	185	21.8
m-xylene	9.6	162	16.9
o-xylene	3.2	175	54.7
1,2,4-trimethylbenzene	3.6	57	15.8
1,3,5-trimethylbenzene	6	97	16.2
Cumene	0.6	50	83.3
1,2,4,5-tetramethylbenzene	0.47	3.5	7.4
1-methylnaphthalene	1.4	28	20.0
2-methylnaphthalene	1.8	32	17.8
Biphenyl	3.1	21	6.8
Phenanthrene	1.2	6.6	5.5
Anthracene	3	5.9	2.0
9-methylanthracene	0.44	0.88	2.0
Pyrene	1.8	2.8	1.6

Note: The LC_{50} is the concentration of a compound necessary to cause 50 percent mortality in laboratory test organisms within a predetermined time period (e.g., 48 hours) (USEPA 2000).

Relative toxicity = optimum solubility/LC_{50}.

While lightweight aromatics such as benzene tend to be water soluble and relatively toxic, they also are highly volatile. Thus, most or all of the lightweight hydrocarbons accidentally released into the environment evaporate, and the environmental persistence of crude oil tends to be low. High molecular weight aromatic compounds, including PAHs, are not very water-soluble and have a high affinity for organic material. Consequently, these compounds, if present, have limited bioavailability, which render them substantially less toxic than more water-soluble compounds (Neff 1979). Additionally, these compounds generally do not accumulate to any great extent because these compounds are rapidly metabolized (Lawrence and Weber 1984; West et al.1984). There are some indications, however, that prolonged exposure to elevated concentrations of these compounds may result in a higher incidence of growth abnormalities and hyperplastic diseases in aquatic organisms (Couch and Harshbarger 1985).

Significantly, some constituents in crude oil may have greater environmental persistence than lightweight compounds (e.g., benzene), but their limited bioavailability renders them substantially less toxic than other more soluble compounds. For example, aromatics with four or more rings are not acutely toxic at their limits of solubility (Muller 1987). Based on the combination of toxicity, solubility, and bioavailability, benzene was determined to drive toxicity associated with potential crude oil spills.

Table 4 summarizes chronic toxicity values (most frequently measured as reduced reproduction, growth, or weight) of benzene to freshwater biota. Chronic toxicity from other oil constituents may occur, however, if sufficient quantities of crude oil are continually released into the water to maintain elevated concentrations.

Table 4 Chronic Toxicity of Benzene to Freshwater Biota

Taxa	Test species	Chronic Value (ppm)
Fish	Fathead minnow (*Pimephales promelas*)	17.2 *
	Guppy (*Poecilia reticulata*)	63
	Coho salmon (*Oncorhynchus kitsutch*)	1.4
Amphibian	Leopard frog (*Rana pipens*)	3.7
Invertebrate	Zooplankton (*Daphnia* spp.)	>98
Algae	Green algae (*Selenastrum capricornutum*)	4.8 *

Note: Test endpoint was mortality unless denoted with an asterisk (*). The test endpoint for these studies was growth.

The potential impacts to aquatic organisms of various-sized spills to waterbodies were modeled assuming the benzene content within each type of crude oil completely dissolved in the water. The benzene concentration was predicted based on amount of crude oil spilled and streamflow. The estimated benzene concentrations were compared to conservative acute and chronic toxicity values for protection of aquatic organisms. For aquatic biota, the lowest acute and chronic toxicity thresholds for benzene are 7.4 ppm and 1.4 ppm, respectively, based on standardized trout toxicity tests (USEPA 2000). These toxicity threshold values are considered protective of acute and chronic effects to aquatic biota. Although trout are not found in many of the habitats crossed by the project, trout are among the most sensitive aquatic species and reliable acute and chronic trout toxicity data are available.

