4. MATTOON SITE

4.1 CHAPTER OVERVIEW

This chapter provides information regarding the affected environment and the potential for impacts on each resource area in relation to construction and operation of the FutureGen Project at the proposed Mattoon Site. To aid the reader and to properly address the complexity of the FutureGen Project, as well as the need to evaluate four sites (two in Illinois and two in Texas), this Environmental Impact Statement (EIS) was prepared as two separate volumes. Volume I of the EIS includes the purpose and need for the agency action, a description of the Proposed Action and Alternatives, and a summary of the potential environmental consequences. Volume II addresses the affected environment and potential impacts for each of the four proposed alternative sites. Presenting the affected environment immediately followed by the potential impacts on each resource area allows the reader to more easily understand the relationship between current site conditions and potential project impacts on a particular resource. ***The Best and Final Offer (BAFO) information for the Mattoon site and its potential impacts have been addressed in Sections S.4.3 and 2.4.5, and Table S-1, S-12 and 3-3, and therefore are not reflected in the text of this section.***

Volume II is organized by separate chapters for each proposed site: Chapter 4-Mattoon, Illinois; Chapter 5-Tuscola, Illinois; Chapter 6-Jewett, Texas; and Chapter 7-Odessa, Texas.

This chapter is organized by resource area as follows:

- 4.2 Air Quality
- 4.3 Climate and Meteorology
- 4.4 Geology
- 4.5 Physiography and Soils
- 4.6 Groundwater
- 4.7 Surface Water
- 4.8 Wetlands and Floodplains
- 4.9 Biological Resources
- 4.10 Cultural Resources
- 4.11 Land Use
- 4.12 Aesthetics
- 4.13 Transportation and Traffic
- 4.14 Noise and Vibration
- 4.15 Utility Systems
- 4.16 Materials and Waste Management
- 4.17 Human Health, Safety, and Accidents
- 4.18 Community Services
- 4.19 Socioeconomics
- 4.20 Environmental Justice

Each resource section provides an introduction, describes the region of influence (ROI) and the method of analysis, and discusses the affected environment and the environmental impacts from construction and operation of the FutureGen Project at the candidate site. The affected environment discussion describes the current conditions at the proposed power plant and sequestration site, and utility and transportation corridors. This is followed by a discussion of potential construction and operational impacts. A summary and comparison of impacts for all four candidate sites are provided in the EIS Summary and in Chapter 3. Unavoidable adverse impacts, mitigation measures, and best management practices (BMPs) for all four candidate sites are also provided in Chapter 3.

4.1.1 POWER PLANT FOOTPRINT

The specific configuration of the power plant, rail loop, and access roads within the candidate sites would be determined after site selection, during the site-specific design phase. For purposes of analysis, the impact assessment for the proposed power plant site assumed a representative configuration or layout depicted in Chapter 2, Figure 2-18. The proposed power plant site would involve up to 200 acres (81 hectares) to house the power plant, coal and equipment storage, associated processing facilities, research facilities, railroad loop surrounding the power plant envelope, and a buffer zone; the site could ultimately be located anywhere within the larger power plant parcel. Therefore, impact discussions in this chapter identify environmentally sensitive areas to be avoided and address potential impacts to be evaluated, avoided, or mitigated within the entire power plant parcel.

4.1.2 NO-ACTION ALTERNATIVE

As discussed in Chapter 2, Proposed Action and Alternatives, the No-Action Alternative is treated in this EIS as the “No-Build” Alternative. That is, under the No-Action Alternative, the Alliance would not undertake a FutureGen-like project in the absence of Department of Energy (DOE) funding assistance. In the unlikely event that the Alliance did undertake a FutureGen-like project in the absence of DOE funding assistance, impacts might be similar to those predicted in this EIS. However, the Alliance would not be subject to the oversight or the mitigation requirements of DOE.

One goal of the FutureGen Project would be to test and prove a technological path toward minimization of greenhouse gas (GHG) emissions from coal-fueled electric power plants. Should the FutureGen Project prove successful and the concept of carbon dioxide (CO_2) capture and geologic sequestration receive widespread application across the U.S. and around the world, the current trend of increasing CO_2 emissions to the atmosphere from coal-fueled power plants could be reduced. In the absence of concept proof, industry and governments may be unwilling to initiate all of the technological changes that would help to significantly reduce current trends and consequential increase of CO_2 concentrations in the Earth’s atmosphere.

Impacts associated with the No-Action Alternative are provided in Chapter 3.

4.1.3 MATTOON SITE

Proposed Mattoon Power Plant and Sequestration Site

The proposed Mattoon Site consists of approximately 444 acres (180 hectares) of farmland located approximately 1 mile (1.6 kilometers) northwest of the City of Mattoon, in Coles County, Illinois. Key features of the Mattoon Site are listed in Table 4.1-1. The proposed power plant and sequestration site would be located on the same parcel of land. The proposed site is bordered to the northeast by State Route (SR) 121 and a Canadian National Railroad. Potable water would be supplied by extending existing lines from Mattoon’s public water supply system. Process water would be provided from the effluent of the municipal wastewater treatment plants (WWTPs) of the cities of Mattoon and possibly Charleston, Illinois. Sanitary wastewater service would be provided through an extension of Mattoon’s public wastewater system. Natural gas would be delivered through a high-pressure line that is within 0.25 mile (0.4 kilometer) of the proposed site. The proposed power plant would connect to the power grid via existing or new high voltage transmission lines. Following Table 4.1-1, Figures 4.1-1 and 4.1-2 illustrate the Mattoon Site and utility corridors, respectively.

Table 4.1-1. Mattoon Site Features

Feature	Description
Power Plant Site	The proposed Mattoon Power Plant and Sequestration Site consists of approximately 444 acres (180 hectares) located in Mattoon Township, Coles County, Illinois. The proposed site consists of 93 percent farmland and 3 percent public rights-of-way (ROWs), with the remaining percentage being rural residential development and woodlands. The Site Proponent is a group consisting of the State of Illinois (through the Illinois Department of Commerce and Economic Opportunity), the City of Mattoon, Coles County, and Coles Together (an economic development organization). The proposed site is currently privately owned, but the Site Proponent has an option to purchase the site title, which would be conveyed to the Alliance. The northeast boundary of the proposed site is adjacent to SR 121. Rail access is immediately adjacent to the northeast site boundary. The proposed power plant site is located approximately 1 mile (1.6 kilometers) northwest of Mattoon and approximately 150 miles (241.4 kilometers) south of Chicago. This Coles County site is used as farmland, is flat, and is surrounded by a rural area of low-density population.
Sequestration Site Characteristics and Predicted Plume Radius	The sequestration site is located on the same parcel of land as the power plant site. CO_2 injection would occur within the Mt. Simon saline-bearing sandstone at a depth of 1.3 to 1.6 miles (2.1 to 2.6 kilometers). The Mt. Simon formation is overlain by a thick (500- to 700-foot [152- to 213-meter]) regional seal of low permeability siltstones and shales of the Eau Claire formation and is underlain by Precambrian granitic rock. The St. Peter sandstone is proposed as an optional target reservoir. It occurs at a depth of 0.9 mile (1.4 kilometers), which is about 0.4 mile (0.6 kilometer) above the Mt. Simon formation. The St. Peter sandstone is estimated to be over 200 feet (61 meters) thick with state-wide lateral continuity. Both the Mt. Simon and St. Peter reservoirs have been successfully used for natural gas storage in other parts of Illinois. To estimate the size of the plume of injected CO_2, the Alliance used numerical modeling to predict the plume radius from the injection well. This modeling estimated that the plume radius at Mattoon could be as large as 1.2 miles (1.9 kilometers) after injecting 1.1 million tons (1 MMT) of CO_2 annually for 50 years. The dispersal and movement of the injected CO_2 would be influenced by the geologic properties of the reservoir, and it is unlikely that the plume would radiate in all directions from the injection point in the form of a perfect circle. However, for reference purposes, this modeled radius corresponds to a circular area equal to 2,789 acres (1,129 hectares). Data from a recent two-dimensional (2D) seismic line across the proposed injection site indicated that the continuity of the seismic reflectors on this seismic line suggests that there is no significant faulting cutting the plane on the seismic line within 1.5 miles (2.4 kilometers) to the west and 1.5 miles (2.4 kilometers) to the east of the Mattoon Sequestration Site (Patrick Engineering, 2006).
Utility Corridors	
Potable Water	Potable water would be supplied to the plant site from the Mattoon public potable water system. A 1-mile (1.6-kilometer) pipeline extension would be constructed within the ROW of County Road (CR) 800N from the proposed power plant site to a 10-inch (25-centimeter) potable water pipeline on 43rd Street south of SR 121.

Table 4.1-1. Mattoon Site Features

Feature	Description
Process Water	The proposed Mattoon Site would obtain process water from the effluent of the municipal WWTPs of Mattoon and possibly Charleston. For the Mattoon WWTP effluent, a 6.2-mile (10.0-kilometer) pipeline would be constructed, with all but 2 miles (3.2 kilometers) within an existing public ROW located within the city boundary. The Site Proponent has option contracts to buy the necessary easements for these 2 miles (3.2 kilometers) of pipeline. The possible addition of a new 8.1-mile (13.0-kilometer) pipeline from the Charleston WWTP would be within an existing ROW owned by Mattoon and Charleston. The jointly-owned ROW follows the Lincoln Prairie Grass Bike Trail, and existing 138-kilovolt (kV) overhead electric lines run the entire length. An on-site reservoir (on the power plant property) could be constructed to store up to 25 million gallons (94.6 million liters) of process water to satisfy water requirements. A small reservoir of 7 acres (2.8 hectares) would be adequate. If a larger reservoir were constructed (approximately 40 acres [16.2 hectares] in size) with a capacity of 200 million gallons (757 million liters), the Mattoon WWTP effluent would be sufficient by itself to supply the proposed plant's process water.
Sanitary Wastewater	Sanitary wastewater service would be provided to the proposed plant site through an extension of Mattoon's existing public wastewater system. A sanitary sewer lift station would be constructed at the proposed site. A 1.25-mile (2.0-kilometer) wastewater force main would then be constructed in the ROW of SR 121 to an existing sanitary lift station at the intersection of SR 121 and 43rd Street.
Electric Transmission Lines	Option 1: The proposed power plant would connect with an existing 138-kV transmission line located 0.5 mile (0.8 kilometer) from the proposed site. This line runs north-south and is owned by Ameren Corporation. A corridor easement to connect the proposed site to the existing 138-kV line has already been acquired by Mattoon. There are three scenarios to tie into this line under Option 1. Option 1a: Tie directly into the existing 138-kV line with transfer switching. Option 1b: Install a substation at the interconnection of the new easement with the existing ROW. Option 1c: Run a new transmission line south next to the existing 138-kV line and connect with the existing substation less than 2 miles (3.2 kilometers) away near Route 16. The existing substation would need to be upgraded. Option 2: Under this option, the proposed site would be connected to the nearest 345-kV line at the Neoga South Substation located 16 miles (25.7 kilometers) south of the proposed site. This option would require 16 miles (25.7 kilometers) of new line and ROW to connect the proposed plant with this substation.
Natural Gas	A natural gas mainline is located approximately 0.25 mile (0.4 kilometer) east of the proposed power plant site. This is a high-pressure line, and a new tap and delivery station would be required. The Site Proponent has obtained an option for additional land for the pipeline ROW that would give flexibility in the route to connect to this line.
CO_2 Pipeline	The CO_2 injection well for the FutureGen Project at Mattoon would be located at the proposed power plant site. Therefore, no off-site CO_2 pipeline or corridor would be necessary.

Table 4.1-1. Mattoon Site Features

Feature	Description
Transportation Corridors	The site is located 7 miles (11.3 kilometers) west of Interstate (I) Highway 57 (I-57), along SR 121. The Canadian National-Peoria Subdivision rail line is immediately adjacent to the northeast site boundary. The Canadian National/Illinois Central mainline connects to the Peoria Subdivision rail line approximately 3.5 miles (5.6 kilometers) from the proposed site. Illinois is located within the East North Central Demand Region for coal, which also includes Ohio, Indiana, Wisconsin, and Michigan. According to the Energy Information Administration (EIA, 2000), the East North Central Demand Region is ideally situated for access to coal, which it receives from each of the major U.S. supply regions. In 1997, the average distance that a coal shipment traveled to reach a destination in this region was about 830 miles (1,336 kilometers) (EIA, 2000). In terms of a straight-line distance, Mattoon is approximately 300 miles (483 kilometers) from the Pittsburgh Coalbed (near south-central Ohio in the northern Appalachian Basin), 900 miles (1,448 kilometers) from the Powder River Basin (PRB) (eastern Wyoming), and 50 miles (80.5 kilometers) from the nearest active coal mine within the Illinois Basin (Vermillion County, Illinois).

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

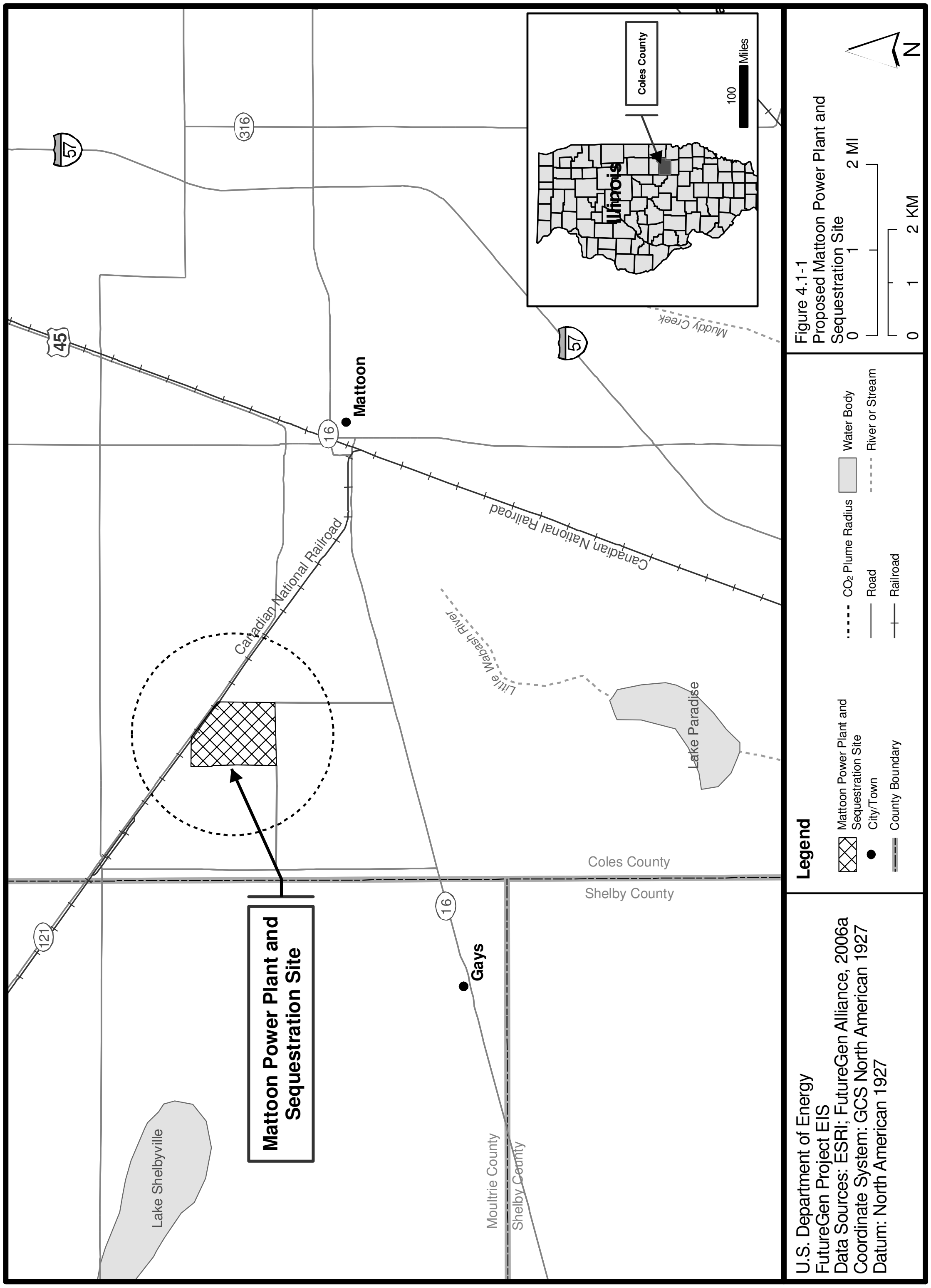

Figure 4.1-1
Proposed Mattoon Power Plant and Sequestration Site

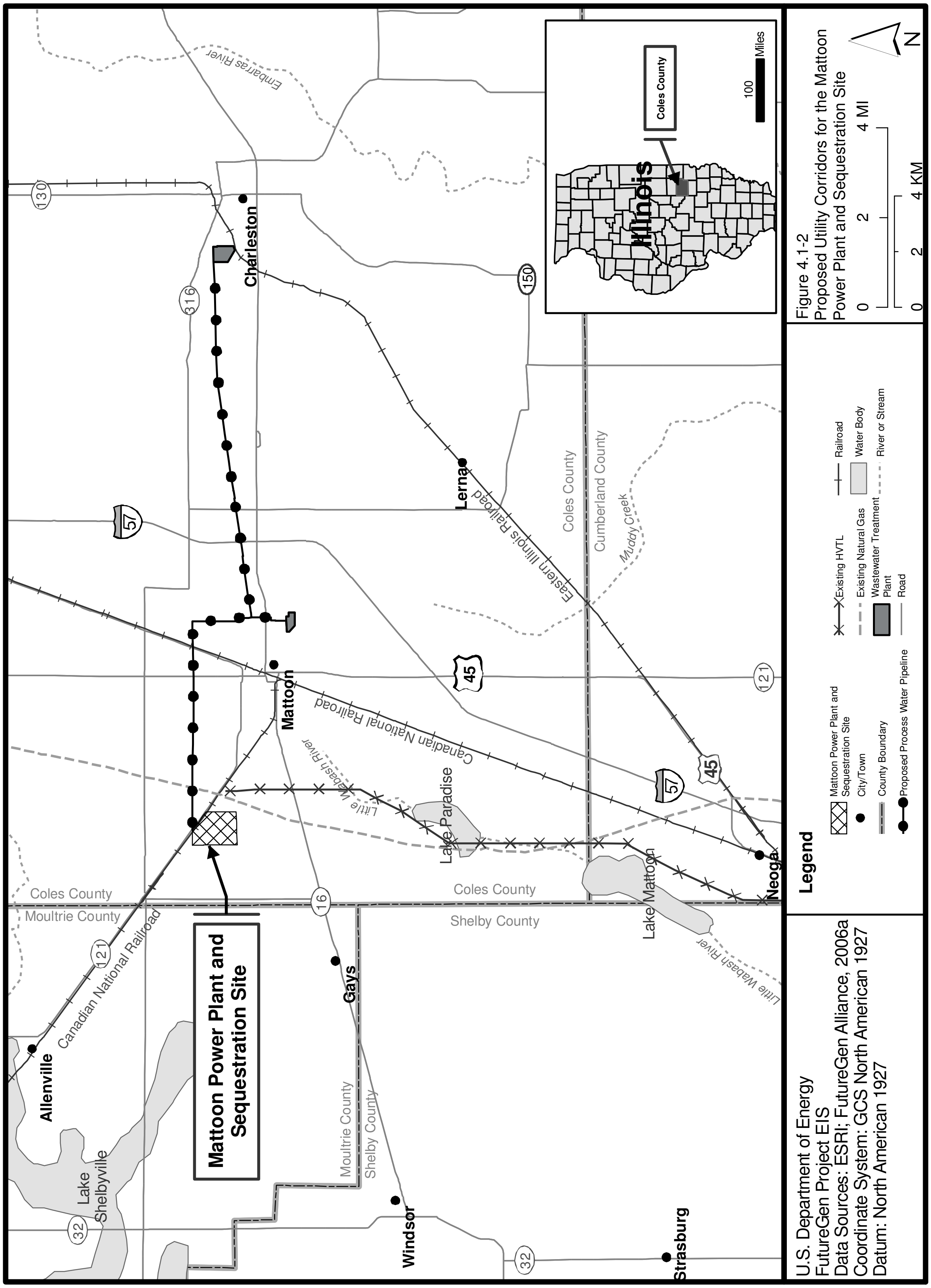

Figure 4.1-2
Proposed Utility Corridors for the Mattoon Power Plant and Sequestration Site

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4.2 AIR QUALITY

4.2.1 INTRODUCTION

This section describes existing local and regional air quality and the potential impacts that may occur from constructing and operating the FutureGen Project at the Mattoon Power Plant and Sequestration Site. The FutureGen Project would use integrated gasification combined-cycle (IGCC) technology and would capture and sequester carbon dioxide (CO_2) in deep underground formations. Chapter 2 provides a discussion of the advancements in IGCC technology associated with the FutureGen Project that would reduce emissions of air pollutants. Because of these technologies, emissions from the FutureGen Project would be lower than emissions from existing IGCC power plants and state-of-the-art (SOTA), conventional coal-fueled power plants.

4.2.1.1 Region of Influence

The ROI for air quality includes the area within 50 miles (80.5 kilometers) of the boundaries of the proposed Mattoon Power Plant and Sequestration Site. Sensitive receptors that have been identified within the ROI are discussed in Section 4.2.2.3.

4.2.1.2 Method of Analysis

DOE reviewed available public data and also studies performed by the Alliance to determine the potential for impacts based on whether the proposed FutureGen Project would:

- Result in emissions of criteria pollutants and hazardous air pollutants (HAPs);
- Result in mercury (Hg) emissions and conflict with the Clean Air Mercury Rule (CAMR) as related to coal-fueled electric utilities;
- Cause a change in air quality related to the National Ambient Air Quality Standards (NAAQS);
- Result in consumption of Prevention of Significant Deterioration (PSD) increments as defined by the Clean Air Act (CAA), Title I, PSD rule;
- Affect visibility and cause regional haze in Class I areas;
- Result in nitrogen and sulfur deposition in Class I areas;
- Conflict with local or regional air quality management plans;
- Result in emissions of greenhouse gases (GHGs);
- Cause solar loss, fogging, icing, or salt deposition on nearby residences; and
- Discharge odors into the air.