Tables 5 to **12** summarize the predicted acute and chronic toxicity to aquatic resources. Broadly, acute toxicity could potentially occur if substantial amounts of crude oil were to enter most rivers and streams, as demonstrated by the Moderate and Large Spill Scenarios. If such an event were to occur within a small

stream, aquatic species in the immediate vicinity and downstream of the rupture could be killed or injured. Chronic toxicity also could potentially occur in small and moderate sized streams and rivers. However, emergency response, containment, and cleanup efforts would help reduce the concentrations and minimize the potential for chronic toxicity. In comparison, relatively small spills (less than 50 barrels) into moderate and large rivers would not pose a major toxicological threat. In small to moderate sized streams and rivers, some toxicity might occur in localized areas, such as backwaters where concentrations would likely be higher than in the mainstream of the river.

The likelihood of a release into any single waterbody is low, with an occurrence interval of once every 250,000 to 6,800,000 years (**Tables 5** to **12**). If any release did occur, it is likely that the total release volume of a spill likely would be 50 barrels or less based on historical spill volumes, or less than 10,000 barrels based on the spill volume study. Maximum spill volumes for these rivers would be approximately 20,000 barrels.

Table 13 shows the likelihood of spills in selected river systems, as well as average flow of water available to dilute any potentially spilled material. Higher stream volumes correlate with more rapid dilution of any potentially spilled material and therefore lower toxicity.

While a release of crude oil into any given waterbody might cause immediate localized toxicity to aquatic biota, particularly in smaller streams and rivers, the frequency of such an event would be low. Nevertheless, streams and rivers with aquatic biota represent the sensitive environmental resources that could be temporarily impacted by a crude oil release.

Wetlands/Prairie Potholes/Playa Lakes

Although planning and routing efforts have reduced the overall number of wetlands (including prairie potholes and playa lake environments) and static waterbody environments crossed by the Keystone Pipeline, wetlands and waterbodies with persistently saturated soils are present along and adjacent to the Keystone Pipeline route. The effects of crude oil released into a wetland environment will depend not only upon the quantity of oil released, but also on the physical conditions of the wetland at the time of the release. Wetlands include a wide range of environmental conditions. Wetlands can consist of many acres of standing water dissected with ponds and channels, or they may simply be areas of saturated soil with no open water. A single wetland can even vary between these two extremes as seasonal precipitation varies. Wetland surfaces are generally low gradient with very slow unidirectional flow or no discernable flow. The presence of vegetation or narrow spits of dry land protruding into wetlands also may isolate parts of the wetland. Given these conditions, spilled materials may remain in restricted areas for longer periods than in river environments.

Crude oil released from a subsurface pipe within a wetland could reach the soil surface. If the water table reaches the surface, the release would manifest as floating crude oil. The general lack of surface flow within a wetland would restrict crude oil movement. Where surface water is present within a wetland, the spill would spread laterally across the water's surface and be readily visible during routine right-of-way (ROW) surveillance. The depth of soil impacts likely would be minimal, due to shallow (or emergent) groundwater conditions. If humans or other important resource exposures were to occur in proximity to the wetland, then regulatory drivers would mandate the scope of remedial actions, timeframe for remediation activities, and cleanup levels. However, response and remediation efforts in a wetland have the potential for appreciable adverse effects from construction/cleanup equipment. If no active remediation activities were undertaken, natural biodegradation and attenuation would ultimately allow a return to preexisting conditions in both soil and groundwater. This would likely require a timeframe on the order of tens of years. Keystone will utilize the most appropriate cleanup procedures as determined in coordination with the applicable federal and state agencies.

Table 5 Comparison of Estimated Diluted Bitumen Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life (7.4 ppm) for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Diluted Bitumen)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	**11**	**5,905,509**	**217**	**1,344,412**	**2175**	**1,877,913**	**4349**	**5,218,915**
Lower Moderate Flow Stream	100	7.4	1	4,133,856	**22**	**941,089**	**217**	**1,314,539**	**435**	**3,653,240**
Upper Moderate Flow Stream	1,000	7.4	0.1	3,100,392	2.2	705,816	**22**	**985,904**	**43**	**2,739,930**
High Flow Stream	10,000	7.4	0.01	1,771,623	0.2	403,324	2.2	563,374	4.3	1,565,674

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport diluted bitumen 90% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.