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

Based on the above criteria, DOE assessed potential air quality impacts from construction and operational activities related to the FutureGen Project at the proposed Mattoon Power Plant and Sequestration Site. For impacts related to FutureGen Project operations, DOE conducted air dispersion modeling of criteria pollutants using EPA's refined air dispersion model, AERMOD (American Meteorological Society/EPA Regulatory Model). Details on the air modeling protocol are presented in Appendix E. To establish an upper bound for potential impacts, DOE used the FutureGen Project's estimate of maximum air emissions, which was developed by the Alliance and reviewed by DOE, for the air dispersion modeling, based on 85 percent plant availability and unplanned restarts as a result of plant upset (also called unplanned outages) (see Table 4.2-1). The estimate of maximum air emissions was developed using the highest pollutant emission rates for various technology options being considered for the FutureGen Project (see Section 2.5.1.1). Surrogate data from similar existing or permitted units (e.g., the Orlando Gasification Project [Orlando Project]) were used for instances where engineering details and emission data were not available due to the early design stage of the FutureGen Project (DOE, 2007). ***However, a power plant built with these conceptual designs, under normal steady-state operations, could meet the specified FutureGen Project Performance Targets (see Section 2.5.6).***

Table 4.2-1 presents expected emissions of air pollutants from the FutureGen Project during the 4-year research and development period and beyond. Emissions from the first year of proposed power plant operation, which are expected to be highest, represent the upper bound for potential air emissions and were modeled for this EIS. Emissions would be expected to decrease each year, as learning and experience would reduce the frequency and types of unplanned restart events from an estimated 29 in the first year to 3 in the fifth year and beyond (see Appendix E). Consequently, annual emissions would be expected to decrease progressively from the first year of operation to the fourth year of operation and beyond. Because emissions of some criteria pollutants are projected to exceed 100 tons per year (tpy) (90.7 metric tons per year [mtpy]) (even with less than 3 restarts per year), the FutureGen Project would be classified as a major source under Clean Air Act regulations.

Table 4.2-1. Yearly Estimates of Maximum Air Emissions from the FutureGen Project[1] (tpy [mtpy])

Pollutant	Year 1	Year 2	Year 3	Year 4	Year 5 Onward[2]
Sulfur Oxides[3] (SO_X)	543 (492)	322 (292)	277 (251)	255 (231)	100 (90.7)
Nitrogen Oxides[4] (NO_X)	758 (687)	754 (684)	753 (683)	753 (683)	750 (680)
Particulate Matter[5] (PM_{10})	111 (100)	111 (100)	111 (100)	111 (100)	111 (100)
Carbon Monoxide[5] (CO)	611 (554)	611 (554)	611 (554)	611 (554)	611 (554)
Volatile Organic Compounds[5] (VOCs)	30 (27.2)	30 (27.2)	30 (27.2)	30 (27.2)	30 (27.2)
Mercury[5] (Hg)	0.011 (0.01)	0.011 (0.01)	0.011 (0.01)	0.011 (0.01)	0.011 (0.01)

[1] Because the FutureGen Project would be a research and development project, DOE assumes that the maximum facility annual availability would be 85 percent. Values are estimated based on maximum emissions rates for design Case 1, 2, or 3A, plus maximum emissions rates for design Case 3B and includes emissions from unplanned restarts (upset conditions).
[2] Year 1 to Year 4 calculated based on information provided by the Alliance. Year 5 estimated by DOE; not provided by the Alliance.
[3] SO_x emissions from coal combustion systems are predominantly in the form of sulfur dioxides (SO_2).
[4] NO_x emissions from coal combustion are primarily nitric oxide (NO); however, for the purpose of the air dispersion modeling, it was assumed that all NO_x emissions are nitrogen dioxides (NO_2). One of the technologies being considered for the FutureGen Project is post-combustion selective catalytic reduction (SCR), which would reduce the annual NO_X emissions to 252 tpy (228.6 mtpy).
[5] Values for PM_{10}, CO, VOCs, and Hg would remain constant between Year 1 through 5 because unplanned restarts would not affect these emissions. Conversely, SO_2 and NO_2 emissions would decrease each year due to expected decrease in restart events. See Appendix E, Tables E-2 and E-3.
tpy = tons per year; mtpy = metric tons per year.
Source: FG Alliance, 2007.

In addition to assessing impacts of criteria pollutant emissions, DOE assessed impacts of HAP emissions by estimating the annual quantities of HAPs that would be emitted from the proposed

FutureGen Power Plant. These estimates were developed based on emissions predicted for the Orlando Project, which would burn a carbon-rich syngas (DOE, 2007). The estimated HAPs may be overstated since the FutureGen Project would include new technologies that would produce syngas that would contain lower levels of carbon. The estimated emissions are presented in Section 4.2.3.2.

DOE also assessed the potential for impacts to local visibility from the vapor plume using qualitative measures because engineering specifications needed to conduct quantitative modeling for vapor plume sources (e.g., cooling towers) were not available. Class-I-related modeling, including pollutant dispersion and air-quality-related values (AQRV), were reviewed for their applicability. Potential effects to soil, vegetation, animals, human health, and economic development were also reviewed.

4.2.2 AFFECTED ENVIRONMENT

4.2.2.1 Existing Air Quality

The Illinois Environmental Protection Agency (IEPA) Bureau of Air has monitoring sites throughout the state, which monitor ambient air quality and designate areas or regions that either comply with all of the NAAQS or fail to meet the NAAQS for one or more criteria pollutants. The NAAQS specify the maximum allowable concentrations of six criteria pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), lead (Pb), and inhalable particles, which are also known as respirable particulate matter (PM). The PM_{10} standard covers particles with diameters of 10 micrometers or less and the $PM_{2.5}$ standard covers particles with diameters of 2.5 micrometers or less. Areas that meet the NAAQS for a criteria pollutant are designated as being in "attainment" for that pollutant, and areas where a criteria pollutant concentration exceeds the NAAQS are designated as "non-attainment" areas. Where insufficient data exist to determine an area's attainment status, the area is designated as unclassifiable. Maintenance areas are those non-attainment areas that have been redesignated as attainment areas and are under a 10-year monitoring plan to maintain their attainment status.

The proposed Mattoon Power Plant and Sequestration Site is located in Coles County, Illinois. Coles County is part of the East Central Illinois Intrastate Air Quality Control Region (AQCR). No ambient air monitoring data are recorded in Coles County (FG Alliance, 2006a); however, in the East Central Illinois Intrastate AQCR, monitors are located in Champaign County, which is within the proposed Mattoon Power Plant Site ROI, and McLean County, which is outside the ROI. These monitors measure O_3 and $PM_{2.5}$ concentrations. The East Central Illinois Intrastate AQCR has no history of non-attainment for the six criteria pollutants. The nearest SO_2 monitor within the ROI of the proposed site is in Macon County in the West Central Interstate AQCR. This monitor indicates attainment with the SO_2 NAAQS. Neither the East Central Illinois Intrastate AQCR nor other AQCRs within the ROI of the proposed Mattoon Power Plant and Sequestration Site has monitors for NO_X, PM_{10}, and CO concentrations. Concentrations of Pb have not been recorded in recent years due to a decrease in use of leaded gasoline in automobiles, which has lowered Pb concentrations in the ambient air to levels well below the NAAQS. Table 4.2-2 provides monitored background data of O_3, $PM_{2.5}$, and SO_2 for the proposed Mattoon Power Plant and Sequestration Site. ***Appendix E provides additional details.***

While the ROI for the proposed project is currently designated as in attainment or unclassified, air moving from nearby non-attainment areas could likely contribute to the air quality within the region of the proposed Mattoon Power Plant and Sequestration Site. The nearest non-attainment and maintenance areas are located in ***St. Louis, MO-IL*** (***72.3*** miles [***116.3*** kilometers] away) and Vigo County, Indiana (46 miles [74.0 kilometers] away). Site-specific monitoring to collect representative background data for all criteria pollutants could be required at the proposed project site as part of the PSD permit application process (EPA, 1990), although the IEPA has indicated that such monitoring would not be required.

However, the Alliance may choose to conduct site-specific monitoring for criteria pollutants as appropriate for development of a detailed site characterization if the proposed Mattoon Site is selected.

Table 4.2-2. Monitoring Stations and Ambient Air Quality Data

Monitoring Site Location	Distance from Proposed Site (miles [kilometers])	Pollutant and Averaging Time	Monitored Data[1]	Primary/ Secondary Standard[1]
Decatur, Illinois Macon County West Central Illinois Interstate AQCR	45 (72.4)	O_3 (1-hour) O_3 (8-hour) $PM_{2.5}$ (Annual) $PM_{2.5}$ (24-hour) SO_2 (Annual) SO_2 (24-hour) SO_2 (3-hour)	0.093 0.070 13.3 34.1 0.004 0.024 0.040	0.12 0.08 15 35 0.03 0.14 None
Champaign, Illinois Champaign County East Central Illinois Interstate AQCR	48 (77.2)	O_3 (1-hour) O_3 (8-hour) $PM_{2.5}$ (Annual) $PM_{2.5}$ (24-hour)	0.082 0.079 12.5 31.9	0.12 0.08 15 35
Bondville, Illinois Champaign County East Central Illinois Interstate AQCR	52 (83.7)	$PM_{2.5}$ (Annual) $PM_{2.5}$ (24-hour)	12.6 31.8	15 35
Normal, Illinois McClean County East Central Illinois Interstate AQCR	100 (160)	O_3 (1-hour) O_3 (8-hour) $PM_{2.5}$ (Annual) $PM_{2.5}$ (24-hour)	0.093 0.072 12.7 34.3	0.12 0.08 15 35

[1] Units for O_3 and SO_2 are in parts per million (ppm) and $PM_{2.5}$ is in micrograms per cubic meter (µg/m^3). To determine representative background data for both PM_{10} and $PM_{2.5}$, 24-hour and annual averaging period, the monitored data were averaged over a period of 3 years (2003 to 2005). For all other pollutants and corresponding averaging periods, the highest of the second-highest values for each year for a period of 3 years (2003 to 2005) was used (see Appendix E).
Source: EPA, 2006a; FG Alliance, 2006a.

4.2.2.2 Existing Sources of Air Pollution

Emissions from the proposed FutureGen Project and potential environmental consequences must be considered in the context of both regional air quality and existing local sources of emissions. Existing sources of emissions outside and within the ROI are discussed. Additionally, local sources (i.e., within 1 mile [1.6 kilometers] of the proposed Mattoon Power Plant and Sequestration Site) are discussed.

Outside the Region of Influence

Traffic-related pollution and pollution from existing industrial sources, associated with nearby large cities, can contribute to air quality problems in rural areas. The proposed Mattoon Power Plant and Sequestration Site has the large Illinois cities of Champaign and Urbana to the north (approximately 52 miles [83.7 kilometers]); Springfield to the west (approximately 83 miles [133.6 kilometers]); Indianapolis, Indiana, to the east; and Terre Haute, Indiana, to the southeast. The greater metropolitan Chicago area is approximately 180 miles (289.7 kilometers) to the north of the proposed site and is in non-attainment for O_3 and $PM_{2.5}$. The St. Louis, Missouri, area, which is 90 miles (144.8 kilometers) southwest of Mattoon is also in non-attainment for O_3 and $PM_{2.5}$. However, because of the west-to-east trend of overall air patterns and closer proximity to the proposed site, the St. Louis area would probably have a greater influence on air quality in Mattoon than the greater metropolitan Chicago area. Additionally, the medium-sized city of Decatur is located about 45 miles (72.4 kilometers) northwest and is in a prevalent upwind direction from the proposed Mattoon Power Plant and Sequestration Site. For pollutants for which there were no monitored background data, background data from cities such as Briadwood and Peoria, which are attainment areas but outside the ROI, were used.

Inside the Region of Influence

Small towns or cities within 10 miles (16.1 kilometers) of Mattoon include Windsor, Gays, Allenville, Lerne, Humboldt, and Charleston, and could contribute to background ambient air quality. The types and quantities of air pollutants emitted from existing sources located within 10 miles (16.1 kilometers) of the proposed power plant site may contribute to the background concentrations of pollutants within and surrounding the ROI. According to the EPA Envirofacts website (http://www.epa.gov/enviro), the major sources of criteria pollutants and HAPs within a 10-mile (16.1-kilometer) radius are RR Donnelley and Sons Company, Masterfoods USA, GE Lighting LLC, and AJ Walker Construction Company (EPA, 2006b). Other sources include the vehicle traffic in Mattoon and surrounding areas plus possible fugitive emissions of hydrocarbons from the Mattoon Oil and Gas Field, which extends along a north-south oriented trend through the western side of Mattoon as well as to the north and to the south of the city. These existing sources provide a context for understanding the potential emissions and associated air quality impacts from the proposed project.

> A **major source** is ***generally*** a unit that emits any one criteria pollutant in amounts equal to or greater than thresholds of 100 tpy (90.7 mtpy) or one HAP in amounts greater than or equal to 10 tpy (9.1 mtpy) or a combination of HAP in amounts greater than or equal to 25 tpy (22.7 mtpy). For sources that are not in one of the 28 categories ***defined by the PSD rule***, the threshold is 250 tpy (226.8 mtpy) of criteria pollutants (40 Code of Federal Regulations [CFR] 52.21, 2006). ***Because a fossil-fuel fired steam electric generating unit is one of the 28 categories defined by the PSD rule, the 100 tpy threshold applies.***

Local

No major emissions sources are located within 1 mile (1.6 kilometers) of the proposed Mattoon Power Plant and Sequestration Site. With the exception of the western margin of Mattoon, the area within 1 mile (1.6 kilometers) of the proposed power plant and sequestration site supports mostly agricultural activities (row crops). The croplands are not highly susceptible to wind erosion and, most of the time, would not present a source of wind-blown particulates or dust. However, cultivation and tilling of the soil may cause some dust suspension or render the soil more susceptible to wind erosion for short periods of time.

4.2.2.3 Sensitive Receptors (Including Class I Areas)

There are two residences across the street from the proposed site on the north and east sides, and two additional residences within approximately 0.25 mile (0.4 kilometer). Approximately 20 additional residences are located within 1 mile (1.6 kilometers) of the site, including a group of residences on Western Avenue. There are no hospitals, schools, or nursing homes within 1 mile (1.6 kilometers) of the proposed site.

Within the 10-mile (16.1-kilometer) radius of the proposed Mattoon Power Plant Site, there are about 24 residences, 10 schools, one hospital, and five nursing homes (see Figure 4.2-1) (FG Alliance, 2006a).

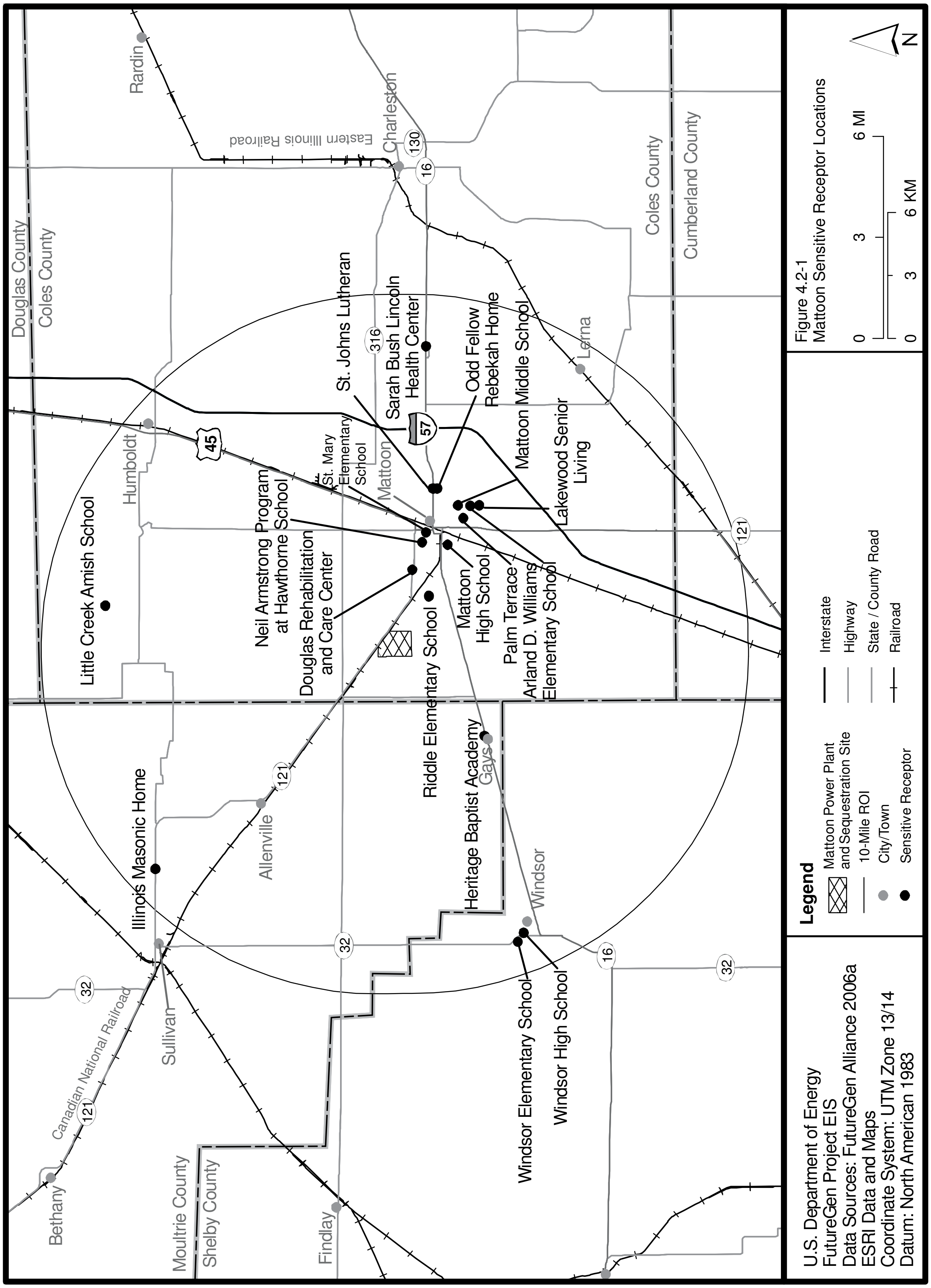

Figure 4.2-1
Mattoon Sensitive Receptor Locations

Class I Areas

For areas that are already in compliance with the NAAQS, the PSD requirements provide maximum allowable increases in concentrations of pollutants, which are expressed as increments. Allowable PSD increments currently exist for three pollutants: SO_2, NO_2, and PM_{10}. They apply to the three types of areas classified under the PSD regulations: Classes I, II, and III, where the smallest allowable increments correspond to Class I areas (Table 4.2-3).

Table 4.2-3. Allowable PSD Increments (μg/m³)

Pollutant, Averaging Period		Class I Area	Class II Area	Class III Area
SO_2	3-Hour	25	512	700
	24-Hour	5	91	182
	Annual	2	20	40
NO_2	Annual	2.5	25	50
PM_{10}	24-Hour	8	30	60
	Annual	4	17	34

μg/m³ = micrograms per cubic meter.
Source: EPA, 2005.

Class I areas, which are those areas designated as pristine, require more rigorous safeguards to prevent deterioration of the air quality, and include many national parks and monuments, wilderness areas, and other areas as specified in 40 CFR 51.166(e). The closest Class I area is 190 miles (305.8 kilometers) from the proposed Mattoon Power Plant and Sequestration Site (see Table 4.2-4), which is well beyond the 62-mile (100-kilometer) distance required to consider impacts to Class I areas under the PSD regulations. All other clean air regions are designated Class II areas, with moderate pollution increases allowed (FWS, 2007). The proposed Mattoon Power Plant and Sequestration Site is located in a Class II area.

Table 4.2-4. Nearest Class I Areas to Proposed Mattoon Power Plant and Sequestration Site

Class I Area/Location	Distance (miles)	Distance (kilometers)	Direction
Mammoth Cave National Park, Kentucky	190	305.8	SE
Mingo National Wildlife Refuge, Missouri	198	318.7	SW

Source: FG Alliance, 2006a.

4.2.2.4 Air Quality Management Plans

The CAA requires states to develop federally approved regulatory programs, called State Implementation Plans (SIPs), for meeting the NAAQS throughout the state. These plans aim to limit emissions from sources as necessary to achieve and maintain compliance. In part, SIPs focus on new major stationary sources and modifications to existing major stationary sources. A state's New Source Review (NSR)/PSD review program is defined and codified in its SIP. The Illinois SIP is available from the IEPA.

The FutureGen Project would be required to undertake the NSR/PSD permit application process after a host site is selected. State and local governmental officials contacted during the development of this EIS and the supporting Environmental Information Volume (EIV) indicate that there are no local air quality management plans currently in existence for the ROI (FG Alliance, 2006a). Additionally, these officials have no knowledge of specific local needs or concerns for air quality management at the proposed Mattoon Power Plant and Sequestration Site.

4.2.3 IMPACTS

4.2.3.1 Construction Impacts

Construction at the proposed power plant and sequestration site, utility corridors, and transportation corridors would result in localized increases in ambient concentrations of SO_2, NO_X, CO, VOCs, and PM. These emissions would result from the use of construction equipment and vehicles, including trucks, bulldozers, excavators, backhoes, loaders, dump trucks, forklifts, pumps, and generators. In addition, fugitive dust emissions (i.e., PM emissions) would occur from various construction-related activities, including earth moving and grading, material handling and storage, and vehicles traveling over dirt and gravel areas.

Given the size of the proposed site and the short duration of the construction period, potential impacts would be localized and temporary in nature. Construction impacts would be minimized through the use of best management practices (BMPs), such as wetting the soil surfaces, covering trucks and stored materials with tarps to reduce windborne dust, and using properly maintained equipment (see Section 3.4).

Power Plant and Sequestration Site

DOE assumed that up to 200 acres (81 hectares) of the proposed 444-acre (180-hectare) site would be directly affected for the purposes of the air impact analysis. DOE estimates that construction of the proposed Mattoon Power Plant and Sequestration Site would take 44 months. The CO_2 injection wells would be located within the proposed power plant site and only a very small fraction of the land area would be disturbed by either exploratory investigations (e.g., geophysical surveys) or construction of the sequestration facilities (e.g., injection and monitoring wells).

PM concentrations would be localized because of the relatively rapid settling of larger dust particles and impacts to off-site receptors would be temporary. In addition, PM emissions would decrease with the total amount of land disturbed, as PM emissions were calculated on the basis of site acreage. Impacts of the SO_2, NO_X, CO, and VOC emissions from vehicular sources would be temporary in nature and could cause minor to moderate short-term degradation of local air quality. The air pollutant emissions would be minimized through the use of BMPs, such as limiting the amount of vehicle trips, wetting the soil surfaces, covering trucks, limiting vehicle idling, and properly maintaining equipment.