-Benzene concentrations are compared against the acute toxicity threshold for benzene.

-Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.094 spills/year along the Keystone Pipeline Mainline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 6 Comparison of Estimated Synthetic Crude Oil Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life (7.4 ppm) for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Synthetic Crude)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	1	6,842,909	**27**	**1,403,496**	**269**	**2,089,507**	**538**	**6,648,130**
Lower Moderate Flow Stream	100	7.4	0.1	4,790,037	2.7	982,447	**27**	**1,462,655**	**54**	**4,653,691**
Upper Moderate Flow Stream	1,000	7.4	0.01	3,592,527	0.3	736,835	3	1,096,991	5.4	3,490,268
High Flow Stream	10,000	7.4	0.001	2,052,873	0.03	421,049	0.3	626,852	0.5	1,994,439

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.

-Benzene concentrations are compared against the acute toxicity threshold for benzene.

-Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.090 spills/year along the Keystone Pipeline Mainline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 7 Comparison of Estimated Diluted Bitumen Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Diluted Bitumen)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	**11**	**1,494,147**	**217**	**857,465**	**2175**	**954,506**	**4349**	**2,402,322**
Lower Moderate Flow Stream	100	7.4	1	1,045,903	**22**	**600,226**	**217**	**668,154**	**435**	**1,681,625**
Upper Moderate Flow Stream	1,000	7.4	0.1	784,427	2.2	450,169	**22**	**501,116**	**43**	**1,261,217**
High Flow Stream	10,000	7.4	0.01	448,244	0.2	257,240	2.2	286,352	4.3	720,697

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport diluted bitumen 90% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.

-Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.151 spills/year along the entire Keystone Pipeline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 8 Comparison of Estimated Synthetic Crude Oil Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Synthetic Crude)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm))	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	1	6,094,152	**27**	**1,358,541**	**269**	**1,927,825**	**538**	**5,442,000**
Lower Moderate Flow Stream	100	7.4	0.1	4,265,906	2.7	950,979	**27**	**1,349,478**	**54**	**3,809,400**
Upper Moderate Flow Stream	1,000	7.4	0.01	3,199,430	0.3	713,234	2.7	1,012,108	5	2,857,050
High Flow Stream	10,000	7.4	0.001	1,828,246	0.03	417,562	0.3	578,348	0.5	1,632,600

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.

-Benzene concentrations are compared against the acute toxicity threshold for benzene.

-Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.093 spills/year along the Keystone Pipeline Mainline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 9 Comparison of Estimated Diluted Bitumen Concentrations Following a Spill to the Chronic Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Diluted Bitumen)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.1	5,905,509	1.3	1,344,412	**13**	**1,877,913**	**26**	**5,218,915**
Lower Moderate Flow Stream	100	1.4	0.01	4,133,856	0.1	941,089	1.3	1,314,539	**2.6**	**3,653,240**
Upper Moderate Flow Stream	1,000	1.4	0.001	3,100,392	0.01	705,816	0.1	985,904	0.3	2,739,930
High Flow Stream	10,000	1.4	0.0001	1,771,623	0.001	403,324	0.01	563,374	0.03	1,565,674

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport diluted bitumen 90% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.

-The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.

-Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.

-Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.094 spills/year along the Keystone Pipeline Mainline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 10 Comparison of Estimated Synthetic Crude Oil Concentrations Following a Spill to the Chronic Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Synthetic Crude)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.01	6,842,909	0.2	1,403,496	**1.6**	**2,089,507**	**3.2**	**6,648,130**
Lower Moderate Flow Stream	100	1.4	0.001	4,790,037	0.02	982,447	0.2	1,462,655	0.3	4,653,691
Upper Moderate Flow Stream	1,000	1.4	0.0001	3,592,527	0.002	736,835	0.02	1,096,991	0.03	3,490,268
High Flow Stream	10,000	1.4	0.00001	2,052,873	0.0002	421,049	0.002	626,852	0.003	1,994,439

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.

-The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.

-Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.

-Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.090 spills/year along the Keystone Pipeline Mainline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 11 Estimated Diluted Bitumen Concentrations Compared to the Chronic Toxicity Threshold for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Diluted Bitumen)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.1	1,494,147	1.3	857,465	**13**	**954,506**	**26**	**2,402,322**
Lower Moderate Flow Stream	100	1.4	0.01	1,045,903	0.1	600,226	1.3	668,154	**2.6**	**1,681,625**
Upper Moderate Flow Stream	1,000	1.4	0.001	784,427	0.01	450,169	0.1	501,116	0.3	1,261,217
High Flow Stream	10,000	1.4	0.0001	448,244	0.001	257,240	0.01	286,352	0.03	720,697

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport diluted bitumen 90% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.

-The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.

-Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.

-Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.151 spills/year along the entire Keystone Pipeline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 12 Estimated Synthetic Crude Oil Concentrations Compared to the Chronic Toxicity Threshold for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Synthetic Crude)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)	Benzene Conc. [1] (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.01	6,094,152	0.2	1,358,541	**1.6**	**1,927,825**	**3.2**	**5,442,000**
Lower Moderate Flow Stream	100	1.4	0.001	4,265,906	0.02	950,979	0.2	1,349,478	0.3	3,809,400
Upper Moderate Flow Stream	1,000	1.4	0.0001	3,199,430	0.002	713,234	0.02	1,012,108	0.03	2,857,050
High Flow Stream	10,000	1.4	0.0001	1,828,246	0.0002	417,562	0.002	578,348	0.003	1,632,600

[1]While estimated benzene concentrations may exceed actual solubility limits, the calculated values are retained to illustrate the magnitude of the exceedence.

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown, which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone Pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.

-Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.

-The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.

-Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.

-Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).

-Occurrence intervals are based on an overall predicted incident frequency of 0.093 spills/year along the Keystone Pipeline Mainline, projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 13 Large River Systems Crossed by the Proposed Keystone Pipeline[1]

Major River/Major Lake	Annual Failure Frequency	Median Stream Flow (cfs)[2]
Missouri River (SD/NE Border)	5.83×10^{-5}	20,100
Platte River	2.33×10^{-5}	18,00
Missouri River (KS/MO Border)	5.02×10^{-5}	45,700
Mississippi River	7.24×10^{-5}	146,200
Kaskaskia River/Carlyle Lake	1.60×10^{-5}	1,900

[1]Due to Homeland Security issues, the precise maximum spill volume for specific location is considered highly sensitive and confidential, and is therefore not provided in this document.

[2]USGS 2007 average stream flow 1990-1995.

The chance of a spill occurring at any specific wetland along the pipeline is very low. Based on survey data and aerial interpretation, wetlands comprise 44.4 miles of the entire Keystone Pipeline system (Table 3.5-8 of the revised Keystone Environmental Report tables filed September 2007). Of the estimated maximum of 1.5 spills postulated to occur during a 10-year period within the entire pipeline system, about 0.05 spills would be expected to occur within wetland areas (equivalent to one spill every 130 years). If any release did occur, it is likely that the total release volume of a spill likely would be 50 barrels or less based on historical spill volumes, or less than 10,000 barrels based on the spill volume study.

The predicted effects of a spill reaching standing water (e.g., reservoirs, prairie potholes) would depend largely upon the volume of crude oil entering the waterbody and the volume of water within the waterbody.

Table 14 summarizes the amount of water necessary to dilute spill volumes below aquatic toxicity thresholds. It is critical to note that this preliminary approach does not account for fate and transport mechanisms, mixing zones, environmental factors, and emergency response capabilities. However, it does provide an initial benchmark for identifying areas of potential concern.

Table 14 Amount of Water Required to Dilute Crude Oil Spills Below Threshold Values

Barrels of Crude Oil	Volume of Water Required to Dilute Crude Oil Spills Below Threshold (acre-feet)[1]	
	Acute Toxicity Threshold (7.4 milligrams per liter [mg/L])	Chronic Toxicity Threshold (1.4 mg/L)
Diluted Bitumen		
50	4.6	24.3
150	13.8	72.9
1,000	92.0	486
10,000	920	4,862
Synthetic Crude Oil		
50	0.57	3.0
150	1.7	9.3
1,000	11.4	60.1
10.000	114	601

[1]Thresholds based on aquatic toxicity and drinking water thresholds established for benzene. The estimated benzene content of the diluted bitumen is 0.15 percent by weight. The synthetic crude oil is estimated to have a benzene content of 0.02 percent by weight.

Based on a review of publicly available toxicity literature for wetland plant groups (i.e., algae, annual macrophytes, and perennial macrophytes), crude oil is toxic to aquatic plants but at higher concentrations than observed for fish and invertebrates. Therefore, spill concentrations that are less than toxic effect levels for fish and invertebrates (see Aquatic Organisms, above) also would be protective for wetland plant species.

In summary, while a release of crude oil into wetland and static waterbodies has the potential to cause temporary environmental impacts, the frequency of such an event would be low. Nevertheless, wetlands and static waterbodies represent sensitive environmental resources.

3.0 Risk to Ecologically Sensitive High Consequence Areas (HCAs)

Consequences of inadvertent releases from pipelines can vary greatly, depending on where the release occurs. Pipeline safety regulations use the concept of HCAs to identify specific locales and areas where a release could have the most significant adverse consequences. HCAs include populated areas, drinking water, and unusually sensitive areas (USAs) consisting of both sensitive drinking water resources and ecologically sensitive areas. These locations are identified using data compiled from a variety of data sources, including federal and state agencies (e.g., USFWS) as well as Natural Heritage database information for sensitive species. Portions of the Keystone Pipeline Project cross areas that are considered HCAs by the USDOT due to potential risks to ecologically sensitive resources (**Table 15**). These areas focus on the characteristics of rarity, imperilment, or the potential for loss of large segments of an abundant population during periods of migratory concentration. These include:

- Critically imperiled and imperiled species and/or ecological communities,
- Threatened and endangered (T&E) species (or multi-species assemblages where three or more different candidate resources co-occur),
- Migratory waterbird concentrations.
- Areas containing candidate species or ecological communities identified as excellent or good quality, and
- Areas containing aquatic or terrestrial candidate species and ecological communities that are limited in range.

These ecologically sensitive areas are frequently associated with major river systems (e.g., Missouri, Platte, and Mississippi Rivers). As with other HCAs, these locations will be subject to higher levels of inspection, as per 49 CFR Part 195, in order to reduce the probability of pipeline incident.

The USDOT acknowledges that spills within a sensitive area might not actually impact the sensitive resource and encourages operators to conduct detailed analysis, as needed. Keystone has conducted a preliminary evaluation of HCAs crossed or located downstream of the pipeline (submitted to DOS in March 2007). To mitigate the potential for impacts to sensitive resources, HCAs are subject to higher levels of inspection, as per 49 CFR Part 195. Keystone also has evaluated the location of valves as a measure to reduce potential risk to HCAs. As a result of the preliminary HCA evaluation, some proposed valve locations were moved and additional valves were added to protect HCAs (see Keystone's March 2007 filing with the DOS).

Keystone's preliminary Risk Assessment conservatively calculated a spill frequency of no more than 1.5 spills over the entire pipeline length in a 10-year period. Based on this spill frequency, it is estimated that no more than potentially 0.19 of these spills might occur in HCAs (**Table 15**). Although the number of predicted spills that could affect ecologically sensitive HCAs is relatively small, the potential impacts of these individual spills are expected to be greater than in other areas due to the environmental sensitivity within these areas. **Table 16** also shows the potential number of spills and their predicted sizes.