Utility Corridors

The proposed utility corridors could include a natural gas pipeline, process water pipeline, potable water pipeline, sanitary wastewater pipeline, and electric transmission line. Construction of the utility corridors would require less acreage, use less equipment, and take less time than the construction of the proposed power plant. The duration of utility corridor construction would range from 1 month for the process water pipeline to 6 months for the other pipelines. The emissions from construction would include SO_2, NO_X, PM, CO, and VOCs. Impacts from emissions of these pollutants would be localized and temporary in nature and could cause minor to moderate short-term degradation of air quality in the areas where construction is taking place.

Transportation Corridors

Access to the proposed Mattoon Power Plant and Sequestration Site would be primarily via SR 121 along the northeast boundary of the site. Additionally, the Canadian National Railroad – Peoria Spur also runs along the northeast border of the proposed power plant site. Delivery to and from the proposed site could be accomplished either by railway or roadway; therefore, construction of additional public roadways or railways would not be required, and no impact would be expected. However, if the Mattoon Power Plant and Sequestration Site is selected for the FutureGen Project, the Illinois Department of Transportation (IDOT) has committed to upgrading County Highway (CH) 13 to a Class II truck route from CH 18 to the entrance of the plant, including the intersection with SR 121 (FG Alliance, 2006a). Impacts associated with upgrading this roadway would be dependent on the extent of construction activities required.

4.2.3.2 Operational Impacts

Power Plant Site

Sources of Air Pollution

Primary sources of air emissions associated with the FutureGen Project would be the combustion turbine, flare, gasifier preheat, cooling towers, and sulfur recovery system (see Figure 2-18). DOE and the Alliance have estimated the maximum potential emissions that would be expected (see Table 4.2-1) using data from equipment typical of an IGCC power plant. However, because the FutureGen Project is in the early stages of design, specific engineering and technical information on the equipment that would ultimately be used is not available. Other sources of air emissions could include mobile sources such as plant vehicular traffic and personnel vehicles, which would be equipped with standard pollution-control devices to minimize emissions.

Local traffic within the proposed power plant site would be expected to emit small amounts of criteria pollutants. In addition, coal delivery trains (five trains per week) would emit a small amount of criteria pollutants from the train exhaust, and potentially PM during coal unloading and handling. However, coal handling emissions are not expected to appreciably change air quality because the emissions would be reduced by minimizing points of transfer of the material, enclosing conveyors and loading areas, and installing control devices such as baghouses and wetting systems.

Clean Air Act General Conformity Rule

Section 176(c)(1) of the Clean Air Act requires that federal actions conform to applicable SIPs for achieving and maintaining the NAAQS for the criteria air pollutants. In 1993, EPA promulgated a rule titled "Determining Conformity of General Federal Actions to State or Federal Implementation Plans," codified at 40 CFR Parts 6, 51, and 93. The rule is intended to ensure that criteria air pollutant emissions and their precursors (e.g., VOCs and NO_X) are specifically identified and accounted for in the attainment or maintenance demonstration contained in a SIP. The conformity rule applies to proposed federal actions that would cause emissions of criteria air pollutants above certain levels in locations designated as non-attainment or maintenance areas for the emitted pollutants. Under the rule, an agency must engage in a conformity review process and, depending on the outcome of that review, conduct a conformity determination.

DOE conducted a conformity review to assess whether a conformity determination (40 CFR Part 93) is needed for the proposed FutureGen Project. As discussed in Section 4.2.2.1, Coles County is in attainment or unclassified with the NAAQS for all pollutants. Additionally, Coles County is not designated as a maintenance area. Consequently, no conformity determination is needed (see Section 4.2.2.4).

Criteria Pollutant Emissions

DOE conducted refined modeling using AERMOD. Table 4.2-5 presents the results of the AERMOD modeling for the operational phase of the proposed Mattoon Power Plant. Limited amounts of background air concentration data for the Mattoon area were available for use in this EIS. For SO_2 and $PM_{2.5}$, representative background data were available from monitors within the same AQCR as Coles County or within the ROI. For NO_2, PM_{10}, and CO, DOE used background data from monitors that were outside the ROI but within attainment areas to represent ambient concentrations for those pollutants. To determine representative background data for both PM_{10} and $PM_{2.5}$ 24-hour and annual averaging periods, DOE took the average of the second-highest monitored data over a period of 3 years (2003 to 2005). For all other pollutants and corresponding averaging periods, the highest of the second-highest values of each year for a period of 3 years (2003 to 2005) was used (see Appendix E).

Table 4.2-5 shows that concentrations of pollutants during the operational phase combined with background concentrations would be below their respective NAAQS during normal plant operation and plant upset. Additionally, the proposed FutureGen Project would not exceed the Class II PSD allowable increments; however, short-term 3-hour and 24-hour SO_2 concentrations could approach Class II PSD increment limits during plant upset from emissions associated with unplanned restart events. These unplanned restart emissions of SO_2 would typically be higher than steady-state SO_2 emissions, because syngas would be directly flared without the benefit of the sulfur recovery unit (see Appendix E). The probability of the proposed power plant exceeding the 3-hour SO_2 Class II PSD increment at the proposed Mattoon Power Plant Site during periods of plant upset is 0.23 percent and zero percent during normal operating scenarios. The probability of the proposed power plant exceeding the 24-hour SO_2 Class II PSD increment at the proposed Mattoon Power Plant Site at any time is zero. Maximum concentrations of the pollutants at anytime would be limited to a radius of less than 1 mile (1.6 kilometers) from the center of the proposed Mattoon Power Plant Site. Currently, two residences are across the street from the site on the north and east sides, two additional residences are within 0.25 mile (0.4 kilometer), and about 20 additional residences are within 1 mile (1.6 kilometers). These residences would be impacted.

Table 4.2-5. Comparison of Maximum Concentration Increases *to* NAAQS and PSD Increments

Pollutant	Maximum Concentration FutureGen Project Alone[1] (µg/m³)	Maximum Concentration FutureGen Project + Background (µg/m³)	NAAQS (µg/m³)	Class II PSD Increments (µg/m³)	PSD Increment Consumed by FutureGen Project (percent)	Distance of Maximum Concentration (miles [kilometers])
SO_2 (normal operating scenario)[2]						
3-hour	0.72	123.75	1,300	512	0.14	0.61 (0.98)
24-hour	0.26	70.93	365	91	0.29	1.00 (1.6)
SO_2 (upset scenario)[3]						
3-hour	511.82	634.85	1,300	512	99.96	0.67 (1.1)
24-hour	88.00	158.67	365	91	96.70	0.67 (1.1)
SO_2 Annual[4]	0.18	10.65	80	20	0.92	0.63 (1.0)

Table 4.2-5. Comparison of Maximum Concentration Increases *to* NAAQS and PSD Increments

Pollutant	Maximum Concentration FutureGen Project Alone[1] (µg/m³)	Maximum Concentration FutureGen Project + Background (µg/m³)	NAAQS (µg/m³)	Class II PSD Increments (µg/m³)	PSD Increment Consumed by FutureGen Project (percent)	Distance of Maximum Concentration (miles [kilometers])
NO_2[4, 5]						
Annual	0.26	30.35	100	25	1.03	0.63 (1.0)
PM/PM_{10}[4, 6]						
24-hour	0.52	57.86	150	30	1.75	1.00 (1.6)
Annual	0.04	26.04	50	17	0.22	0.63 (1.0)
$PM/PM_{2.5}$[4, 6]						
24-hour	0.52	32.46	35	n/a	n/a	1.00 (1.6)
Annual	0.04	12.54	15	n/a	n/a	0.63 (1.0)
CO[7]						
1-hour	11.33	5,622.76	40,000	n/a	n/a	0.50 (0.8)
8-hour	5.01	3,462.94	10,000	n/a	n/a	0.63 (1.0)

[1] Value based on site-specific meteorological and terrain data. Except for the 3-hour SO_2 during the upset scenario, the highest maximum predicted concentrations are provided for all pollutants and corresponding averaging times, based on the worst-case emissions rates, meteorological data, and terrain data. For the 3-hour SO_2 averaging time during the upset scenario, the 85th highest maximum predicted concentration is provided. Although the highest maximum 3-hour SO_2 concentration could exceed the PSD increment during the upset scenario, the 3-hour increment would not be exceeded at least 99.77 percent of the time. The highest maximum predicted concentrations for the other pollutants and corresponding averaging times would not be expected to exceed the PSD Class II increment at any time.
[2] The normal operating scenario is based on steady-state emissions and is a period when the plant is operating without flaring, sudden restarts, or other upset conditions (see Appendix E).
[3] The upset scenario is based on unplanned restart emissions and is a period when a serious malfunction of any part of the IGCC process train usually results in a sudden shutdown of the combined-cycle units gas turbine and other plant components (see Appendix E).
[4] Annual impacts are based on maximum annual emissions (see Appendix E) over 7,446 hours per year.
[5] There are no short-term NAAQS for NO_2.
[6] There are no unplanned restart emissions of PM_{10} and $PM_{2.5}$ pollutants; therefore, short-term impacts (24-hour) are based on steady-state emissions.
[7] Although there are unplanned restart emissions of CO pollutants, the short-term impacts (1-hour and 8-hour) are based on steady-state emissions because steady-state CO emissions are larger than unplanned restart CO emissions.
n/a = not applicable; µg/m³ = micrograms per cubic meter.
Source: AERMOD modeling results (see Appendix E).

Hazardous Air Pollutants

HAP emissions from the FutureGen Project were estimated based on the Orlando Project, a recent IGCC power plant that was determined to provide the best available surrogate data (DOE, 2007). DOE scaled the Orlando Project data based on relative emission rates of VOCs and PM to produce more appropriate estimates of emission rates for the FutureGen Project. However, only emissions from the gas turbine were considered to account for differences between the Orlando design and the FutureGen Project. These differences include the FutureGen Project's use of oxygen (O_2) in the gasifier instead of air, the use of a catalytic shift reactor to convert CO to CO_2, and CO_2 capture and sequestration features.

Predicted HAP emissions are presented in Table 4.2-6. These data indicate that the FutureGen Project would not emit any individual HAP above the 10-tpy (9.1-mtpy) major source threshold. Additionally, at 0.32 tpy (0.3 mtpy) of combined HAPs, the proposed FutureGen Project would not be a major source of HAPs as defined under the ***PSD***. Health hazards and risks associated with these HAP emissions and other air toxins are discussed in Section 4.17.

Table 4.2-6. Annual Hazardous Air Pollutant Emissions[1]

Chemical Compound	Combustion Turbine Emissions	
	tpy	mtpy
2-Methylnaphthalene	7.41E-04	6.72E-04
Acenaphthyalene	5.36E-05	4.86E-05
Acetaldehyde	3.72E-03	3.37E-03
Antimony[2]	2.08E-02	1.89E-02
Arsenic[2]	1.09E-02	9.93E-03
Benzaldehyde	5.99E-03	5.44E-03
Benzene	1.00E-02	9.09E-03
Benzo(a)anthracene	4.77E-06	4.32E-06
Benzo(e)pyrene	1.14E-05	1.03E-05
Benzo(g,h,i)perylene	1.96E-05	1.78E-05
Beryllium[2]	4.69E-04	4.26E-04
Cadmium[2]	1.51E-02	1.37E-02
Carbon Disulfide	9.27E-02	8.41E-02
Chromium[2, 3]	1.41E-02	1.28E-02
Cobalt[2]	2.97E-03	2.69E-03
Formaldehyde	6.89E-02	6.25E-02
Lead[2]	1.51E-02	1.37E-02
Manganese[2]	1.62E-02	1.47E-02
Mercury[2]	4.73E-03	4.29E-03
Naphthalene	1.10E-03	9.96E-04
Nickel	2.03E-02	1.84E-02
Selenium	1.51E-02	1.37E-02
Toluene	1.53E-03	1.39E-03
TOTAL	3.21E-01	2.91E-01

[1] Emission rates scaled by the ratio of VOC or PM emissions from Orlando Gasification Project EIS to the FutureGen Project. The Orlando Project's VOC emissions were multiplied by a factor of 0.2727, based on 30 tpy (27.2 mtpy) VOC for the FutureGen Project divided by 110 tpy (99.8 mtpy) VOC for the Orlando Project. The Orlando Project's PM emissions were multiplied by a factor of 0.6894, based on 111 tpy (100.7 mtpy) PM for the FutureGen Project divided by 161 tpy (146.1 mtpy) PM for the Orlando Project.
[2] Compounds that are considered to be PM are in bold text.
[3] Conservatively assumed all chromium to be hexavalent.
tpy = tons per year; mtpy = metric tons per year.
Source: DOE, 2007.

Mercury

CAMR ***establishes "standards of performance" limiting mercury emissions from new and existing coal-fired power plants and creates a market-based cap-and-trade program that reduces nationwide utility emissions of mercury in two distinct phases. CAMR applies to units*** that produce more than 25-MW equivalent ***electrical*** *output* and that would sell ***more than one-third of their potential*** electric***al output***. Under CAMR, e***ach State must submit a plan whereby the State will meet its mercury emissions budget under the nationwide cap; a State plan may deviate from the model rule developed by EPA but may not exceed its budget. T***he Illinois Pollution Control Board requires controls that would reduce 90 percent of input Hg from various coal-fueled electrical generating units by mid-year 2009. The FutureGen Project would be subject to CAMR because it is a unit that would generate approximately 275 megawatts-electrical (MWe) and would sell more than one-third of its potential electric output. The FutureGen Project would remove over 90 percent of Hg during the syngas cleanup process using activated carbon beds. ***Upon facility startup, the FutureGen Project would need to comply with the State plan for CAMR, as well as meet the Federal NSPS emission limits. Continuous monitoring for Hg would also be required.***

The AERMOD analysis predicted that a negligible annual concentration of Hg (3.78×10^{-6} micrograms per cubic meter) would ***result*** within 0.63 mile (1.0 kilometer) of the proposed power plant site.

Radionuclides and Radon

Coal is largely composed of organic matter, but some trace elements in coal are naturally radioactive. These radioactive elements include uranium (U), thorium (Th), and their numerous decay products, including radium (Ra) and radon (Rn). During coal processing (e.g., gasification) most of the uranium, thorium and their decay products are released from the original coal matrix and are distributed between the gas phase and the ash product. Almost all radon gas present in feed coal is transferred to the gas phase. In contrast, less volatile elements such as thorium, uranium, and the majority of their decay products are almost entirely retained in the solid ash or slag.

The concentration of uranium and thorium in coal is low. Analyses of Eastern and Western coals show that in the majority of samples, concentrations of uranium and thorium fall in the range from slightly below 1 to 4 parts per million (ppm). Similar uranium and thorium concentrations are found in a variety of common rocks and soils. For example, average thorium concentration in the earth's crust is approximately 10 ppm. Based on standards for hazardous pollutants, EPA determined that current levels of radionuclide emissions (both parent elements and various decay products) from coal-fired boilers represent a level of risk that protects the public health with an ample margin of safety. Therefore, since the FutureGen plant objective is to achieve near-zero emissions and will have greater particulate control, the risk from air emissions for the FutureGen plant is projected to be less than the plants represented in the EPA study.

The fate and transport of radionuclides in a coal combustion power plant is reasonably well understood, and most radionuclides (with the exception of radon, see below) will partition to the slag or ash. However, limited research to date has been conducted on gasification facilities. DOE sponsored testing and measurement of a number of trace substances, including radionuclides, at the Louisiana Gasification Technology, Inc., (LGTI) facility located within the Dow Chemical complex in Plaquemine, Louisiana. The objective was to characterize such emissions from an integrated gasification combined cycle power plant. Sampling and chemical analyses included samples from inlet streams (e.g., coal, makeup water, ambient air conditions) and outlet streams leaving the plant (e.g., slag, water, exhaust streams). Limited data indicates that radionuclides behave in a similar manner to combustion facilities but the available data is insufficient to draw significant conclusions. As mentioned previously, FutureGen will have extremely high particulate control compared to conventional coal plants, a requirement for reliable operation of combustion turbines. In addition,

FutureGen will have advanced highly efficient control equipment for removal of other syngas contaminants including mercury, sulfur and CO_2 beyond those that were included in the LGTI facility. These additional emission control devices provide added locations where radionuclides may be trapped, resulting in substantially lower emissions compared to existing facilities that use conventional technologies.

Radon is a naturally occurring, inert gas that is formed from normal radioactive decay processes. Radon in the atmosphere comes largely from the natural release of radon from rock and soil close to the Earth's surface. Radon in coal will be present in the gas phase (e.g., gas bubbles within the coal). The source of the radon is from the decay over time of uranium 235 and 238 or thorium 232 that would have occurred in the coal seam. Some of the radon gas in the coal would be released during mining and coal preparation prior to arriving at the FutureGen plant. The radon released during the gasification process would be present in the syngas product leaving the gasifier. Various syngas cleaning and conditioning processes will be included in the FutureGen plant, likely including water and solvent scrubbing processes as well as absorbent/adsorbent systems. Since radon is soluble in water it is possible that a significant portion of the radon will be transferred to the water stream. Some radon will likely pass through the various scrubbing operations and will be emitted through the stack gas. Technology is currently available and commercially used to remove radon from water (e.g., granular activated carbon, aeration processes) and waste water treatment facilities will be designed to provide suitable control of regulated pollutants.

DOE recognizes that radionuclides are present at detectable levels in coal throughout the U.S. While EPA has indicated that the risk of exposure from emissions from utilities is substantially lower than risks from background radiation, DOE acknowledges that there are research gaps related to the ultimate fate of radionuclides in advanced coal technologies. Characterization and monitoring of gaseous and solid effluents from the facility will be consistent with necessary requirements to ensure compliance with required permits. As a research facility aimed to provide the pathway of achieving coal-based energy generation with zero emissions, FutureGen is a likely candidate location for advancing the understanding of the ultimate fate of trace substances in coal, including the ultimate fate of radionuclides.

Greenhouse Gases

GHGs include water vapor, CO_2, methane, NO_X, O_3, and several chlorofluorocarbons. Water vapor is a naturally occurring GHG and accounts for the largest percentage of the greenhouse effect. Next to water vapor, CO_2 is the second-most abundant GHG. Uncontrolled CO_2 emissions from power plants are a function of the energy output of the plants, the feedstock consumed, and the power plants' net efficiency at converting the energy in the feedstock into other forms of energy (e.g., electricity, useable heat, and hydrogen gas). Because CO_2 is relatively stable in the atmosphere and essentially uniformly mixed throughout the troposphere and stratosphere, the climatic impact of CO_2 emissions does not depend upon the CO_2 source location on the earth (DOE, 2006a). Although regulatory agencies are taking actions to address GHG effects, there are currently no Illinois or federal standards or regulations limiting CO_2 emissions and concentrations in the ambient air.

The proposed FutureGen Project would produce electricity and hydrogen fuel while emitting CO_2. DOE estimates that up to 0.28 million tons (0.25 million metric tons [MMT]) per year of CO_2 would be released into the atmosphere. A goal of the FutureGen Project is to capture and permanently sequester at least 90 percent of the CO_2 generated by the proposed power plant at a rate of 1.1 to 2.8 million tons (1.0 to 2.5 MMT) per year. By sequestering the CO_2 in geologic formations, the FutureGen Project aims to prove one technological option that could virtually eliminate future CO_2 emissions from similar coal-based power plants.

DOE's Energy Information Administration (EIA) report (DOE, 2006a) indicates that U.S. CO_2 emissions have grown by an average of 1.2 percent annually since 1990 and energy-related CO_2 emissions constitute as much as 83 percent of the total annual CO_2 emissions. DOE reviewed EPA's Emissions and Generation Resource Integrated Database (eGRID) to gain an understanding of the scale of the estimated CO_2 emissions from the proposed FutureGen Project compared to existing coal-fueled plants (EPA, 2006c). eGRID provides information on the air quality indicators for almost all of the electric power generated in the U.S.

The most recent data that can be accessed electronically are for the year 2000. A review of the database yielded the following information:

- In 2000, CO_2 emissions from all coal-fueled plants in Illinois equaled 94.7 million tons (85.9 MMT). The average emissions rate of these coal plants was 2,326 pounds (1,055 kilograms) per megawatt-hour.
- Based on the average CO_2 emissions rates of nine representative coal plants in the size range of 153 to 508 MW, a conventional 275-MW coal-fueled power plant would emit 2.17 million tons (2.0 MMT) per year at an 85 percent capacity factor. This is in the same range as the estimated amount of CO_2 (1.1 to 2.8 million tons [1.0 to 2.5 MMT] per year) that would be sequestered by the proposed FutureGen Project.

Carbon capture and sequestration, if employed widely throughout the U.S. in future power plants or retrofitted existing power plants, could help reduce and possibly reverse the growth in national annual CO_2 emissions.

Acid Rain ***Program and Clean Air Interstate Rule*** *Requirements*

Acid rain or acid deposition can occur when acid precursors (such as SO_2 and NO_X) are released into the atmosphere, and they react with O_2 and water to form acids (EPA, 2007). Acid rain can cause soil degradation; increase acidity of surface water bodies; and reduce growth, injure, or even cause death of forests and aquatic habitats. The Acid Rain Program, established under ***CAA*** Title IV, ***generally*** requires electric generating units ***producing electricity for sale*** to obtain a Phase II Acid Rain Permit and meet the objectives of the program, which are achieved through a system of marketable ***SO_2*** allowances ***and through NO_X emission limitations***. The FutureGen Project would be required to obtain a Phase II Acid Rain Permit and would operate in a manner that is consistent with EPA's overall efforts to reduce emissions of acid precursors. Continuous emissions monitoring for SO_2, NO_X, and CO_2, as well as ***for*** volumetric gas flow and opacity, is ***generally required under*** the acid rain regulations, which ***also*** include ***other*** monitoring, recordkeeping, and reporting ***requirements***. ***CAIR, established under CAA section 110, expanded on the Acid Rain Program for 28 States in the eastern United States by lowering the cap for SO_2. CAIR also established a NO_X cap-and-trade program that broadens the geographic scope of the NO_X Budget Trading Program (NO_X SIP Call) and tightens the cap. CAIR has similar requirements for obtaining allowances and for monitoring, recordkeeping, and reporting.*** Upon facility startup, the FutureGen Project would need to ***hold*** SO_2 ***and NO_X emission*** allowances to ***cover*** actual SO_2 ***and NO_X*** emissions from the facility.

Odors

Operation of the FutureGen Project may cause noticeable odors. The chemical components that could cause noticeable odors are hydrogen sulfide (H_2S) and ammonia (NH_3). H_2S is formed during the gasification of coal containing sulfur. The FutureGen Project would use an acid gas removal system that would potentially remove 99 percent of the sulfur in the syngas stream, thereby reducing the amount of H_2S emitted and reducing the impact from H_2S odors. For the FutureGen Project, the fuel stock would be blown into the gasifier using O_2; therefore, the NH_3 in the syngas would be formed from fuel bound nitrogen. Additionally, NH_3 would be used in a selective catalytic reduction (SCR) system, a potential component of the FutureGen Project that controls NO_X emissions. While the current FutureGen Project design configurations include an SCR system, current research activities sponsored under the DOE Fossil Energy Turbine Program are investigating technologies that can achieve the NO_X emissions goals through combustion modifications only, thereby eliminating the need for post-combustion SCR (DOE, 2006b). The Alliance estimates that approximately 1,333 tons (1,209 metric tons) of NH_3 per year would be consumed in the FutureGen SCR process (FG Alliance, 2006e).

Both gases would normally only be emitted as small quantities of fugitive emissions (e.g., through valve or pump packing); however, if an accidental large release were to occur, such as a pipe rupture in the Claus Unit (the sulfur recovery unit) or from on-site NH_3 storage, a substantial volume of odor would be noticeable beyond the plant boundary. Other odors could be emitted from activities such as equipment maintenance, coal storage, and coal handling; however, these potential odors should be limited to the immediate site area and should not affect off-site areas. Illinois regulates all odors detected in the ambient air (i.e., beyond the fence line) under the provisions of Title 35 Part 245. Depending on the wind direction, even small volumes of H_2S and NH_3 odors could be a nuisance for up to 20 residences within 1 mile (1.6 kilometers) of the proposed Mattoon Power Plant Site.

Local Plume Visibility, Shadowing, Fogging, and Water Deposition

The proposed Mattoon Power Plant would have two main sources of water vapor plumes: the gas turbine exhaust stack and the cooling towers. The height of the cooling tower is typically less than the height of the gas turbine exhaust stack, which for the FutureGen Project is estimated to be 250 feet (76.2 meters) (FG Alliance, 2006e). Because of a reduced height, the cooling tower presents a greater concern than the gas turbine exhaust stack for impacts such as ground-level fogging, water deposition, and solids deposition (including precipitates). Cooling tower "fogging" occurs when the condensed water vapor plume comes in contact with the ground for short time periods near the tower. ***Evaporated water would be pure water, although water droplets carried with the exhaust air (called drift) would have the same concentration of impurities as the water entering and circulating through the tower. Water treatment additives could contain anti-corrosion, anti-scaling, anti-fouling and biocidal additives which can create emissions of VOCs, particulate matter, and toxic compounds. The drift is not expected to cause excessive pitting or corrosion of metal on nearby structures or equipment due to the relatively small amount of water released and the presence of trace amounts of anti-corrosion additives. Similarly, the treatment additives are not expected to cause noticeable adverse impacts to local biota due to the very small amounts released.*** Potential deposition of solids would occur because the Mattoon Site proposes to use process water from the Charleston and Mattoon WWTPs, which may contain total dissolved solids and other PM (FAO, 1992) (see Table 4.7-2). Effects from vapor plumes and deposition would be most pronounced within 300 feet (91.4 meters) of the vapor source and would decrease rapidly with distance from the source. ***However, as a best management practice, the drift rate and associated deposition of solids could be reduced by employing baffle-like devices, called drift eliminators.*** Both cooling towers and the gas turbine exhaust plume may cause some concern for shadowing and aesthetics. Plume shadowing is generally a concern only when considering its effect on agriculture, which, due to the attenuation of sunlight by the plume's shadow, may reduce yield.

At the proposed Mattoon Power Plant and Sequestration Site, nearby residences or agriculture could be impacted by fogging, water deposition, icing, or solid deposition under rare meteorological events; however, the impacts would be minimal. The greatest concern would be for traffic hazards created on SR 121, which borders the northeast side of the proposed power plant property. Because the proposed Mattoon Site has 444 acres (180 hectares) and the FutureGen Project footprint requires 60 acres (24 hectares), it is unlikely that the boundary of the power plant would be located within 300 feet (91.4 meters) of the road. If the locations of the cooling tower and stack are more than 300 feet

(91.4 meters) from the road, fog from the plant would dissipate and deposition of solids on the road should not occur. Overall, solar loss, fogging, icing, or salt deposition from the proposed Mattoon Power Plant would not interfere with quality of life in the area.

Effects of Economic Growth

Any air quality impacts due to residential growth would be in the form of automobile and residential (fuel combustion) emissions that would be dispersed over a large area. Commercial growth would be expected to occur at a gradual rate in the future, and any significant new source of emissions would be required to undergo permitting by the IEPA. Impacts of economic growth on ambient air quality and PSD increments are unknown at this time. As part of the PSD permitting process, a determination of existing background concentrations of pollutants and additional modeling work would be required to estimate the maximum air pollutant concentrations that would be associated with the proposed Mattoon Power Plant as a result of future economic growth. Section 4.19 provides detailed discussions of the impacts of economic growth from the FutureGen Project on the local resources.

Effects on Vegetation and Soils

Section 165 of the Clean Air Act requires preconstruction review of major emitting facilities to provide for the prevention of significant deterioration and charges federal managers with an affirmative responsibility to protect the AQRVs of Class I areas. Implementing regulations requires an analysis of the potential impairment to visibility, soils, and vegetation. Subsequently, EPA developed "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals," which specifies the air pollutant screening concentrations for which adverse effects may occur for various vegetation species and soils, depending on their sensitivity to pollutants (EPA, 1980). While the Mattoon Power Plant Site is more than 62 miles (100 kilometers) from a Class I area, it is surrounded by cropland that could be affected by the plant's air emissions. Therefore, DOE compared the power plant's predicted maximum air pollutant emissions with the EPA screening concentrations (Table 4.2-7). Based on this comparison, the power plant's emissions would be well below applicable screening concentrations. Emissions also would be well below the secondary NAAQS criteria, which are established to prevent unacceptable effects to crops and vegetation, buildings and property, and ecosystems.

Table 4.2-7. Screening Analysis for Effects on Vegetation and Soils

Pollutant	Averaging Period[1]	Maximum Total Concentration[2] (µg/m^3)	Screening Concentrations[3] (µg/m^3)	Secondary NAAQS (µg/m^3)
SO_2	3-hour	634.85	786	1,300
NO_2	Annual	30.35	94	100

[1] Maximum concentration for shortest averaging period available.
[2] Maximum concentration, including background data (see Table 4.2-5).
[3] The most conservative values were utilized, based on the highest vegetation sensitivity category.
µg/m^3 = micrograms per cubic meter.
Source: EPA, 1980.

Effects on Animals

The secondary NAAQS were established to set limits to protect public welfare, including protection against harm to animals. The maximum predicted concentrations from the FutureGen Project estimated from the upper-bound emissions of the FutureGen Project's estimates of maximum air emissions, in addition to the ambient background concentration, are below the secondary NAAQS for all pollutants.

Sequestration Site

The proposed CO_2 sequestration reservoir is within bedrock layers located several thousand feet beneath the ground surface, far below the soil zone, ***groundwater table***, and overlying unsaturated zone (see Section 4.5 and Chapter 2). Because co-sequestration of H_2S and CO_2 is being considered as part of research and development activities for the FutureGen Project, minor air emissions of H_2S and CO_2 would occur during routine operations over the lifetime of the proposed injection period, which DOE expects to be between 20 to 30 years, and possibly up to 50 years. Sources of emissions during sequestration site operations could include:

- Injection wells, monitoring wells, and other wells; and
- Aboveground valves, piping, and well heads that comprise the transmission system.

Injection Wells, Monitoring Wells, and Other Wells

Wells provide the greatest opportunity for the escape of sequestered fluids. The injection well would extend into a target injection zone, with steel pipe inserted its full length and cemented into the bore hole to prevent upward escape of sequestered fluid around the outside of the pipe. Within the steel casing, tubing is installed from the well head down to the top of the injection zone, with the annular space sealed against the casing with a packer. The annular space is filled with heavy liquid, such as brine, to help control any accidental leakage into the annular space. This tubing could be removed and replaced should it become corroded or damaged over time. The technology is standard for constructing a well of this type and no measurable fugitive emissions from the well would be expected. Monitoring wells would be constructed in a similar manner as the injection wells, so they would be secure and could also be monitored for leaks and repaired as needed. There should be no contact by CO_2 with the soils. The sequestration reservoir would be tested for assurance that no leak paths exist prior to project operations. Pre-existing oil wells that are not related to the FutureGen Project present a greater risk of leakage. If Mattoon is selected to host the FutureGen Project, DOE anticipates that some means of identifying the locations of pre-existing wells over the plume and monitoring these wells for leakage would be employed at levels commensurate with the risks posed by the pre-existing wells. Wells that provide leakage points would be repaired or plugged to prevent leakage and emissions. All exploratory wells would be properly plugged with concrete and abandoned before operation of the sequestration facility if they are not used as injection wells or monitoring wells, preventing potential fugitive emissions from the sequestered CO_2.

Aboveground Valves, Piping, and Well Heads

The supercritical CO_2 that would be piped from the plant to the injection wells would enter each well through a series of valves attached to the underground steel pipe to ensure proper direction and control of flow. These valves would be above ground and easily accessible to workers for controlling well operation and conducting well maintenance. There would typically be four valves with flanged fittings for each well. Fugitive emissions from each valve were estimated based on a California South Coast Air Quality Management District (SCAQMD, 2003) valve emission factor of 0.0013 pound (0.6 gram) per hour for non-methane organic compounds. In addition to the expected fugitive emissions typical of gate valves, periodic well inspections, testing, and maintenance would be another source of emissions. The well valves would be periodically manipulated to allow insertion of inspection or survey tools to test the integrity of the system or to repair or replace system components. During each of those instances, some amount of CO_2 gas would be vented to the atmosphere.

The annual emissions estimate is based on the two injection wells required, accounting for the tubing volume and the number of evacuations that would occur each time a valve is opened. DOE estimates annual emissions of approximately 66 tons (59.9 metric tons) of CO_2. A number of tracers would also be used to track the fate and transport of the injected CO_2. Descriptions of these compounds are provided in

Section 4.16. Fugitive emissions from valves, piping, and well heads may also contain very minute amounts of these tracers.

Utility Corridors

There are no planned operational activities along the proposed utility corridors that would cause air emissions impacts. Routine maintenance along the corridors would not result in fugitive emissions. However, if repairs were required and an underground line had to be excavated, there would be localized and temporary soil dust releases during the excavation process, which would be minimized through BMPs.

Transportation Corridors

During operation of the power plant, transportation-related air emissions would be produced from train and truck shipments to and from the plant and also from employee automobiles. Major pollutants emitted from automobiles, trucks, and trains include hydrocarbons (HC), NO_X, CO, PM, and CO_2. Trucks emit more HC and CO than trains on a brake horsepower per hour basis although they emit less NO_x and PM on the same basis. The higher values for HC and CO are caused by the differences in driving cycle—the truck driving cycle is much more dynamic than that of a train, which has more constant speed operations (Taylor, 2001). The FutureGen Project would aim to utilize train shipments for materials and waste to the greatest extent possible to increase transportation efficiency and reduce shipping costs but to also minimize related air pollution.

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4.3 CLIMATE AND METEOROLOGY

4.3.1 INTRODUCTION

This section addresses the region's climate and meteorology and the potential impacts on construction and operation of the proposed FutureGen Project.

4.3.1.1 Region of Influence

The ROI for climate and meteorology includes the proposed Mattoon Power Plant and Sequestration Site, and the utility and transportation corridors.

4.3.1.2 Method of Analysis

DOE reviewed the Mattoon EIV (FG Alliance, 2006a) report to assess the potential impacts of climate and meteorology on the proposed FutureGen Project. Factors identified in this section include normal and extreme temperatures, and severe weather events such as tornadoes and floods. There were no uncertainties identified in relation to climate and meteorology at the proposed Mattoon Site.

DOE assessed the potential for impacts based on the following criteria:

- Potential for aspects of the project to fail or cause safety hazards due to temperature variations and extremes; and
- Potential for aspects of the project to fail or cause safety hazards due to a high probability for severe weather events.

4.3.2 AFFECTED ENVIRONMENT

This section describes the central Illinois region's climate and provides information on climate, meteorology, and severe weather events for Coles County.

4.3.2.1 Local and Regional Climate

> The **Köppen Climate Classification System** is the most widely used system to classify world climates. Categories are based on the annual and monthly averages of temperature and precipitation. The Köppen System recognizes five major climatic types, and each type is designated by a capital letter (A through E). Additional information about this classification system is available at http://www.blueplanetbiomes.org/climate.htm (Blue Planet Biomes, 2006).

The proposed Mattoon Power Plant and Sequestration Site is located in Coles County, in the east-central region of Illinois, near the city of Mattoon. This region has a moist, mid-latitude, humid continental climate consistent with the Köppen Climate Classification "Cfa." The Köppen Climate Classification System recognizes five major climate types based on annual and monthly temperature and precipitation averages. Each major type is designated by a capital letter A through E. The letter "C" refers to humid, mid-latitude climates where land/water differences play a large part. These climates have warm, dry summers and cool, wet winters. Further subgroups are designated by a second, lowercase letter that distinguishes seasonal temperature and precipitation characteristics. The letter "f" refers to moist climates with adequate precipitation in all months and no dry season. This letter usually accompanies A, C, and D climates. To further denote climate variations, a third letter was added to the code. The letter "a," found in C and D climates, refers to hot summers where the warmest month is over

72°F (22°C). Maximum precipitation occurs in the spring and minimum precipitation occurs in the winter. Average annual ***precipitation*** is about 40 inches (102 centimeters), and measurable precipitation occurs about 100 days per year. Average winter snowfall is around 20 inches (50 centimeters); however, only one snowfall per year generally exceeds 6 inches (15 centimeters) (FG Alliance, 2006a).

Winters in the region are generally cold and summers are generally hot. Average high and low January temperatures are around 33°F (0.6°C) and 16.6°F (-8.6°C), respectively. On average, the temperature falls below 0°F (-17.8°C) 7 or 8 days a year in the winter. In mid-summer, average high temperatures reach 86°F (30°C) and average low temperatures reach 66°F (18.9°C). High temperatures frequently reach 90°F (32.2°C) or more in the summer. Table 4.3-1 summarizes representative temperature, precipitation, and wind speed data.

Table 4.3-1. Seasonal Weather Data

Weather Parameter	Spring	Summer	Fall	Winter
Average Daily Temperature, °F (°C)	67.2 (19.6)	76 (24.4)	50.0 (10.0)	36.5 (2.5)
Average Precipitation, inches (centimeters)	***11.5*** (***29.2***)	***11.0*** (***27.9***)	***10.0*** (***25.4***)	***7.0*** (***17.8***)
Average Snow, inches (centimeters)	0.7 (1.8)	0.0 (0.0)	4.2 (10.7)	13.1 (33.3)
Average Wind Speed, miles per hour (kilometers per hour)	11.6 (18.7)	8.0 (12.9)	10.3 (16.6)	11.2 (18.0)

°F = degrees Fahrenheit; °C = degrees Celsius.
Source: FG Alliance, 2006a.

A wind rose is a graph created to show the directional frequencies of wind. Wind rose data from 1998 to 2006 are presented in Figure 4.3-1. The wind rose is representative of the percent of time that the wind blows at a particular speed and direction. The concentric circles on the wind rose represent percentage of time. The wind rose is based on climate data from Coles County Memorial Airport located about 7 miles (11 kilometers) east of the proposed power plant site. As the wind rose indicates, the most common wind directions are from the south and south-southwest (FG Alliance, 2006a). For the proposed FutureGen Project, the primary use of wind rose data is for evaluating potential hazardous material releases to estimate plume transport times and determine potential population exposure.

The average annual wind speed in the region is 9.0 mph (14.5 kmph), and winds from the south and south-southwest are most prevalent. Calm winds (below 1.5 mph [2.4 kmph]) prevail around 8 percent of the time on an annual basis. In the winter, the average wind speed is 11.2 mph (18.0 kmph), and the most frequent wind speeds are between 8.0 and 19.6 mph (12.9 to 31.5 kmph). The most prevalent winter winds are from the south, southwest, and northwest. In the spring, the average wind speed is 11.6 mph (18.7 kmph), and the most frequent wind speeds are between 12.7 and 19.6 mph (20.4 and 31.5 kmph). Winds from the south through southwest are most common in the spring, with no apparent secondary maximum from any other direction; however, winds from the northeast are rare. Winds are usually lighter in the summer with an average speed of 8.0 mph (12.9 kmph). The most prevalent wind directions in the summer are from the southwest. In the fall, the average wind speed is 10.3 mph (16.6 kmph), with the most prevalent winds from the south and south-southwest, although winds from the west-northwest are also common. Winds from the northeast are rare in the fall (FG Alliance, 2006a).

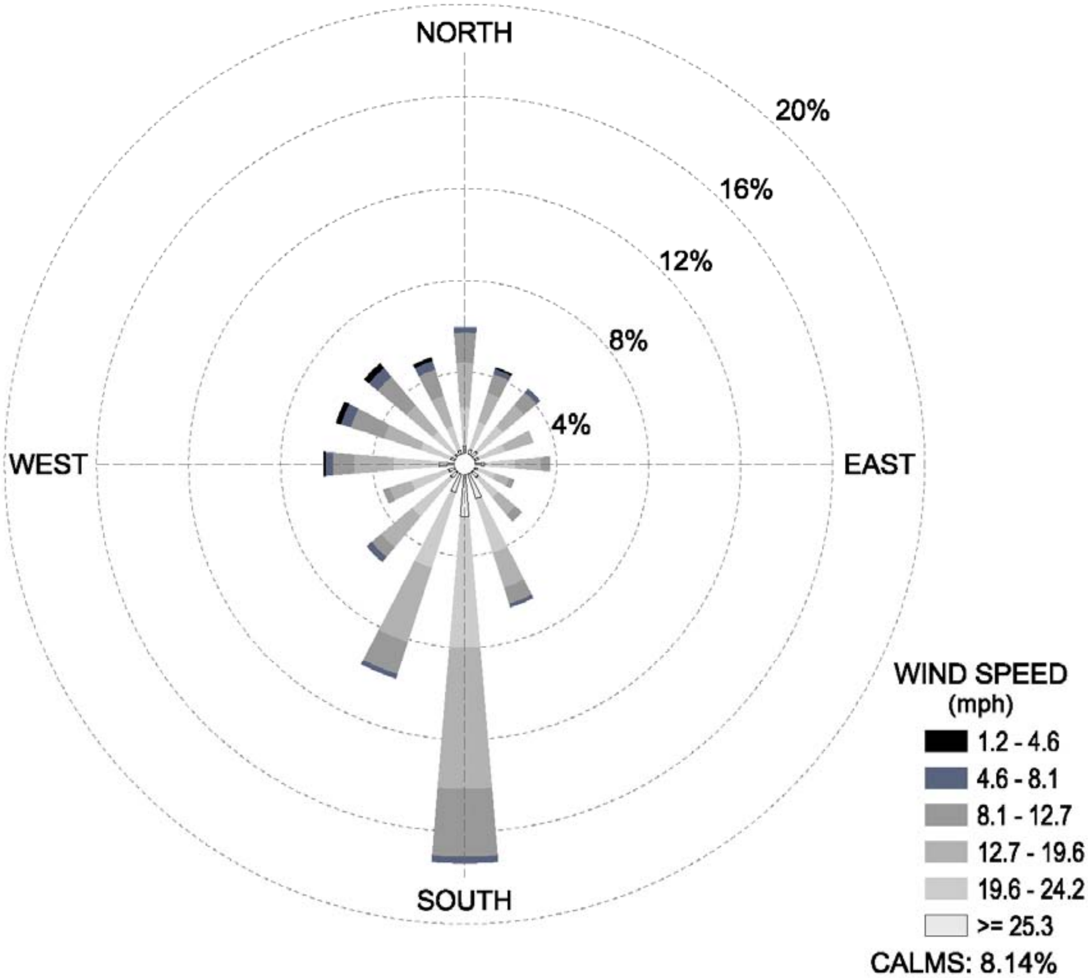

Figure 4.3-1. Wind Rose for the Mattoon Region

The proposed power plant and sequestration site is located in the central plains region of Illinois, which historically experiences a full spectrum of weather phenomena, including extreme heat and cold, ice storms and blizzards, high winds and heavy rainfalls, thunderstorms, localized floods, and tornadoes. Based on historical norms, each year Coles County can expect between 45 and 50 thunderstorms, between one and four tornadoes, and 4 or 5 days with winds that exceed 45 mph (72.4 kmph). Over a 10-year span, the region can expect about 25 hailstorms, 12 snowfalls of 6 inches (15.2 centimeters) or more, and 11 ice storms (FG Alliance, 2006a).

4.3.2.2 Severe Weather Events

Relevant severe weather events for the ROI include frozen precipitation (hail, snow, and ice), tornadoes, floods, and drought. The proposed project site is located hundreds of miles inland from both the Atlantic Coast and the Gulf Coast. For this reason, coastal hurricanes do not occur within the region and have been excluded from discussion.

Hail, Snow, and Ice

On average, each year the Coles County region receives two or three hail storms, one snowfall of 6 inches (15.2 centimeters) or more, and one storm with icy precipitation that forms a glaze on road surfaces, trees, and power lines.

Tornadoes

The National Oceanic Atmospheric Administration (NOAA) documents tornado activity in the region. The Fujita Scale is a standard qualitative metric to characterize tornado intensity based on the damage caused. This scale ranges from F0 (weak) to F6 (violent). From 1950 to ***2007***, 29 tornadoes were reported in Coles County, including 13 F0 tornadoes, 10 F1 tornadoes, four F2 tornadoes, and two F3 tornadoes. An F3 tornado has not been reported in Coles County since 1974 (NOAA, 2006). ***Based on historical tornado activity within Coles County, there could be 14 F1 or greater tornadoes in the county (over 508 square miles [1,316 square kilometers]) over the possible 50 year lifespan of the FutureGen Project. For comparison purposes with the other candidate sites, using a nominal county size of 850 square miles (2,202 square kilometers), the tornado frequency would equate to approximately 24 F1 or greater tornadoes over 50 years.***

> The most common metric for tornado strength is the **Fujita Scale**. There are six categories on this scale. F0 and F1 are considered weak, F2 and F3 are strong, and F4 through F6 are violent. Each category represents a qualitative level of damage and an estimated range of sustained wind speed delivered by the tornado. Additional information about the Fujita Scale is available at http://www.tornadoproject.com/fscale/fscale.htm (The Tornado Project, 1999).