Table 15 Mileage Summary of USDOT Defined Ecologically Sensitive HCAs Along the Keystone Pipeline Project, Based on Centerline Filed July 2007

State	Miles of Pipeline within Ecologically Sensitive HCA	Projected Number of Spills in 10 Years within Ecologically Sensitive HCA (occurrence interval)
North Dakota	2.0	0.0002 (4,545 yrs)
South Dakota	14.9	0.002 (608 yrs)
Nebraska	8.4	0.0009 (1,085 yrs)
Kansas	7.2	0.0008 (1,260 yrs)
Missouri	29.3	0.003 (310 yrs)
Illinois	3.8	0.0004 (2,422 yrs)
Keystone Mainline subtotal	*65.6*	*0.007 (139 yrs)*
Nebraska	0.0	0.0
Kansas	36.4	0.004 (250 yrs)
Oklahoma	3.0	0.0003 (2,990 yrs)
Cushing Extension Subtotal	*39.4*	*0.004 (230 yrs)*
Project Total	**105.0**	**0.012 (87 yrs)**

Projected number of spills in 10 years and occurrence interval were conservatively estimated based on the maximum probability of spills (1.5 spills in 10 years during operation at 591,000 bpd and transporting diluted bitumen). This estimates the maximum possible risk, and assumes risk is evenly disturbed along the entire proposed pipeline and Cushing Extension.

Table 16 Release and Spill Volume Occurrence Interval Associated with the Keystone Pipeline Project

	Miles of Pipe[1]	Total Number of Predicted Spills	<50 barrels (bbls)	50 to 1,000 bbls	1,000 to >10,000 bbls	>10,000 bbls
KEYSTONE MAINLINE						
Ecologically Sensitive HCAs	65.6	0.007 (138 years)	0.00022 (4,529 years)	0.00038 (2,599 years)	0.00035 (2,894 years)	0.00014 (1,283 years)
CUSHING EXTENSION						
Ecologically Sensitive HCAs	39.4	0.004 (231 years)	0.00013 (7,541 years)	0.00023 (4,328 years)	0.00021 (4,848 years)	0.00008 (12,125 years)

[1]The amount of pipe located within HCAs was quantified by geographical information system (GIS) and was based on the intersection of a 1,000-foot-wide corridor (centered on the pipeline route) and USDOT-defined HCAs. Probability of a spill was based on the highest projected spill frequency rate on the Keystone pipeline of 0.151 spills per year.

To protect these sensitive resources, HCAs would be subject to a higher level of inspection per USDOT regulations. Federal regulations require periodic assessment of the pipe condition and correction of identified anomalies within HCAs. Keystone will develop management and analysis processes that integrate available integrity-related data and information and assess the risks associated with segments that can affect HCAs.

Based on Keystone's preliminary assessment of HCAs (Appendix B of the Risk Assessment filed in April 2007 with DOS), some valve locations have been moved and additional valves have been added to protect HCAs. These updated locations have been submitted to the DOS in the March 2007 filing. In addition, Keystone will develop and implement a risk-based integrity management program (IMP). The IMP will use state-of-practice technologies applied within a comprehensive risk-based methodology to assess and mitigate risk associated with all pipeline segments including HCAs.

4.0 Summary

This risk assessment delineates the calculated ecological risks associated with the operation of the Keystone Pipeline. Calculated risk of spills was determined to be very low, with an overall predicted incident frequency of 0.151 spills per year. Historical data indicate that the most probable spill volume would be less than 50 barrels or less than 10,000 barrels based on the spill volume study. The likelihood of a release to any single waterbody has an occurrence interval of once every 250,000 to 6,800,000 years. This report indicates the following:

A) The risk of crude oil spills from the Keystone Pipeline is low.

B) The risk of environmental impacts from oil spills also is low due to:

- The calculated assessment of benzene concentrations is highly conservative (i.e., highly conservative assumptions grossly overestimate benzene concentration); and
- There is no inclusion of the effect of response, containment and clean-up activities that would occur with any actual spill from the pipeline. These activities would reduce effects and minimize impacts from an oil spill.

In addition, risk to ecologically sensitive HCAs is mitigated by design and operational requirements. This conclusion is supported by the following:

- USDOT has identified ecologically sensitive HCAs using Natural Heritage database information;
- Designation as an HCA provides a higher level of protection that is mandated by regulations; and
- Site-specific mitigation measures have already been identified and implemented to protect HCAs.

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