Floods

The Kaskaskia River is located about 4 miles (6 kilometers) north of the proposed plant site. During heavy rains, this river can overflow and cause localized flash floods. The NOAA database shows that, between 1999 and 2006, 18 floods have occurred in Coles County. Seven of these floods were county-wide and seven were mainly in the Mattoon region, only one of which caused significant damage (primarily in the Mattoon region). The nearby presence of the Kaskaskia River and the relative flat topography of the region contribute to potential flood conditions in the region (FG Alliance, 2006a). As noted in Section 4.8.2.2, the proposed power plant and sequestration site is not in the 100-year or 500-year floodplains.

Drought

Illinois is located in the Ohio Valley area. This area has suffered notable periods of drought over the past 100 years with extended periods of severe to extreme drought in 1895 to 1896, 1900 to 1901, 1908, 1914, 1930, 1935 to 1937, 1940 to 1942, 1953 to 1954, 1963 to 1964, 1987, and 1996. A statewide network of data collection sites, operated by state and federal agencies, has been established to monitor drought conditions. These sites provide real-time climate, stream flow, aquifer, and reservoir information to water management professionals to develop drought mitigation and response plans. Additional information on the State of Illinois Drought Contingency Plan can be found at http://drought.unl.edu/plan/state%20plans/Illinois.pdf.

4.3.3 IMPACTS

4.3.3.1 Construction Impacts

Power Plant Site

Severe temperature or weather conditions could temporarily delay construction at the proposed power plant site. An ice glaze or snowstorm could prevent material deliveries to and from the site. A hail storm could cause minor damage to equipment at the construction site and extremely low temperatures could also damage equipment and delay construction progress, although such temperature extremes are uncommon.

A flood could impact construction activities at the proposed power plant site; however, the chance for a flood would be very small because the proposed power plant site would be located entirely outside of the 500-year floodplain. A strong tornado could potentially impact construction activities at the proposed power plant site***. The tornado frequency is equivalent to approximately 24 F1 or greater tornadoes over a 50 year period for an area of 850 square miles (2,202 square kilometers). The probability of a tornado greater than F1 intensity within the county is approximately 1 every 3 to 4 years and the power plant site represents 0.14 percent of the land area in the county. Therefore, the probability of a tornado hitting the power plant would be low. Furthermore,*** risks posed on construction safety by climate and severe weather events would be mitigated through compliance with all applicable industry standards and with federal, state, and local regulatory requirements (FG Alliance, 2006a).

Severe or extreme drought conditions could increase the potential for wildfires in the area. Drought conditions would also increase the number of water trucks needed to reduce fugitive dust emissions and to support other construction activities. In dry, hot weather, construction workers may need to wear a dust mask and work for shorter time intervals between breaks.

Sequestration Site

The proposed sequestration site is on the same property as the proposed power plant site; therefore, direct and indirect impacts of climate on construction at the proposed sequestration site would be the same as those discussed for the proposed power plant site.

Utility Corridors

Severe temperature or weather conditions could temporarily delay construction at the proposed utility corridors. The potential impacts from ice glaze, large snowfall, hail, or tornado would be comparable to those described for the proposed power plant site. Small portions of the proposed electrical transmission corridor are within the 100-year floodplain; however, because this corridor would cross such small portions of the 100-year floodplain and construction activities in the utility corridor would occur over a limited time span, the potential for a flood to have direct or indirect impacts on construction would be low.

Transportation Corridors

Road and rail transportation routes currently extend directly to the proposed power plant site. The proposed upgrade of CH 13 and the intersection of CH 13 and SR 121 would occur adjacent to the site, and the impacts from climate and severe weather would be comparable to those at the proposed power plant site.

4.3.3.2 Operational Impacts

Power Plant Site

It is unlikely that operations at the proposed power plant site would be directly or indirectly affected by temperature extremes in the region. Although summer temperatures would be warm and winters generally bring cold temperatures and sizeable snowfalls, the proposed power plant site would be designed to operate under a wide range of weather conditions.

Because the land around the proposed power plant site is flat, land topography would not influence stack emissions downwash. However, water vaporization from cooling tower operation could potentially contribute to local fog conditions. Cooling tower "fogging" occurs when the condensed water vapor plume comes in contact with the ground for short time periods near the tower. Although this potential impact is referred to as fogging, cooling tower plume touchdown or fogging is usually a temporary event for only a few operational hours. Section 4.2 provides further discussion.

Ice glaze, large snowfall, or hail could disrupt material deliveries to and from the proposed power plant site and cause minor impacts on operations; however, these conditions would be largely mitigated by proper facility design and operational strategies.

The possibility of a tornado in the region poses the potential for both direct and indirect impacts on power plant operations. A strong tornado could directly impact plant operations if sufficient damage were incurred at the plant site. Indirect impacts could occur if a tornado struck nearby communities and affected the ability of workers or supplies to reach the site. ***The tornado frequency is equivalent to approximately 24 F1 or greater tornadoes over a 50 year period for an area of 850 square miles (2,202 square kilometers). The probability of a tornado greater than F1 intensity within the county is approximately 1 every 3 to 4 years and the power plant site represents 0.14 percent of the land area in the county. T***herefore, the chance for significant direct and indirect impacts from a tornado would be low.

It is very unlikely that a flood would cause a direct or indirect impact on operations at the proposed power plant site because the site would be located outside of the 500-year floodplain. The risks posed on operational safety would be mitigated through compliance with all applicable industry standards and with federal, state, and local regulatory requirements.

Severe or extreme drought conditions could increase the potential for wildfires in the area. Ready availability of water is crucial for both fire protection and daily power plant operations. Because severe to extreme drought conditions are likely over the planned life of the facility, contingency plans and design features must be established to address these conditions to ensure that the necessary water is always available.

Sequestration Site

Because the proposed sequestration site is located on the same property as the proposed power plant site, direct and indirect impacts of climate on operation of the sequestration site would be the same as those discussed for the power plant site.

Utility Corridors

Operation of the proposed underground utilities would not be affected by climate or severe weather because pipelines would be buried at appropriate depths to prevent weather-related damage, such as from freeze and thaw cycles. Operation of the proposed electrical transmission lines could potentially be affected by climate or severe weather conditions in the region. The potential impacts from ice glaze, large snowfall, hail, or tornado would be comparable to those described for the proposed power plant site. A significant ice glaze could down transmission lines and temporarily interrupt electrical service to and from the proposed power plant.

Minor portions of the proposed electrical transmission corridor would cross small areas within the 100-year floodplain; however, the transmission line would be designed to address the possibility of a flood. Therefore, the potential for direct or indirect impacts on operations due to a flood would be low.

Transportation Corridors

Operation of transportation routes to the site could be affected by climate or severe weather conditions in the region. A significant ice glaze, snowfall, or tornado could interrupt the transport of workers or materials to and from the proposed power plant site.

Minor portions of the proposed transportation infrastructure corridors cross small areas within the 100-year floodplain; however, the infrastructure would be designed to address the possibility of a flood. Therefore, direct or indirect impacts on operations due to a flood would be low.

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4.4 GEOLOGY

4.4.1 INTRODUCTION

The geologic resources of the proposed Mattoon Power Plant and Sequestration Site, and related corridors are described in this section, followed by a discussion of the potential impacts to these resources.

4.4.1.1 Region of Influence

There are three ROIs for geologic resources. The first ROI includes the land area on the surface that could be directly affected by construction and operation of the FutureGen Project at the proposed Mattoon Power Plant and Sequestration Site. The second ROI includes the subsurface geology related to the radius of the injected CO_2 plume. Numerical modeling indicates that the plume radius associated with injecting 1.1 million tons (1 MMT) of CO_2 per year for 50 years would be 1.2 miles (1.9 kilometers), equal to an area of 2,789 acres (1,129 hectares) (FG Alliance, 2006a). The plume radius and land area above the CO_2 plume are shown in Figure 4.4-1. The third ROI is a wider area (100 miles [161 kilometers]) that was evaluated to include potential effects from seismic activity.

4.4.1.2 Method of Analysis

The geologic setting includes the near-surface geology of the entire project and all deeper strata that make up the proposed sequestration reservoir. DOE evaluated the potential effects of the construction and operation of the proposed project on specific geologic attributes. In addition, DOE assessed the potential for impacts on the project due to geologic forces (e.g., earthquakes). The potential for impacts was based on the following criteria:

- Occurrence of local seismic destabilization (induced seismicity) and damage to structures;
- Occurrence of geologic-related events (e.g., earthquake, landslides, sinkholes);
- Destruction of high-value mineral resources or unique geologic formations or rendering them inaccessible;
- Alteration of geologic formations;
- Migration of sequestered CO_2 through faults, inadequate caprock or other pathways such as abandoned or unplugged wells;
- Human exposure to radon gas; and
- Noticeable ground heave or upward vertical displacement of the ground surface.

DOE based its evaluation on a review of reports from state geologic surveys and information provided in the Mattoon EIV (FG Alliance, 2006a).

DOE identified uncertainties in relation to geological resources at the Mattoon Site. These include the porosity and permeability of the target formation where CO_2 would be sequestered. Analog well data were analyzed; however, site-specific test well data were not collected. A 2D seismic line was shot across the proposed injection site location to provide information on the formations at the sequestration site.

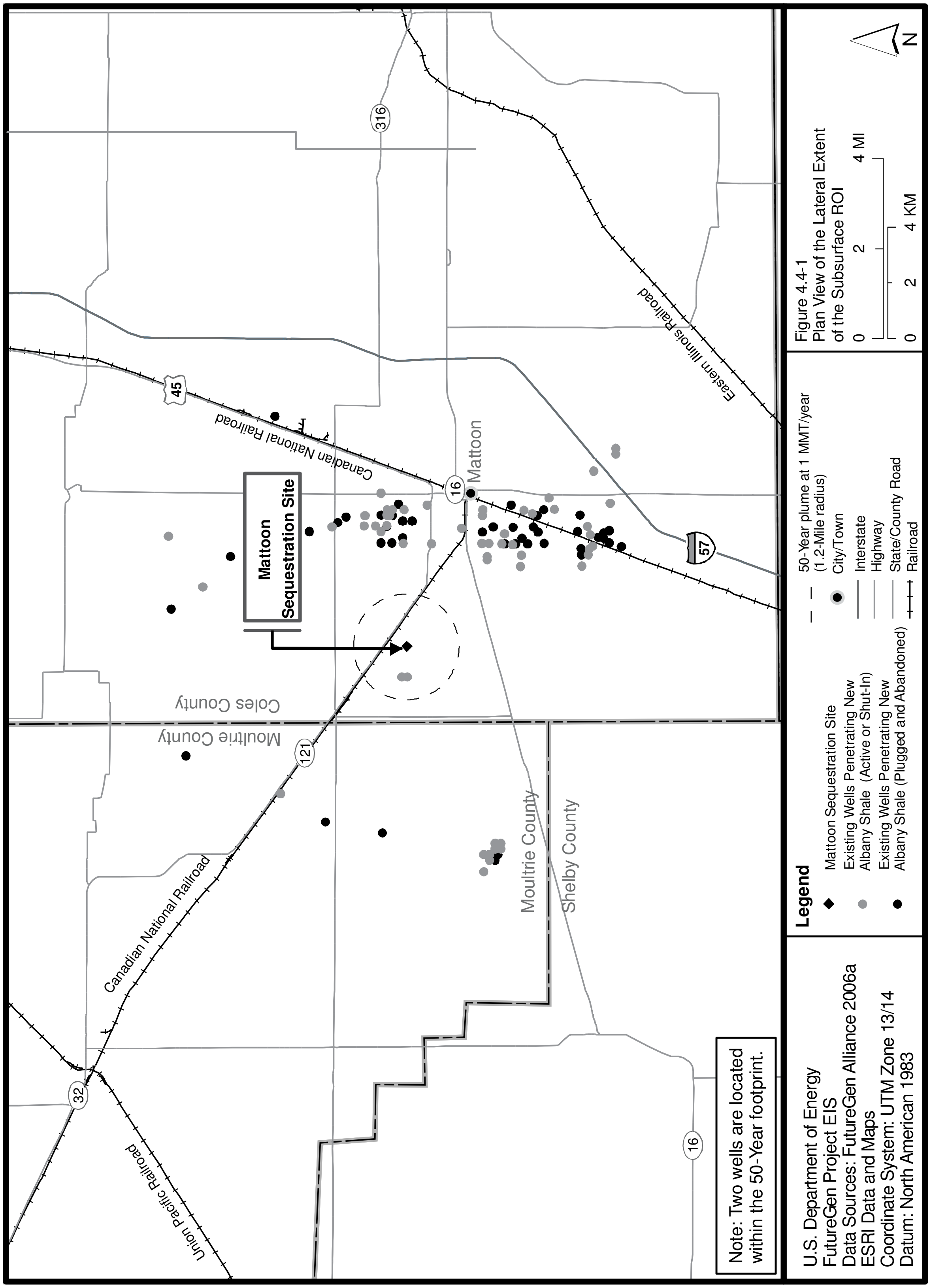


Figure 4.4-1
Plan View of the Lateral Extent of the Subsurface ROI

4.4.2 AFFECTED ENVIRONMENT

4.4.2.1 Geology

The proposed Mattoon Power Plant and Sequestration Site is 444 acres (180 hectares) in size. The site is essentially flat with an average slope of between 0.5 and 1 percent. The elevation of the site varies from 718 feet (219 meters) to 679 feet (207 meters) above mean sea level (AMSL).

Illinois is covered with glacial deposits that date from the Pleistocene and Holocene epochs of the Quaternary Period (up to approximately 2 million years before present). Beneath that recent veneer, Illinois is dominated by limestone and shale, which was deposited in shallow-water and coastal environments during the Paleozoic Era, beginning about 570 million years ago.

Figure 4.4-2 is a stratigraphic column of the geology beneath the proposed Mattoon Power Plant and Sequestration Site. The surficial Quaternary glacial deposits are about 100 to 125 feet (31 to 38 meters) thick and are underlain by the Pennsylvanian age McLeansboro Group. This group includes coal seams interbedded with shale-limestone-shale formations. The McLeansboro Group is more than 1,500 feet (457 meters) thick and is underlain by about 0.9 mile (1.4 kilometers) of primarily shale and interbedded sandstones with some limestones and dolomites.

Lying below these strata is the proposed target formation (or sequestration reservoir) for CO_2 injection, the Mt. Simon sandstone formation. This formation is brine saturated and is about 0.2 to 0.3 mile (0.3 to 0.5 kilometer) thick below the project site. The CO_2 injection target would occur at a depth of 1.3 to 1.6 miles (2.1 to 2.6 kilometers). It is the oldest formation of the Paleozoic Era and rests on the pre-Cambrian igneous "basement" rocks. The Mt. Simon is composed of medium- to coarse-grained quartz sandstone, feldspar-bearing sandstone, and thin layers of micaceous shale near the top of the formation. The Mt. Simon is overlain by 500 to 700 feet (152 to 213 meters) of low permeability siltstones and shales of the Eau Claire formation, which would serve as the primary seal for the sequestration reservoir.

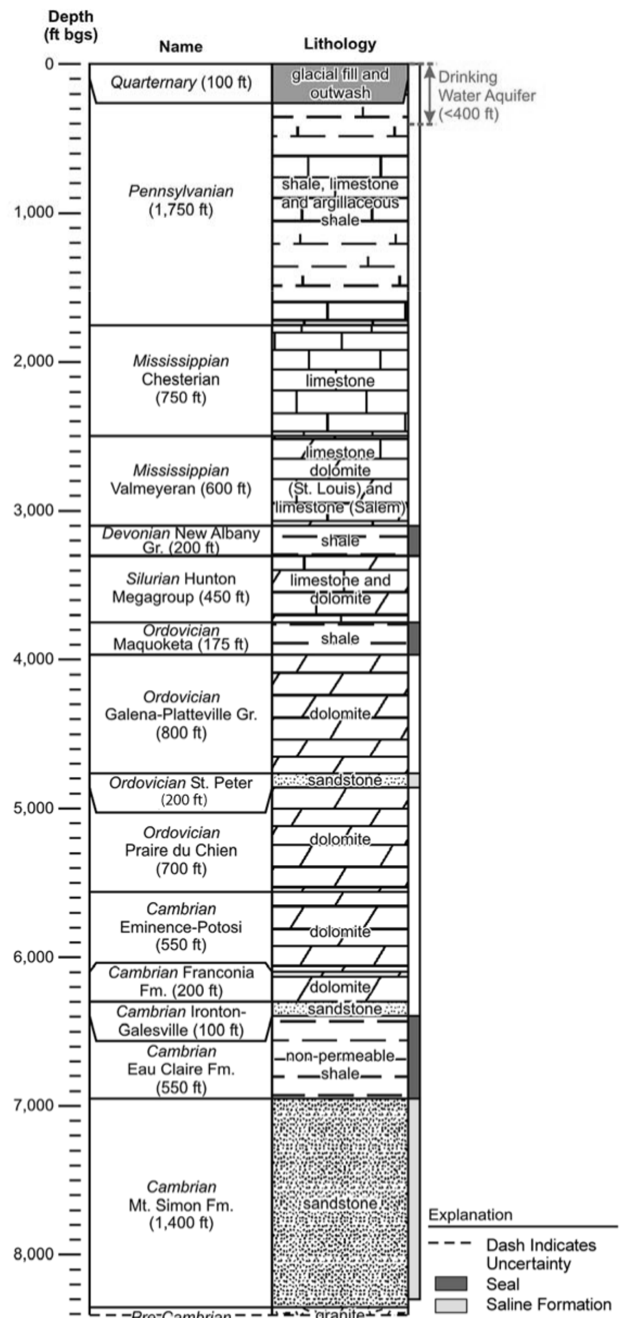
The Ordovician-age St. Peter sandstone is proposed as an optional target reservoir. It occurs at a depth of 0.9 mile (1.4 kilometers) below the earth's surface, which is about 0.4 mile (0.6 kilometer) above the Mt. Simon formation (see Figure 4.4-2). At the Mattoon Site, the St. Peter is estimated to be more than 200 feet (61 meters) thick with good lateral continuity and permeability. Both Mt. Simon and St. Peter reservoirs have been successfully used for natural gas storage in other parts of Illinois. In particular, the Mt. Simon supports 38 natural gas storage reservoirs in Illinois (FG Alliance, 2006a).

Structurally, the principal tectonic feature of this area is the Charleston Monocline. This step-like fold marks the western edge of the greater La Salle Anticlinorium, which extends from southwest Indiana to north central Illinois, a compound anticline consisting of a series of subordinate anticlines and synclines, the whole having the general contour of an arch. The Charleston monocline strikes north-northwest, and its steep limb dips southwest. Structural relief is as great as 0.5 mile (0.8 kilometer) (FG Alliance, 2006a).

A **monocline** is an open, step-like fold in rock over a large area.

The Mattoon Power Plant and Sequestration Site lies in a very gentle syncline and is about 6 miles (10 kilometers) west of the lower limb of the Charleston Monocline. The axis of a smaller fold, the Mattoon Anticline, passes about 2 miles (3.2 kilometers) east of the Mattoon Site. The Mattoon Anticline trends north-south and provides structural trapping for the Mattoon oil and gas field.

An **anticline** is an upfolded strata in which layers slope away from the axis of the fold, or central ridge.



ft bgs= feet below ground surface

Source: FG Alliance, 2006a

Figure 4.4-2. Stratigraphy of the Mattoon Injection Area

It is likely that basement faults controlled the tectonic features discussed above. Although no faults are mapped in the project area, any faults that might exist would come to the surface of the bedrock and would be hidden by the glacial deposits at the earth's surface. It is unlikely that large through-cutting transmissive faults occur within the Paleozoic rocks because of the substantial oil reserves trapped at multiple elevations within the Mattoon anticline (FG Alliance, 2006a). The oil reserves would not be trapped if there were transmissive faults in the anticline.

Because of the possibility of faults associated with the Mattoon Anticline and the greater La Salle Anticlinorium, a regional geologic stress analysis was conducted to yield insight on the orientation of open fractures and possible transmissive faults. Throughout Illinois, the magnitude of the regional earth stresses and their direction are fairly consistent. The stress trend, or principal direction, is west-southwest to east-northeast. Stress values are dependent on depth, and maximum and intermediate horizontal stresses are greater than the vertical stress. The proposed injection site is in an overall compressional (mixed thrust and strike-slip fault) setting. Faults and fractures parallel to the greatest principal stress are more likely to be transmissive and faults or fractures not parallel to this direction are more likely to be sealing (FG Alliance, 2006a).

Geological Resources in the Mattoon Area

Five mature oil fields are located within a 10-mile (16.1-kilometer) radius of the proposed Mattoon Power Plant and Sequestration Site. These fields all have anticlinal closure. The Mattoon Oil Field is located east of the project area, but no oil or gas wells are present within approximately 1.5 miles (2.4 kilometers) of the proposed power plant site. The oil field has produced oil from Mississippian and Devonian strata at depths of 0.3 to 0.6 mile (0.5 to 1 kilometer), although currently many of the wells are plugged and abandoned because of declining production.

Oil and gas leasing is common in the Mattoon area. Three petroleum exploration wells are located above the maximum plume footprint projected for the Mattoon injection well; one well was drilled to the Mississippian, one to the Devonian and one to the Silurian (see Figure 4.4-2). No wells penetrate the primary seal of the Eau Claire formation (FG Alliance, 2006a).

Although coal is present throughout the area, only relatively small areas of Springfield and Herrin Coal are mineable. The Springfield and Herrin Coals occur at average depths of 1,000 to 1,100 feet (305 to 335 meters) in the Mattoon area. There are no active mines in the immediate project area.

Most factors known to cause subsidence are not present in the project area. Such factors include undermining for coal or other resources, and withdrawal of large quantities of water from aquifers. Subsidence has not been detected over areas in Illinois where oil has been extracted (FG Alliance, 2006a).

4.4.2.2 Seismic Activity

The proposed Mattoon Power Plant and Sequestration Site is located roughly 40 to 50 miles (64 to 81 kilometers) northwest of an area of seismic activity known as the Wabash Valley Seismic Zone, which extends from southeastern Illinois into southwestern Indiana. The New Madrid Fault Zone is located roughly 200 miles (322 kilometers) south-southwest of the proposed site in the general area of the common borders of southern Illinois, western Kentucky and Tennessee, and southeastern Missouri. This area has spawned the most powerful earthquakes recorded in the continental United States (Richter magnitudes of 8.0). However, as discussed below, earthquakes centered in the area of the New Madrid Fault Zone have historically not caused damage in central Illinois.

The historical record of earthquakes having epicenters in Illinois begins on January 8, 1795. On that date, a mild earthquake occurred near Fort Kaskaskia on the Mississippi River in southwestern Illinois. During the 200 years since that event there have been about 200 other earthquakes in Illinois. Only nine of these quakes were strong enough to cause even minor damage. The largest Illinois quake ever recorded occurred in southeastern Illinois on November 9, 1968, and measured magnitude 5.4 on the Richter scale (ISGS, 1995a).

A search of the USGS database of historic earthquakes shows that since 1974, 29 earthquakes have occurred within 100 miles (160.9 kilometers) of the proposed Mattoon Power Plant and Sequestration Site. Magnitudes ranged from 2.7 to 5.1. The most recent 2.7 magnitude earthquake centered 83 miles (133.6 kilometers) from the proposed site occurred in December 6, 2005. The closest earthquake was a magnitude 3.0 that occurred on April 24, 1990, and was centered approximately 12 miles (19 kilometers) from the site (USGS, 2006).

As previously discussed, minor earthquakes are known to occur in Illinois, but damaging quakes are very infrequent. Minor damage (e.g., items falling from shelves) from Illinois earthquakes is reported about once every 20 years. Most recently, a Richter magnitude 5.0 earthquake shook southeastern Illinois in June 1987, causing minor structural damage in the Lawrenceville and Olney areas, approximately 60 miles (97 kilometers) south-southeast of the proposed Mattoon Power Plant and Sequestration Site. Serious damage (i.e., major structural damage) from earthquakes occurs every 70 to 90 years. Devastating earthquakes (i.e., almost complete destruction over large areas) are very rare in the central United States, occurring about once every 700 to 1,200 years. The last strong earthquake to strike the Midwest happened on October 31, 1895. The quake, centered just south of Illinois in Charleston, Missouri, had an estimated magnitude of 6.8 on the Richter scale. Although this quake was widely felt throughout the mid-continental United States, it caused serious damage only in the immediate Charleston area (ISGS, 1995b).

4.4.2.3 Target Formation Properties

Characteristics

The thickest and most widespread saline reservoir in the Illinois Basin is the Cambrian-age Mt. Simon sandstone (see Figure 4.4-2). It is overlain by the Eau Claire formation, a very low permeability regional shale, and is underlain by Precambrian igneous rocks that form the "basement." The Mt. Simon is a regionally extensive formation. Several wells in central Illinois indicate the depth and thickness of the Mt. Simon. It is anticipated that greater than 0.2 mile (0.3 kilometer) of Mt. Simon is present at the proposed Mattoon Power Plant and Sequestration Site. Drilling at the Weaber-Horn No.1 well, located 35 miles (56.3 kilometers) south of the proposed site, penetrated over 0.2 mile (0.3 kilometer) of Mt. Simon sandstone before reaching the Precambrian basement (FG Alliance, 2006a). Because of the structure of the Illinois Basin, the Mt. Simon likely thins to the south of the proposed site, indicating that the Mt. Simon at the proposed Mattoon Site is likely to be thicker than the Mt. Simon encountered at the Weaber-Horn No.1 well.

Depth

Regional data from the Illinois Geological Survey show the expected depth to the top of the Mt. Simon sandstone at the proposed Mattoon Power Plant and Sequestration Site to be approximately 1.3 to 1.6 miles (2.1 to 2.6 kilometers). Bottom hole temperature at the base of the Mt. Simon (1.6 miles [2.6 kilometers]) is estimated to be 145°F (62.8°C) and the bottom hole hydrostatic pressure is estimated to be 3,590 pounds per square inch (psi) (FG Alliance, 2006a). The proposed injection zone would use the entire thickness of the Mt. Simon formation, although significant injection would occur primarily in the more permeable regions of the formation (those with greater effective porosity) as discussed below in *Storage Capacity*. The St. Peter sandstone is proposed as an optional target reservoir at an injection depth of 0.9 mile (1.4 kilometer).

Injection Rate Capacity

Using the entire thickness of the Mt. Simon for injection and using analog data concerning porosity from the Weaber-Horn No.1 well discussed above, it was concluded that the required injection rate would likely be met by one CO_2 injection well. One well would be sufficient if the well's injection rate was equivalent to the low end of injection rates for underground natural gas storage wells currently operating in the Illinois Basin (FG Site Proposal [Mattoon, Illinois], 2006). Furthermore, reservoir modeling indicates that the proposed injection rate could be met with one injection well even if the thickness of porous sandstone is actually found to be as low as approximately 200 feet (61 meters) instead of the currently estimated 585 feet (178.3 meters) (FG Alliance, 2006a).

Storage Capacity

The storage capacity of a reservoir depends on its porosity, permeability, thickness and lateral extent. The Mt. Simon formation is a regionally extensive sandstone with effective porosity (i.e., porosity greater than 12.6 percent) generally occurring in 1- to 2-feet (0.3- to 0.6-meter) thick beds separated by lower permeability rock. Permeability is measured in units of millidarcy (md) and values of 0.001 md or less are almost impermeable, 0.1 md is "tight" or of very low permeability, 1 to about 50 md is to be low permeability, and higher values are permeable.

The Mt. Simon has very large storage capacity because it is laterally extensive regionally and has numerous porous and permeable intervals. Regional well data indicate that the Mt. Simon should be porous at the proposed Mattoon Site. The average porosity of the two regional wells was 20.6 and 15.4 percent and the storability (sum of porosity-thickness product) was 102 and 59.7 pore-feet. The permeability to air was estimated for each interval that exceeded 12.6 percent porosity. The arithmetic average of permeability was 833 and 466 md at the two regional wells, indicating very high permeability.

At the Manlove anticline (located 48 miles [77.2 kilometers] north of the proposed Mattoon Site), the Mt. Simon is used for natural gas storage. One hundred-fifty billion cubic feet (4.2 billion cubic meters) of methane are stored in the uppermost 200 feet (61 meters) of the Mt. Simon sandstone. This is equivalent to approximately 25 million tons (22.7 MMT) of CO_2. The Mt. Simon sandstone likely contains 500 permeable feet (152 permeable meters) to inject and sequester CO_2 below the proposed Mattoon Site. The proposed Mattoon Site would have a much larger volume of reservoir in which to inject CO_2 than what is found at the Manlove anticline.

Seals, Penetrations, and Faults

The Illinois Basin has the largest number of saline natural gas storage fields in the United States. These gas storage fields provide important analogs that can be used to analyze the potential for CO_2 sequestration. These analogs illustrate seal integrity, injection capability, storage capacity, and reservoir continuity in the north-central and central Illinois Basin. The long history, almost 50 years, of successful natural gas storage in the Mt. Simon sandstone is indicative of the containment quality of this saline reservoir.

Primary Seal

The regional geology of central Illinois has been well understood for decades. Regional cross-sectional diagrams of the rock strata in the central part of Illinois show that the Eau Claire formation is a laterally persistent low permeability shale layer above the Mt. Simon and that it is expected to provide a good seal. Gas storage projects in the Illinois Basin all confirm that the Eau Claire is an effective seal in the northern and central portions of the Basin. Analysis of rock cores from the Manlove Gas Storage Field, 54 miles (86.9 kilometers) to the north, shows that the Eau Claire shale has vertical and horizontal permeabilities of less than 0.1 md (FG Site Proposal [Mattoon, Illinois], 2006).

The Weaber-Horn No.1 well, 35 miles (56.3 kilometers) to the south, penetrates over 500 feet (152 meters) of Eau Claire shale overlying the Mt. Simon. It is estimated that the proposed Mattoon Sequestration Site has a minimum of 400 feet (122 meters) and potentially 500 feet (152 meters) of shale that would serve as the primary seal (FG Site Proposal [Mattoon, Illinois], 2006).

EPA's underground injection control (UIC) database of wells was also used to estimate seal qualities. In this database, the Eau Claire formation median permeability and porosity are 0.000026 md and 4.7 percent, respectively. Cores were obtained through 414 feet (126.2 meters) of the Eau Claire at the Ancona Gas Storage Field, located approximately 100 miles (161 kilometers) to the north of Mattoon, and 110 analyses were performed on the recovered core. Most vertical permeability analyses showed values of <0.001 to 0.001 md. Seventeen analyses were in the range of 0.002-0.009 md and 12 analyses were in the range of 0.010-0.099 md. Only five analyses were in the range of 0.100-0.871 md, the latter being the maximum value (FutureGen Site Proposal [Mattoon, Illinois], 2006). For comparison, 0.001 md is very low permeability, 0.1 md is "tight" or of low permeability, and 1 md is slightly permeable. Therefore, approximately 96.5 percent of the cores obtained were to be at least "tight," and it appears that the Eau Claire formation should be a good primary seal.

Secondary Seals

At least two other shale formations may act as secondary seals – the Maquoketa and New Albany Group Shales (see Figure 4.4-2). These formations are located between 0.6 and 0.8 mile (1 to 1.3 kilometers) below the ground surface in the project area, and each is up to 200 feet (61 meters) thick.

In addition to the primary and secondary seals, there are numerous other fine-grained formations that act as areas of low permeability, both within the estimated 0.2 to 0.3 mile (0.3 to 0.5 kilometer) of Mt. Simon rocks, and also in the estimated 1.2 to 1.3 miles (1.9 to 2.1 kilometers) between the top of the Mt. Simon and the ground surface. These seals are capable of retarding CO_2 vertical migration.

Relation of Primary Seal to Active or Transmissive Faults

Mattoon is in the central part of the Illinois Basin, where near-surface rocks are of late Pennsylvanian age and are likely to be horizontal. The older, deeper rocks have a very slight dip. For instance, the New Albany Shale dips southeastward in the Mattoon area at an average rate of roughly 100 feet per mile (18.9 meters per kilometer) (less than 1 degree).

The Illinois Department of Natural Resources (IDNR) has mapped no significant faults within approximately 50 miles (81 kilometers) of Mattoon (ISGS, 1997). The Midwest Geologic Sequestration Consortium provides a structural map of the pre-Cambrian basement rocks of Illinois that shows a major fault present east of Mattoon in central Coles County trending north-northwest/south-southeast. However, this fault is far from the subsurface ROI and is located below the Mt. Simon formation.

Moreover, a recent 2D seismic line indicated no major faulting in the north-south direction at the injection site (Patrick Engineering, 2006).

As previously discussed, Mattoon and the surrounding area are not seismically active and no major earthquakes have affected this area, so it is not expected that seismic vibrations would activate existing faults.

4.4.2.4 Geologic Sequestration Studies, Characteristics, and Risk Assessment

Currently, there are four CO_2 injection projects worldwide under detailed study. These are the Rangely, Weyburn, In Salah, and Sleipner projects. They are located in the United States, Canada, Algeria, and Norway, respectively. Rangely and Weyburn involve enhanced oil recovery (EOR), In Salah involves enhanced gas recovery (EGR) and saline reservoir injection, and Sleipner is a storage project located off shore in the North Sea.

A database of these and other geologic storage facilities was created and used in conducting the human health risk assessment for this EIS (Section 4.17). These studies of natural and industrial analogs for geologic storage of CO_2 (i.e., sites in similar geologic and hydraulic settings with similar human influences) provide evidence for the feasibility of geologic containment over the long term and for characterizing the nature of potential risks from surface leakage, should it occur. A more detailed description of these studies, their characteristics, and the state of risk assessment for geologic sequestration of CO_2 is provided in Section 4.17 and Appendix D.

4.4.3 IMPACTS

4.4.3.1 Construction Impacts

Power Plant Site

The surficial geology of the proposed power plant site includes glacial deposits that are likely about 100 feet (31 meters) thick. There are no geologic features present that would affect construction of the power plant infrastructure. Because there are no economically extractable geologic resources in the surface geology ROI, there would be no impact to the availability of such resources from construction of the power plant. However, aggregate and other geologic resources (e.g., sand) would be required to support construction activities, but these resources are abundant in central Illinois and the quantities required for construction of the power plant would not have a noticeable effect on their availability. Additional discussion of the availability of construction materials is addressed in Section 4.16.

The relatively flat surface topography of the power plant site precludes any potential impacts from landslides or other slope failures during construction. Similarly, because the area is not seismically active and most of the earthquakes in southern Illinois have a Richter magnitude below 3.0, it is not expected that seismic activity would affect construction of the power plant. The project area should not be affected by subsidence (sinking or lowering of the ground surface) because most factors known to cause subsidence are not present in the project area.

Sequestration Site

Because the sequestration reservoir would be located below the power plant site, potential impacts to geologic resources, and impacts from geologic processes or features such as earthquakes or landslides would be the same for construction at the sequestration site as previously discussed for the power plant site. The injection well and backup well would penetrate over 1.5 miles (2.4 kilometers) of bedrock. It is believed that mineral resources would not be impacted by the installation of the injection well, backup well, or deep monitoring wells (these wells are discussed below).

Utility Corridors

Potential impacts to geologic resources, and impacts from geologic processes or features such as earthquakes or landslides, would be the same for construction along the proposed utility corridors as discussed above for the power plant site.

Transportation Corridors

Potential impacts to geologic resources, and impacts from geologic processes or features such as earthquakes or landslides, would be the same for construction along the proposed transportation infrastructure corridors as discussed above for the power plant site.

4.4.3.2 Operational Impacts

Power Plant Site

During power plant operations, no additional impacts to geologic resources would be expected. The power plant site's relatively flat surface topography and lack of karst geology precludes any potential impacts from landslides, other slope failures, or sinkhole development during operation. Similarly, because the area is not seismically active and only minor earthquakes have been recorded for the project area, it is not expected that seismic activity would affect operation of the power plant.

Sequestration Site

The potential impacts to geologic resources and impacts to the sequestration site from geologic processes during operation are discussed below.

When CO_2 is injected into a deep brine-saturated (saline) permeable formation in a liquid-like (i.e., supercritical) dense phase, it is immiscible in, and less dense than, water. This would be the case at the proposed Mattoon Site. The CO_2 would displace some of the brine. In addition to displacement of brine, CO_2 may dissolve in or mix with the brine, thereby causing a slight acidification of the water, react with the mineral grains, or be trapped in the pore spaces by capillary forces. Some combination of these processes is likely, depending on the specific conditions encountered in the reservoir.

Geochemical modeling of the potential pH changes was conducted for this EIS. The modeling showed that the pH of the brine in the Mt. Simon formation would be expected to drop from 6.4 to 3.8 over many years, creating acidic brine. However, the Mt. Simon is made up primarily of quartz-rich sedimentary rocks (primarily sandstone) that are extremely resistant to chemical changes. Therefore, acidification of the brine solution would not be expected to substantially alter the Mt. Simon formation.

CO_2 emitted from the power plant would include some H_2S. Because of the significant expense required to separate these two elements, it is possible that the Alliance may conduct tests where greater concentrations of H_2S are included in the gas stream to be sequestered. Therefore, geochemical modeling of the potential changes that could occur to the Eau Claire shale (caprock) from the introduction of H_2S into the reservoir formation was conducted. It was concluded that, because of the mineralogy of the Eau Claire formation, there is no reaction mechanism that could serve as a major sink to decrease the concentration of injected H_2S. It was also noted that the chemical reactions would be unlikely to significantly change the dynamics of the injection behavior of the CO_2 and H_2S mixture, although H_2S can cause precipitation of minerals that would reduce the porosity of the formation (FG Alliance, 2006a).

Increases in pore pressure associated with the injection of CO_2 can decrease friction on existing faults and may cause them to become transmissive or to slip. Injection-induced seismicity at the sequestration site is, however, unlikely for the following reasons:

- High injection pressures are dissipated within a short distance of the injection well where the injection zone is thick and has good porosity. As discussed above, the Mt. Simon has an estimated porous interval of 585 feet (178.3 meters) and it is laterally continuous for hundreds of miles.
- The general compressive tectonic regime of the proposed Mattoon Site suggests that existing faults are not likely to slip as a result of normal field operations, especially if the maximum injection pressure is conservatively set at 85 percent of the fracture opening pressure currently required by Illinois UIC regulations.

Although injection-induced seismicity is unlikely, monitoring methods discussed in Section 2.5.2.2 would alert the operator of pressure build-up that could lead to induced seismicity, where appropriate remediation strategies could be employed to prevent or minimize adverse impacts.

The injection pressures that would cause new or existing fractures to open in the target reservoir and caprock are not known and would need to be determined as part of the permitting process. Requiring injection pressures to be substantially below the fracture opening and fracture closure pressures would greatly lower the risk of accidental overpressure and induced fracturing of the formation, the seal, or cements in wellbores, as well as lowering the risk of opening existing fractures. Site-specific injection pressure limits may be established as part of the permitting process.

Numerical modeling was conducted to estimate the potential CO_2 plume migration if an undetected transmissive fracture zone or fault was present that through-cuts the Eau Claire formation above the injection point in the Mt. Simon formation. This fracture zone or transmissive fault was assumed to have permeabilities well in excess of the permeability of the Eau Claire formation (four cases were modeled with permeabilities ranging from 0.01 to 1,000 md). Only narrow faults were evaluated because fracture/fault zones larger than 33 feet (10.1 meters) wide could be detected through geophysical methods and investigated before initiation of an injection program. Injection wells would be relocated, if necessary, to avoid such faults.

The results of the numerical modeling of the fault leakage scenario for the proposed Mattoon Site indicate that, for permeabilities of 1 md and higher, the amount of CO_2 leakage through the fault would be relatively small, as measured by the CO_2 flux rates, extent of the plume, and CO_2 gas pressure at the base of the overlying Maquoketa formation. If the fault were 321 feet (97.8 meters) long and had a permeability of 50 md, the steady-state flux rate would be about 17***,***3***00*** tons (15***,***7***00*** metric tons) of CO_2 per year, or ***after 60 years, approximately 0.9 million tons (0.80 MMT) or 1.6 percent of the 55 million tons (50 MMT) total injected***. The maximum plume extent occurred for the higher permeability faults and was 1.4 miles (2.3 kilometers) at year 60. The plume extent for the 1 and 0.01 md cases was essentially zero. Significant permeation of the Eau Claire shales is unlikely to occur at fault permeabilities less than 1 md (FG Alliance, 2006a).

The potential for leakage of CO_2 from the sequestration reservoir by means other than faults was also evaluated. The injection and backup wells themselves (and any deep monitoring wells in the target formation) would be one of the likely paths for CO_2 migration from the reservoir, because by their nature they perforate all seals present. This is why proper grouting and sealing of the well bores would be very important. Unknown wells and improperly plugged wells within the subsurface ROI could potentially leak CO_2. The proposed Mattoon Site subsurface ROI is surrounded by operating and abandoned petroleum exploration and production wells, with several hundred within 5 miles (8 kilometers) of the proposed injection site, and almost 60 within 2 miles (3.2 kilometers) (see Figure 4.4-1). The primary oil-bearing formations are shallow (0.3 to 0.6 feet [0.5 to 1.0 kilometer]), and most wells are in this depth interval. The deepest wells penetrate the New Albany secondary seal, as it occurs from about 0.6 mile (1 kilometer) deep. As shown on Figure 4.4-1, two of these wells are located within the estimated radius of the maximum plume extent. However, none of the known wells is deep enough to penetrate the primary seal, the Eau Claire formation (FG Alliance, 2006a). There are likely a number of wells in the area whose status is not known, and there is a likelihood of improperly plugged oil wells existing within the subsurface ROI. However, as part of the site-specific assessment to be conducted on the selected site, geophysical surveys will be conducted to locate lost wells. In addition to the two known wells present in the subsurface ROI, such lost wells, if found to be improperly abandoned, could be plugged and abandoned in a manner to meet state regulations and to prevent leakage. The risk assessment estimates the probability of leakage from such wells (Appendix D).

An earthquake has the potential to affect the injection well. If a fault were penetrated by the well bore, the injection well's casing could be sheared if movement occurred on that fault during a seismic event. However, vibrations from an earthquake would not likely cause faulting or affect the integrity of the well. Minor earthquakes do occur in central Illinois, but the project area is not seismically active. Central Illinois lies in a stable continental area where there is little risk of new faulting. In addition, earthquake epicenters in continental areas are typically deeper than the sedimentary strata that would be penetrated by the well (the depth of the shallowest earthquake recorded within 120 miles (193.1 kilometers) of Mattoon was 1.9 miles [3.1 kilometers]). Thus, it is unlikely that the well's casings would be sheared.

There are several sequestration features that indicate that CO_2 would be retained in the proposed injection formation, the Mt. Simon sandstone, including:

- The Mt. Simon formation likely has about 585 feet (178 meters) of permeable sandstone (interbedded with less permeable layers) and extends laterally for hundreds of miles; therefore, more than adequate storage capacity exists in the proposed sequestration reservoir.
- The remaining interbedded sub-layers (totaling 700 to 800 feet [213.4 to 243.8 meters]) of the Mt. Simon formation that are less permeable should act as barriers to the upward migration of CO_2.
- The predominantly quartz mineralogy of the Mt. Simon formation would cause geochemical reactions to be primarily simple dissolution of the CO_2 in the brine formation water, although the presence of feldspar could cause some geochemical trapping of the CO_2 to occur as well.
- The primary seal, the Eau Claire formation, is a low-permeability shale with an estimated thickness of up to 600 feet (183 meters) in the subsurface ROI area.
- The natural gas industry has successfully stored natural gas in the Mt. Simon formation without fracturing the overlying the Eau Claire formation at 10 underground reservoirs in Illinois at depths shallower than the proposed injection zone (ranging from 0.3 to 0.7 mile [0.5 to 1.1 miles]).
- The IEPA stated that the proposed Mattoon Sequestration Site is located in a part of the state where the regional geology is well known and that the area is "well suited for Class I injection activities." In addition, the IEPA stated that no current or former injection wells penetrate either the proposed injection or confining zones near the Mattoon Sequestration Site (FG Alliance, 2006a).

There are many variables that affect the potential to increase pore pressure enough to cause vertical displacement. Collection of site-specific data, including porosity, permeability, and mean effective stress would allow for future modeling of the predicted pressure increases and subsequent potential for ground heave at the proposed Mattoon Site and surrounding area. If a potential problem is identified, injection pressures could be maintained below the levels that would cause heaving.

The EPA has mapped Coles County as an area of Illinois with a high potential for radon to exceed their recommended upper limit for air concentrations within buildings. Thus, if CO_2 were to escape the sequestration reservoir and increase pore pressures in the vadose zone (near surface unsaturated soils above the water table), it could potentially displace radon, forcing it into buildings. As discussed above, several sequestration features indicate that CO_2 should be retained in the sequestration reservoir. If CO_2 were to leak, however, radon transport induced by CO_2 leakage would be highly localized over the point of CO_2 leakage. The risk assessment conducted for this EIS addressed the potential for adverse impacts from radon displacement (see Appendix D). Data concerning potential existing radon levels from state and local sources were used as the baseline. Using conservative assumptions on increases of radon via displacement by CO_2, it was concluded that the situation with respect to radon would remain unchanged as to whether EPA-established action levels would be exceeded. This indicates that there would be no incremental risks above background from radon at the Mattoon Site.

Mineral rights on the site are intact and would be conveyed on the signing of the contract. All mineral rights needed to conduct sequestration would be acquired. Conflicts with commercial accessibility to high-value mineral resources or unique geologic formations would be managed as part of the acquisition of mineral rights.

The project area should not be affected by subsidence (sinking or lowering of the ground surface) because most factors known to cause subsidence are not present in the project area.

Utility Corridors

Potential impacts to geologic resources, and impacts from geologic processes or features such as earthquakes or karst geology, would be the same for operation of the proposed utility corridors as discussed above for the power plant site.

Transportation Corridors

Potential impacts to geologic resources, and impacts from geologic processes or features such as earthquakes or karst geology, would be the same for operation of the proposed transportation infrastructure corridors as discussed above for the power plant site.

4.4.3.3 Fate and Transport of Injected/Sequestered CO_2

As previously mentioned, in saline formations, supercritical CO_2 is less dense than water, which creates strong buoyancy forces that drive CO_2 upwards. After reaching the top of the reservoir formation, CO_2 would continue to migrate as a separate phase until it is trapped as residual CO_2 saturation or in local structural or stratigraphic traps within the sealing formation. In the longer term, significant quantities of CO_2 (up to 30 percent) would dissolve in the formation water and then migrate with the groundwater. Reservoir studies and simulations for the Sleipner Project have shown that CO_2 saturated brine would eventually become denser and sink, thereby eliminating the potential for long-term leakage. These reactions, however, may take hundreds to thousands of years (IPCC, 2005).

The modeling estimated that the plume radius at Mattoon could be as large as 1.2 miles (1.9 kilometers) equal to an area of 2,789 acres (1,129 hectares) after injecting 1.1 million tons (1 MMT) of CO_2 annually for 50 years (FG Alliance, 2006a). The dispersal and movement of the injected CO_2 would be influenced by the geologic properties of the reservoir, and it is unlikely the plume would radiate in all directions from the injection point in the form of a perfect circle.

Geological characteristics of the area (simple sedimentary structure with a low rate of dip; no known transmissive faults or fractures and compressive stress regime; deep reservoir zones in a formation consisting mainly of quartz-rich sandstone layers with up to 585 feet (178.3 meters) of high porosity and permeability sublayers overlain by 300 to 500 feet (91.4 to 152.4 meters) of low permeability shale; and over 6,000 feet (1,829 meters) of overlying mostly fine grained carbonate rock that also includes many sequences of more and less permeable zones) indicate that it would be unlikely that CO_2 would migrate vertically for any significant distance.

However, if a transmissive fracture were present in the subsurface ROI, CO_2 could migrate along its path. Horizontal open fractures within the Mt. Simon would cause the CO_2 to migrate farther laterally than the modeling predicts. Vertical open fractures are more likely at depth than horizontal ones, and fractures or faults trending roughly east-west, if present, may be transmissive. Thus, if such fractures are present in the Eau Claire formation within the ROI, they could promote vertical migration of CO_2. In order for the CO_2 to reach shallow potable groundwater or the biosphere, such fractures would need to penetrate and be open through, or connect in networks through, more than 1.1 miles (1.8 kilometers) of various types of rock. It is unlikely that such fractures exist in the project area due to the presence of significant oil reserves (i.e., trapped fluids); however, further site-specific geologic investigations would be necessary to verify this before initiating injection of CO_2. See Section 4.17 for a detailed discussion of CO_2 transport assumptions and potential associated risks.

4.5 PHYSIOGRAPHY AND SOILS

4.5.1 INTRODUCTION

This section addresses the physiography and soils associated with the proposed Mattoon Power Plant and Sequestration Site and related corridors.

4.5.1.1 Region of Influence

The ROI for physiography and soils is defined as a 1-mile (1.6-kilometer) radius around the proposed power plant, sequestration site, reservoir, and utility corridors.

4.5.1.2 Method of Analysis

DOE reviewed reports from the U.S. Department of Agriculture (USDA), information provided in the Mattoon EIV (FG Alliance, 2006a), and other available public data to assess the potential impacts of the proposed FutureGen Project on physiographic and soil resources. DOE assessed the potential for impacts based on the following criteria:

- Potential for permanent and temporary soil removal;
- Potential for soil erosion and compaction;
- Potential for soil contamination due to spills of hazardous materials; and
- Potential to change soil characteristics and composition.

Some uncertainties were identified in relation to soil resources at the proposed Mattoon Site, such as the porosity and permeability of the various soils where the project infrastructure would be located. Uncertainties, based on the absence of site-specific data, are discussed as appropriate in the following analysis. Prime farmland is discussed in Section 4.11.

4.5.2 AFFECTED ENVIRONMENT

4.5.2.1 Physiography

The proposed Mattoon Power Plant and Sequestration Site is located in Coles County and lies entirely within the Bloomington Ridged Plain of the Central Lowland physiographic province of Illinois. Proposed utility and transportation corridors are also located within the Bloomington Ridged Plain. The Bloomington Ridged Plain is part of the Wisconsinan Till Plain that is characterized by a series of end moraines and ground moraines (USDA, 2006).

> **Moraines** are glacial deposits.
>
> **End moraines** are irregular ridges of glacial sediments that form at the margin or edge of the ice sheet.
>
> **Ground moraines** are rolling-to-flat landscapes that form under the ice sheet.

Coles County was covered by glaciers during the Pleistocene age. Most of the present surface materials and landforms are the result of glacial ice and running water, resulting in nearly level and gently sloping, broad uplands. The greatest change in relief is in areas along major drainage ways, where stream erosion has caused 50- to 65-foot (15- to 20-meter) drops in elevation from the adjacent uplands (USDA, 2006). Physiographically, the proposed Mattoon Power Plant and Sequestration Site consists of very gently rolling to flat surfaces with elevations that vary from approximately 718 feet (219 meters) AMSL to 679 feet (207 meters) AMSL, with average slopes of less than 1 percent. This indicates that there is no landslide potential from natural features. All soils in this area will support vegetative cover that diminishes their erosion potential.

4.5.2.2 Soils

The following section describes the different predominant soils at the proposed power plant and sequestration site and utility and transportation corridors. Descriptions of soil type characteristics and uses are provided in Table 4.5-1.

The soils found within the ROI are agricultural, which is indicative of favorable characteristics for growing vegetation. The presence of crops and vegetation on the ground coupled with low slopes makes the potential for erosion low. The clay till type subsoils and substratum soils located on the proposed power plant and sequestration site are suitable for supporting structures. Phase I Environmental Site Assessments (ESAs) (FG Alliance, 2006a) performed for the site indicate that the soils on the proposed site and corridors are not contaminated. The two primary soils at the proposed plant site are Raub silt loam and Drummer silty clay loam. Other soils present include Toronto silt loam, Wingate silt loam, and Pell silty clay loam (FG Alliance, 2006a) (Table 4.5-1). The proposed sequestration site is located on the plant site; therefore, the soils are the same as the ones described for the proposed plant site. The soils located in the area of the proposed utility corridors include Drummer-Flanagan, Raub-Dana, Xenia-Fincastle-Toronto, Miami-Russell, Drummer-Starks-Brooklyn, and Lawson-Landes-Sawmill Associations (Table 4.5-1).

Table 4.5-1. Predominant Soil Types, Characteristics, and Uses in the Proposed Power Plant and Sequestration Sites and Related Corridors

Soil Type	Characteristics	Uses
Brooklyn	Poorly drained with 0 to 25 percent slopes. Where drained, a perched seasonal high water table is within 12 inches (30 centimeters) of the surface at times between January and May in most years. In the undrained condition, the perched seasonal high water table is within 6 inches (15 centimeters) of the surface at times between November and June in most years. These soils are subject to ponding of about 6 inches (15 centimeters) after heavy rains from November through June. The potential for surface runoff is negligible to medium. Permeability is moderately slow or slow.	Most areas with a drainage outlet are used to grow corn and soybeans. Undrained areas are primarily grass. Native vegetation is grasses and sedges.
Dana	Very deep, moderately well drained soils formed in loess and other silty materials. Permeability is moderate and slopes range from 0 to 12 percent. A perched water table is present at a depth of 2.0 to 3.5 feet (0.6 to 1.1 meters) at times between February and April. Surface runoff is negligible to medium.	Used mostly in the growing of corn, soy beans, and other small grains. Some small areas are used for pasture.
Drummer	Poorly drained soils formed in loess and over loamy stratified outwash sediments on nearly level or depressional outwash plains, stream terraces, and till plains. The slope ranges from 0 to 2 percent and the potential for surface runoff is negligible to low. Permeability is moderate and water ponds occur for brief periods of time in the spring.	Cropland is the main use.

Table 4.5-1. Predominant Soil Types, Characteristics, and Uses in the Proposed Power Plant and Sequestration Sites and Related Corridors

Soil Type	Characteristics	Uses
Fincastle	Somewhat poorly drained soils formed in loess or other silty material and in underlying dense till on till plains. Permeability is moderate in the upper portion and very slow in the dense underlying till. Slopes range from 0 to 6 percent.	Native vegetation is hardwood forest and they are mostly cultivated with corn, soybeans, and wheat and clover grass mixtures.
Flanagan	Somewhat poorly drained soils formed in loess over glacial till on uplands. Slopes range from 0 to 7 percent, potential for runoff is low to high, and permeability is moderately slow.	Most areas are used for cultivated crops.
Landes	Well drained with low potential for surface runoff with 0 to 5 percent slopes. Permeability is moderately rapid in the upper and middle soil layers and rapid in the lower. Flooding from stream overflow is common during the late winter and early spring. A moderately wet phase is recognized that has a seasonal high water table at a depth 4 to 6 feet (1.2 to 1.8 meters) at times between March and May in most years.	Most areas containing these soils are cultivated with corn, soybeans, and small grains as the principal crops. Native vegetation includes both grasses and deciduous trees.
Lawson	Somewhat poorly drained with a frequently saturated zone that occurs within depths of 1 to 3 feet (0.3 to 0.9 meters) during the wettest periods of normal years and is apparent. Lawson soils are characterized with 0 to 5 percent slopes. The surface runoff potential is negligible to low. Flooding occurs rarely to frequently for very brief to long durations.	Many areas are used for forage production. Cultivated areas produce good crop yields where excess water is not a problem. Native vegetation consists of scattered silver maple, white ash, American elm tall prairie grasses, and forbs.
Miami	Moderately well drained with medium potential for surface runoff on the gentle slopes and high on the steeper slopes (0 to 25 percent), which can range up to 60 percent. Permeability is moderate in the upper part of the solum, moderately slow in the lower part of the solum, and slow or very slow in the underlying dense till. An intermittent perched high water table is at a depth of 2.0 to 3.0 feet (0.6 to 0.9 meters) from December to April in normal years.	Most areas are cultivated. Corn, soybeans, and small grain are the principal crops. Some areas are wooded. Native vegetation is deciduous hardwood forest.
Pell	Poorly drained soils formed in loamy glacial till on ground moraines. The slopes range from 0 to 2 percent and surface runoff potential is negligible or low. Surface soil, located from 0 to 15 inches (0 to 38 centimeters), is characterized by black, neutral clay loam.	The main use is cropland.
Raub	Somewhat poorly drained soils formed in loess in the underlying loamy till on till plains. Slopes range from 0 to 2 percent; potential for surface runoff is low; and permeability is moderate in loess, moderately slow in the till subsoil, and slow or very slow in the dense till substratum.	The main land use is for cropland.
Russell	Well drained with low to high potential for surface runoff with 0 to 25 percent slopes. Depth to an intermittent perched high water table is typically 3.5 to 6.0 feet (1.1 to 1.8 meters) from December to April in most years. In some areas, the depth to the seasonal high water table is greater than 6.0 feet (1.8 meters).	Most of this soil is cultivated. Corn and soybeans are the principal crops. Native vegetation is mixed hardwoods of oak, hickory, and sugar maple.

Table 4.5-1. Predominant Soil Types, Characteristics, and Uses in the Proposed Power Plant and Sequestration Sites and Related Corridors

Soil Type	Characteristics	Uses
Sawmill	Poorly to very poorly drained with moderate permeability and negligible surface runoff with 0 to 3 percent slopes. Where drained, these soils have an apparent seasonal high water table 12 inches (30 centimeters) above the surface to 12 inches (30 centimeters) below the surface at some time between January and May in most years. In undrained conditions, the apparent seasonal high water table is 6 inches (15 centimeters) above the surface to 6 inches (15 centimeters) below the surface at times between November and June in most years. Flooding can occur for brief to long periods between November and June.	Many areas of Sawmill soils are cultivated with corn, soybeans, and meadow as the principal crops, and grasses and trees as the native vegetation. Undrained areas are mostly used for pasture or woodland.
Starks	Somewhat poorly drained with 0 to 25 percent slopes. An intermittent apparent seasonal high water table is present at a depth of 6 to 24 inches (15 to 61 centimeters) below the surface at times between January and May in most years. The potential for surface runoff is negligible to low. Permeability is moderate.	Most areas are cultivated. Corn, soybeans, and small grain are the principal crops. Some areas are wooded. Native vegetation is deciduous hardwood forest.
Toronto	Somewhat poorly drained soils formed in loess in the underlying calcareous loamy till. Slopes range from 0 to 6 percent, surface runoff potential is low, and permeability is moderate to moderately slow.	Nearly all soils are used for cropland.
Wingate	The Wingate series consists of moderately well drained soils formed in loess and underlying loamy till on till plains. Slopes range from 0 to 10 percent, surface runoff potential is low to medium, and permeability ranges from moderately permeable to moderately slowly permeable.	The main use is cropland and some is used for pasture.
Xenia	Moderately well-drained soils formed in loess and underlying loamy till. They are deep to very deep soils that have slopes ranging from 0 to 12 percent. Surface runoff ranges from low to high. There is an intermittent perched water table present at a depth of 1.5 to 2.5 feet (0.5 to 0.8 meters) during the winter and spring.	Mainly for cultivating corn, soybeans, small grains, and hay. Native vegetation includes oak, hickory, and maple forest.

Source: FG Alliance, 2006a and NRCS, 2006.

4.5.3 IMPACTS

4.5.3.1 Construction Impacts

Direct impacts that could be caused during construction of the proposed facility include removal of soil, soil-blowing and erosion due to wind and motion of equipment, soil compaction, and change in soil composition. Soil removal disturbs soil properties such as permeability and horizon structure, and disturbs vegetation. Soil-blowing could cause the movement of soil, making it unstable as well as unsuitable for vegetation growth. Soil compaction could cause changes in soil characteristics such as permeability, water capacity, surface runoff, root penetration, and water capacity. Indirectly, impacts to soils could result in soil erosion due to runoff and wind, potential decline in nearby surface water quality due to increased sedimentation, potential soil contamination due to spills, and a decrease in biodiversity due to changing soil characteristics. The potential for impacts to soils to affect groundwater is low due to the generally moderate to moderately low permeability of the soils, coupled with a water table ranging from 20 to 125 feet (6 to 38 meters) deep (FG Alliance, 2006a). During the winter and early spring, many of the soils have a perched water table within a couple of feet of the surface. If a spill were to occur during this time, the perched water table could be contaminated. However, immediate cleanup of spills and other BMPs (see Section 3.1.5) would be used to minimize the potential for a spill to contaminate groundwater.

Power Plant Site

Construction at the proposed power plant site would impact up to 200 acres (81 hectares) of soil. Soil impacts would result from construction of the proposed power plant, storage areas, associated processing facilities, research facilities, parking areas, access roads, and the on-site railroad loop. During construction, soil would be removed from areas where the foundations of the structures would be sited. This soil would be placed on a temporary storage site protected from erosion and runoff for reuse as topsoil replacement or as fill. Removing and replacing these soils would likely result in changes to soil composition and characteristics, such as infiltration rate, within the proposed 200-acre (81-hectare) power plant footprint. Soils impacts would be permanent for areas converted into impervious surface areas (e.g., structure, pads, and parking). Temporary soil compaction would occur in areas of temporary road construction and heavy equipment storage. Soil-blowing and localized erosion would be likely during construction from equipment movement. Construction-related impacts to soils in areas not converted to impervious surfaces would be temporary and these areas would be restored after construction is completed.

Chemical spills could potentially affect up to a 200-acre (81-hectare) area of on-site soil. Chemicals commonly used during construction include oils, paints, solvents, lubricants, and cement. The quantities of these chemicals expected on site during construction are small. The use of segregation, storage, labeling, and adequate handling, as well as secondary containment and other spill prevention techniques, could minimize the potential for a spill to occur. Should a spill occur, it would be contained and would not be expected to permanently impact soil characteristics such as pH, porosity, humidity, and texture. Soils present at the proposed site are abundant throughout the region; therefore, overall impacts would not be adverse. The potential for impacts to prime farmland soil is discussed in Section 4.11.

Sequestration Site

The proposed sequestration site is located on the power plant site; therefore, construction of the associated structures would cause no additional direct and indirect impacts due to the removal of soil and general construction activities. After completion of drilling, soil could be replaced using topsoil separation practices while any extra soil could be used as on-site fill or disposed of off site.

Utility Corridors

The direct and indirect impacts due to the construction of the proposed utility corridors would be relatively minor, consisting of the same types of impacts described for the proposed power plant site. It is estimated that any permanent impact would be related only to the actual footprint of any new towers, where a relatively small amount of soil would have to be removed and compacted to set the structure. There could also be some temporary soil compaction during construction from equipment use and storage.

The proposed potable water pipeline corridor would be 1 mile (1.6 kilometers) long and 20 feet (6.1 meters) wide, affecting an area of 2.4 acres (1.0 hectare). The proposed process water pipeline corridor could be up to 14.3 miles (23 kilometers) long [6.2 miles (10 kilometers) to Mattoon WWTP and 8.1 miles (13.0 kilometers) to Charleston WWTP] and 20.0 feet (6.1 meters) wide, which would affect up to 19.6 acres (7.9 hectares) of soil. The sanitary wastewater pipeline corridor would be 1.25 miles

(2.0 kilometers) long and the disturbed width would be 20 feet (6 meters), affecting 3.0 acres (1.2 hectares) of soil. The natural gas pipeline corridor would have a length of 0.25 mile (0.4 kilometer) and an expected width of 20 feet (6.1 meters), affecting 0.6 acre (0.3 hectare) of soil. Because the proposed sequestration site would be located on the proposed power plant site, no CO_2 pipeline would need to be built. In total, 25.6 acres (10.4 hectares) of disturbed land could be susceptible to removal, erosion, or compaction of soils due to construction of utility corridors.

Transportation Corridors

The direct and indirect impacts due to the construction of the proposed transportation corridors would be relatively minor, consisting of the same types of impacts described for the proposed power plant site. Roadway improvements, consisting of a length of 1.3 miles (2.1 kilometers) and width of 25 feet (8 meters), or 3.8 acres (1.5 hectares) of total disturbed soil, would include roadway widening, resurfacing, new shoulders, and storm water management structures (FG Alliance, 2006a). The on-site loop track and main track connections for the rail would require 2.0 miles (3.2 kilometers) of track construction in a corridor 50 feet (15 meters) wide (12.1 acres [4.9 hectares] of total disturbed soil) (FG Alliance, 2006a). In total, up to 15.9 acres (6.4 hectares) of disturbed land could be susceptible to removal, erosion, or compaction of soils due construction of transportation corridors.

4.5.3.2 Operational Impacts

Direct impacts that could occur from operations include soil contamination due to leaks and spills, increased CO_2 concentration in soils due to CO_2 injection failures, and soil erosion due to wind and movement of machinery. Indirect impacts could include disruption of plant growth and subsurface organisms, and groundwater contamination. It is expected that the impacts during operations, with the use of BMPs, would remain at a minimum due to the limited extent and current ecological status of the proposed Mattoon Power Plant and Sequestration Site. The potential to affect groundwater is low due to the generally moderate to moderately low permeability of the soils, coupled with a water table ranging from 20 to 125 feet (6 to 38 meters) deep (FG Alliance, 2006a). It is anticipated that any spills would be identified and addressed before reaching groundwater sources. Revegetation of disturbed areas during operations would minimize the potential for erosion.

Power Plant Site

During the operation of the proposed plant and associated facilities, no new soil disturbance or removal would occur beyond what was described for construction. Storage of hazardous materials, ash, and coal piles could cause soil contamination if in direct contact with the soil. Revegetation of disturbed areas during operations would minimize the potential for erosion.

Sequestration Site

During operations at the proposed sequestration site, soil would not be disturbed; therefore, there would be no environmental impacts associated with operations. Potential impacts due to a pipeline, surface equipment, or well failure are to be minimal, because risk abatement and safety procedures would be in place. Though it is highly unlikely, because of the high volatility of CO_2 at atmospheric pressure, an increase of CO_2 concentration in the soil due to leaks can lower pH, which could in turn cause a disruption in plant growth and occurrence of subsurface organisms (Damen et al., 2003) (e.g., microbes occurring approximately 0.9 mile [1.4 kilometers] under ground; see Section 4.9). Some levels of ground subsidence and heave have been known to be caused by petroleum production/injection operations, disposal well operations, and natural gas storage operations. Since the CO_2 injection at the proposed Mattoon Site would be at great depth and into very well consolidated rocks, the risks of ground movement are small. Furthermore, since differential heave occurs most commonly when the underlying strata are tilted, faulted, or discontinuous and the underlying strata at the proposed Mattoon Site are horizontal, un-faulted, and continuous, there is a very low potential for differential settlement. Thus, if a small amount of ground heave occurred, it would likely have a negligible impact on soils.

Utility Corridors

During operations, the soil would not be disturbed around the utility corridors; therefore, there would be no environmental impacts associated with operations or maintenance of vegetation around the utilities during operation. Access within the utility corridors would occur through existing access roads or through access points constructed and maintained for any new corridors.

Transportation Corridors

During operations, there would be no additional impacts to the soil due to transportation corridor use and maintenance. Impacts could potentially include soil contamination due to spills, soil-blowing, soil compaction, and soil removal.

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4.6 GROUNDWATER

4.6.1 INTRODUCTION

This section addresses groundwater resources that may be affected by the construction and operation of the proposed FutureGen Project at the proposed Mattoon Power Plant and Sequestration Site and related corridors.

4.6.1.1 Region of Influence

The ROI for groundwater resources includes aquifers that underlie the proposed power plant and sequestration site, and aquifers that may be used to obtain water for construction and operations support. The horizontal extent varies, depending on the particular aspects of the groundwater resource, as follows:

- A distance of 1 mile (1.6 kilometers) from the proposed power plant site defines the general vicinity that could be affected (but to a lesser degree) by changes in groundwater quantity or quality due to the power plant footprint.
- A distance of 1.2 miles (1.9 kilometers) from each sequestration injection well defines the area that could be affected by potential leaks of CO_2 from the target reservoir to overlying aquifers. This distance is based on modeling, which indicates that CO_2 could migrate up to 1.2 miles (1.9 kilometers) from the site of each injection well. The CO_2 injection is proposed to occur on the power plant site.
- The facility footprint (including utility and transportation corridors) defines where construction or other land disturbances could take place. These areas could be susceptible to changes in groundwater infiltration, discharge, or quality. Damage to, or loss of use of, an existing well (including the potential need for well abandonment) could also occur within the facility footprint.

4.6.1.2 Method of Analysis

DOE reviewed reports from state water authorities and information in the Mattoon EIV (FG Alliance, 2006a) to assess the potential impacts of the proposed FutureGen Project on groundwater resources.

Uncertainties identified in relation to groundwater resources at the Mattoon Site include the porosity, brine saturation, and permeability of the target formation where CO_2 would be sequestered. Analog well data were analyzed; however, site-specific test well data were not collected. Uncertainty also exists concerning the presence of transmissive faults or improperly abandoned wells in the area.

DOE assessed the potential for impacts based on the following criteria:

- Depletion of groundwater supplies on a scale that would affect available capacity of a groundwater source for use by existing water rights holders, interference with groundwater recharge, or reductions in discharge rate to existing springs or seeps;
- Relationship to established water rights, allotments, or regulations protecting groundwater for future beneficial uses;
- Potential to contaminate a***n underground source of drinking water (USDW)*** through acidification of the aquifer due to migration of CO_2; toxic metal dissolution and mobilization; displacement of groundwater with brine due to CO_2 injection; and contamination of aquifers due to chemical spills, well drilling, or well completion failures; and
- Conformance with regional or local aquifer management plans or goals of governmental water authorities.

4.6.2 AFFECTED ENVIRONMENT

This section describes groundwater resources in the project area. In general, this description applies to all proposed project areas, although site-specific data are presented where available and applicable.

4.6.2.1 Groundwater Quality and Uses

Public water supplies in Coles County are generally obtained from surface water, with a small amount obtained from groundwater. Groundwater in the county is normally obtained from sand and gravel aquifers that are contained in unconsolidated material above bedrock. The sand and gravel deposits in the vicinity of the proposed power plant site range in depth from about 20 to 125 feet (6 to 38 meters) below the ground surface. There are no indications that groundwater in the vicinity of the proposed plant site is contaminated (FG Alliance, 2006a). No sole source aquifers have been designated in the vicinity of the proposed project area (EPA, 2006a).

Water availability in these sand and gravel deposits is sporadic due to the highly heterogeneous nature (i.e., varying in size and thickness) of the unconsolidated glacial till. Deeper bedrock aquifers are also present in the area, and potable groundwater can be found at depths of up to approximately 175 feet (53.3 meters) (FG Alliance, 2006a).

A search of the Illinois State Water Service's (ISWS) well database was conducted in August 2006 to identify any private, public, industrial, or commercial wells located within approximately 1 mile (1.6 kilometers) of the proposed power plant site. The search identified 34 private wells that are used for domestic and agricultural uses and one well, constructed in 1919, that is classified as industrial/commercial use. There is no evidence supporting the existence of ongoing industrial or commercial activities at the location of the well constructed in 1919, and it is reported that some of the private wells may now be abandoned, but no records documenting proper abandonment are available (FG Alliance, 2006a). Three private wells were identified at the proposed power plant site. The wells were identified as domestic wells and were drilled in 1914, 1920, and 1978 with depths of 45 feet (13.7 meters), 113 feet (34.4 meters), and 79 feet (24.1 meters), respectively, below the ground surface (FG Alliance, 2006a). Depth to the groundwater surface (i.e., water table) was variable, generally ranging from 10 to 50 feet (3 to 15 meters) below the ground surface; although one well was 113 feet (34.4 meters) deep and was reported to have a static water level of 96 feet (29.3 meters) below the ground surface (FG Alliance, 2006a). However, this data point is so anomalous that it may be an error in measurement.

A search of the ISWS Public, Industrial, and Commercial Survey Database did not identify any public, industrial, or commercial wells in the vicinity of the proposed power plant site (FG Alliance, 2006a). ***However, USDWs may exist at the Mattoon Power Plant and Sequestration Site.***

Hardness and chloride concentrations in groundwater are highly variable in Coles County, and high levels of nitrates, hardness, chlorides, and sulfates can occur in localized areas (Bower, 2006). Water obtained from bedrock wells at depths below approximately 175 feet (53.3 meters) is likely to be highly mineralized and too saline (brine) for most uses (FG Alliance, 2006a).

The community of Ashmore, located approximately 20 miles (32 kilometers) east-northeast of Mattoon, is currently served by two municipal groundwater wells screened in the shallow sand and gravel aquifer located outside the city limits. The wells are reported to be about 44 feet (13 meters) deep and each produce 85 gallons (321.8 liters) per minute. The water is reported to be of good quality, although water from one of the wells contains enough manganese and iron to necessitate treatment before public distribution (Bower, 2006).

The City of Lerna, located approximately 2.5 miles (4.0 kilometers) southeast of Mattoon, also uses groundwater, but the available quantity is considered inadequate for demand with an average withdrawal of 18,600 gallons (70,409 liters) per day (Bower, 2006).

Recharge capacity and transmissivity are numerical factors that estimate the capacity of an aquifer to recharge with new water and transmit water, respectively.

No specific data are available regarding the recharge capacity and transmissivity of the sand and gravel deposits located in the vicinity of the proposed power plant site, but personnel from the ISWS estimated that the vicinity of the proposed power plant site might exhibit a recharge capacity equal to or less than approximately 1 inch (2.5 centimeters) per year (FG Alliance, 2006a).

The only transmissivity data for the area is from three public wells located in Cooks Mills, Illinois, and one public well located in Mattoon (FG Alliance, 2006a). Cooks Mills is approximately 5 miles (8.0 kilometers) north of the proposed power plant site; in 1979, transmissivity values were obtained for each well. The transmissivity values of the three wells were 7,920 gallons per day per foot (98,361 liters per day per meter), 13,200 gallons per day per foot (163,935 liters per day per meter), and 12,160 gallons per day per foot (151,019 liters per day per meter) with well depths of 33 feet (10.1 meters), 30 feet (9.1 meters), and 28 feet (8.5 meters), respectively. The public well in Mattoon was located approximately 4 miles (6 kilometers) southeast of the proposed power plant site, and transmissivity was tested in 1939. The transmissivity of the well was 10,000 gallons per day per foot (124,193 liters per day per meter) with a total depth of 56 feet (17.1 meters).

The target formation for CO_2 sequestration is the Mt. Simon formation. In northern Illinois (within about 80 miles [129 kilometers] of the Wisconsin border, and about 230 miles [370 kilometers] north of Mattoon), the Mt. Simon formation is a freshwater aquifer. The surface recharge area of the Mt. Simon formation lies to the north in Wisconsin where the formation outcrops. Near Mattoon, it is a saline formation that lies beneath several hundred feet of caprock (e.g., the Eau Claire shale and siltstone).

The ***deep saline*** aquifers ***proposed for sequestration*** would not fit EPA's definition (EPA, 2006b) of an USDW, which includes any aquifer or part of an aquifer that:

- Supplies any public water system**;**
- ***C***ontains a sufficient quantity of groundwater to supply a public water system and currently supplies drinking water for human consumption or contains fewer than 10,000 milligrams per liter of total dissolved solids (TDS); and
- Is not an exempted aquifer.

Following EPA's definition above, the shallow aquifers near the sequestration site ***may*** be classified as USDW**. *However, the deep saline aquifers targeted for CO_2 sequestration would not qualify as USDW because of their very high total dissolved solids concentrations.***

4.6.3 IMPACTS

4.6.3.1 Construction Impacts

Power Plant Site

Construction activities would not be expected to disturb the groundwater resources beneath the plant or other facilities. The three private wells located at the power plant site would be properly abandoned following state and federal requirements, avoiding any potential contamination of the aquifer. While construction of impervious areas would hinder aquifer recharge in the immediate vicinity of the power plant site, this effect would be minimal, as the size of the aquifer recharge area is much larger than the area of impervious surface that would be created. Water for construction activities would be trucked to the site, so groundwater withdrawals would be unnecessary.

There would be no direct on-site discharge of wastewater to the subsurface. Appropriate Spill Prevention, Control, and Countermeasure (SPCC) plans would be employed to minimize the potential for spills of petroleum, oils, lubricants, or other materials used during construction and to ensure that waste materials are properly disposed of. In the event of a spill, it is unlikely that these materials would reach groundwater sources before cleanup (based on an estimated depth to groundwater of 10 to 50 feet [3 to 15 meters]). Section 4.5 provides further details regarding soil properties, including permeability. In general, no impact on groundwater availability or quality would be anticipated due to construction of the proposed power plant.

Sequestration Site

Because the proposed sequestration site is located on the same property as the proposed power plant site, potential construction impacts would be the same as those for the proposed power plant site, although considerably less impervious cover would be associated with CO_2 injection wells and equipment. One injection well and one backup well would be drilled to a depth of between 1.3 and 1.6 miles (2.1 and 2.6 kilometers) to reach the target injection formation, the Mt. Simon formation. Injection well drilling would use a series of conductor casings to protect shallower groundwater.

Utility and Transportation Corridors

Potential construction impacts would be similar to those discussed for construction of the proposed power plant, with the exception that considerably less impervious area would be created in the corridors.

4.6.3.2 Operational Impacts

Power Plant Site

During operation of the power plant, petroleum, oils, lubricants, and other hazardous materials could be spilled onto the ground surface and potentially impact groundwater resources. However, appropriate SPCC plans would be employed to minimize the potential for such materials used during operation to be released to the surface or subsurface and to ensure that waste materials are properly disposed of. Section 4.5 provides further detail regarding soil properties, including permeability. Since groundwater would not be used as a source for process water, the proposed project would not impact groundwater levels or availability for other uses.

Sequestration Site

The potential impacts associated with CO_2 sequestration in geologic formations are largely associated with the possibility of leakage. The potential for leaks to occur would depend upon caprock integrity and the reliability of well capping methods and, in the longer term, the degree to which the CO_2 eventually dissolves in formation waters or reacts with formation minerals to form carbonates. The mechanisms that could allow leakage of the injected CO_2 into shallower aquifers are:

- CO_2 exceeds capillary pressure and passes through the caprock;
- CO_2 leaks into the upper aquifer via a transmissive fault;
- CO_2 escapes through a fracture or more permeable zone in the caprock into a shallower aquifer;
- Injected CO_2 migrates up dip, and increases reservoir pressure and permeability of an existing fault; or
- CO_2 escapes via improperly abandoned or unknown wells.

CO_2 would be injected into the Mt. Simon formation at a depth of 1.3 and 1.6 miles (2.1 and 2.6 kilometers) below the ground surface. Subsequently, it would mix with the saline groundwater in the formation. Because CO_2 is less dense than the surrounding groundwater, its buoyancy would cause it to move vertically into lower pressure zones until it reached less permeable strata that would act as a seal (e.g., caprock layer). Over time, the CO_2 would dissolve in the formation water and begin to move laterally with the groundwater flow, unless it found a more permeable conduit, such as a transmissive fault or an improperly abandoned well.

However, vertical migration of CO_2 to ***USDW*** aquifers would be highly unlikely due to:

- The depth of the injection zone in the Mt. Simon formation;
- The substantial primary seal provided by the Eau Claire shale (500 to 700 feet [152.4 to 213.4 meters] thick);
- The presence of at least two secondary seals; and
- A total of over 1.1 miles (1.8 kilometers) of various strata (much of it being fine grained) between the injection zone and any potable water aquifers in the project area.

Each series of less permeable and more permeable sedimentary layers within the 1.1 miles (1.8 kilometers) between the top of the Mt. Simon formation and the deepest ***USDW*** aquifers in the project area would be a barrier to upward migration of CO_2. Pressure would force the CO_2 through each layer with lower permeability and then be dissipated due to lateral flow of CO_2 in each layer with higher permeability. There are hundreds of these series and, as a result, extensive vertical movement to ***USDW*** aquifers would not be likely.

Based on data from the nearest deep well with a geologic log (about 35 miles [56 kilometers] away), significant fractures are not identified or suspected. If any fractures are present, due to the compressive stress within the formation, only vertical fractures are likely to be transmissive and they would have to penetrate and be open through 1.1 miles (1.8 kilometers) of various types of rock to allow CO_2 migration to shallow potable water aquifers. A recent 2D seismic survey line shows relatively flat, parallel reflectors in the Eau Claire/Mt. Simon interval below the “Base of Knox” horizon and above the Precambrian. This suggests a lack of major north-south trending vertical faults at the proposed Mattoon Sequestration Site (Patrick Engineering, 2006). DOE considers it unlikely that such fractures exist in the project area.

Reservoir modeling indicates that the largest plume radius would be approximately 1.2 miles (1.9 kilometers) over 50 years of injection at a rate of 1.1 million tons (1 MMT) per year. CO_2 movement would be expected to be primarily horizontal, with very little upward migration out of the injection zone due to trapping beneath the caprock seal provided by the Eau Claire shale and siltstone. Brine in the Mt. Simon formation would be displaced horizontally (and vertically) for an unknown lateral distance. However, given that the areas where the Mt. Simon formation contains potable water are about 200 miles (322 kilometers) from the injection ROI, and the brine groundwater in the Mt. Simon likely moves at no more than a few centimeters per year, it is very unlikely that the potable parts of this aquifer would be affected.

In addition to displacing brine, CO_2 would also dissolve into the brine over time. In formations like the Mt. Simon with slowly flowing water, reservoir-scale modeling for similar projects shows that, over tens of years, up to 30 percent of the CO_2 would dissolve (IPCC, 2005). Once CO_2 dissolves in the brine groundwater, it could be transported out of the injection site by regional scale circulation or upward migration, but the time scales of such transport are millions of years and are thus not considered an impact for this assessment (IPCC, 2005).

Reactions between the CO_2 and brine would produce carbonic acid, a weak acid that would react with the Mt. Simon formation. This formation is quartz-rich and reacts with minerals very slowly, taking hundreds to thousands of years (IPCC, 2005). Toxic metal displacement and dissolution could be a concern in those areas where injected CO_2 reacts with brine if anomalous concentrations of heavy metals were in the pathway of the brine. These dissolved metals could travel over time and be assimilated by groundwater, causing an incremental increase in the concentration of heavy metals in the water. However, in the ROI, there are no known anomalous concentrations of metals that could pose a risk to the aquifer.

Acidification of the aquifer due to dissolution of CO_2 into water would slightly lower the pH of the groundwater. At the Mattoon Site, acidification of shallower groundwater sources would be very unlikely due to the hundreds of feet of separation between the injection target formation and these aquifers as well as the limited pathways for CO_2 to travel upward and mix with groundwater. Similarly, it would be unlikely that CO_2 injection would contaminate overlying aquifers by displacing brine, because this would require pathways, such as faults or deep wells that penetrate the primary seal. Such faults are not believed to exist at the proposed site.

Any eventual CO_2 and brine contamination of any of the small, surficial groundwater reservoirs in the Mattoon region would be limited to individual cases because this resource is of limited extent in the area, and not used for any public water system.

However, monitoring methods could help detect CO_2 leaks before they migrate into an aquifer and mitigation measures could minimize such impacts should they occur (see Section 3.4).

Utility Corridors

The above discussion for the power plant site also applies to the proposed utility corridors, but to a lesser extent as hazardous materials would not be expected to be on site in the utility corridors unless maintenance activities were occurring.

Transportation Corridors

Traffic accidents could result in hazardous materials spills. The spill response measures discussed for the proposed power plant site would be executed to ensure rapid control and cleanup of any hazardous material spill from a traffic accident.

4.7 SURFACE WATER

4.7.1 INTRODUCTION

Surface water is an important resource in Illinois from which communities receive much of their drinking water. Ready access to an abundant supply of water is an important consideration in siting power plants, because water is necessary for steam generation and process water. Drinking water would also be required for the employees at the proposed power plant and sanitary wastewater would be generated by restrooms, sinks, and shower facilities. The proposed FutureGen Power Plant would not discharge any industrial wastewater, as all process wastewater would be treated by the zero liquid discharge (ZLD) system and recycled back to the power plant. The following analysis examined short-term impacts from construction and long-term impacts from operations to surface water resources from the proposed FutureGen Project.

4.7.1.1 Region of Influence

The ROI consists of the proposed power plant and sequestration site, areas within 1 mile (1.6 kilometers) of all related areas of new construction, and any surface water body above the sequestration reservoir. At the Mattoon Site, the sequestration site is also located on the power plant property.

The ROI for surface water resources is limited in most cases to the proposed power plant and sequestration site and related corridors. Because of the types of land disturbing activities that would occur during construction of the proposed power plant, injection wells, and supporting utilities and infrastructure, the disturbed areas would be susceptible to erosion and changes in surface water flow patterns. The areas could also be affected by spills associated with construction or operations.

The ROI for surface water extends beyond the proposed construction sites. Construction and operation activities would affect a larger area in cases where flow patterns were modified or contamination was carried downstream by surface water drainages.

4.7.1.2 Method of Analysis

DOE reviewed available public data, research, and studies compiled in the Mattoon EIV (FG Alliance, 2006a) to characterize the affected environment.

DOE assessed the potential for impacts based on whether the proposed FutureGen Project would:

- Alter stormwater discharges, which could adversely affect drainage patterns, flooding, erosion, and sedimentation;
- Alter infiltration rates, which could affect (substantially increase or decrease) the volume of surface water that flows downstream;
- Conflict with applicable stormwater management plans or ordinances;
- Contaminate public water supplies and other surface waters exceeding water quality criteria or standards established in accordance with the Clean Water Act (CWA), state regulations, or permits;
- Conflict with regional water quality management plans or goals;
- Affect capacity of available surface water resources;

- Conflict with established water rights or regulations protecting surface water resources for future beneficial uses;
- Alter a floodway or floodplain or otherwise impede or redirect flows such that human health, the environment or personal property is affected; or
- Conflict with applicable flood management plans or ordinances.

DOE reviewed reports from the U.S. Geological Survey (USGS), U.S. EPA, and IEPA, and reviewed information provided in the Mattoon EIV (FG Alliance, 2006a) to assess the potential impacts of the proposed FutureGen Project on surface water resources. Surface water data analysis was limited to locations that have the potential for permanent impacts (i.e., power plant and sequestration site). Site-specific surface water data for these areas were not collected. Data were evaluated from area discharge points and sample locations monitored by the agencies previously mentioned. Best professional judgment was applied to determine the likelihood of surface water impairments in the area. Uncertainties and unavailable data are discussed as appropriate in the following analysis.

To avoid or limit adverse impacts, emphasis is placed on adhering to applicable laws, regulations, policies, standards, directives, and BMPs. Most importantly, careful pre-planning of construction and operational activities would allow potential impacts to be minimized before they occur.

4.7.2 AFFECTED ENVIRONMENT

The proposed power plant and sequestration site consists of 444 acres (180 hectares) and is located approximately 1 mile (1.6 kilometers) northwest from the community of Mattoon. Figure 4.7-1 shows the proposed power plant and sequestration site, proposed utility corridors, and surface water resources in the area. Average annual precipitation in Mattoon totals 40 inches (102 centimeters) and local storms have been known to produce flash floods and torrential rainfall, resulting in decreased infiltration and increased surface water runoff (ISWS, 2002; NOAA, 2005). Severe thunderstorms occur infrequently, are of short duration, and cause damage in narrow belts or localized areas (City of Mattoon and IEPA, 2006).

As noted in Section 4.5, the soils in Coles County are of the Saybrook-Dana-Drummer soil association. This soil association is moderately to well drained; with low to medium surface runoff and 0 to 20 percent slopes (ISWS, 2004). The primary soils at the site are the Raub silt loam and Drummer silty clay loam. These soils cover the majority of the site. Other soils present include the Toronto silt loam, Wingate silt loam, and Pell silty clay loam (FG Alliance, 2006a). Soils are discussed in further detail in Section 4.5, but are mentioned briefly here to facilitate the discussion of surface water runoff.

Power Plant and Sequestration Site

The proposed Mattoon Power Plant and Sequestration Site is located in the southernmost portion of the Upper Kaskaskia watershed, but the ROI extends south into the Little Wabash watershed (see Section 4.8). The Kaskaskia/Little Wabash watershed divide serves as the watershed divide between the Upper Mississippi River and Ohio River basins (see Figure 4.7-1 for watershed divides). Within the ROI, the majority of the surface water runoff ultimately drains to the Kaskaskia River and Lake Shelbyville via Whitley Creek and associated drainage channels (FG Alliance, 2006a). Lake Shelbyville is located about 8 miles (12.9 kilometers) west of the site. A small part of the surface water runoff within the ROI (within the southeast portion of the 1 mile [1.6 kilometer] ROI) flows into the Little Wabash River via overland flow, roadside ditches and unnamed tributaries. There are currently no surface water reservoirs, lakes, or ponds within the ROI (FG Alliance, 2006a). The nearest lake is Lake Paradise, which is approximately 4 miles (6.4 kilometers) to the south of the proposed plant and sequestration site. Lake Mattoon is about 7 miles (11.2 kilometers) south of the proposed site.

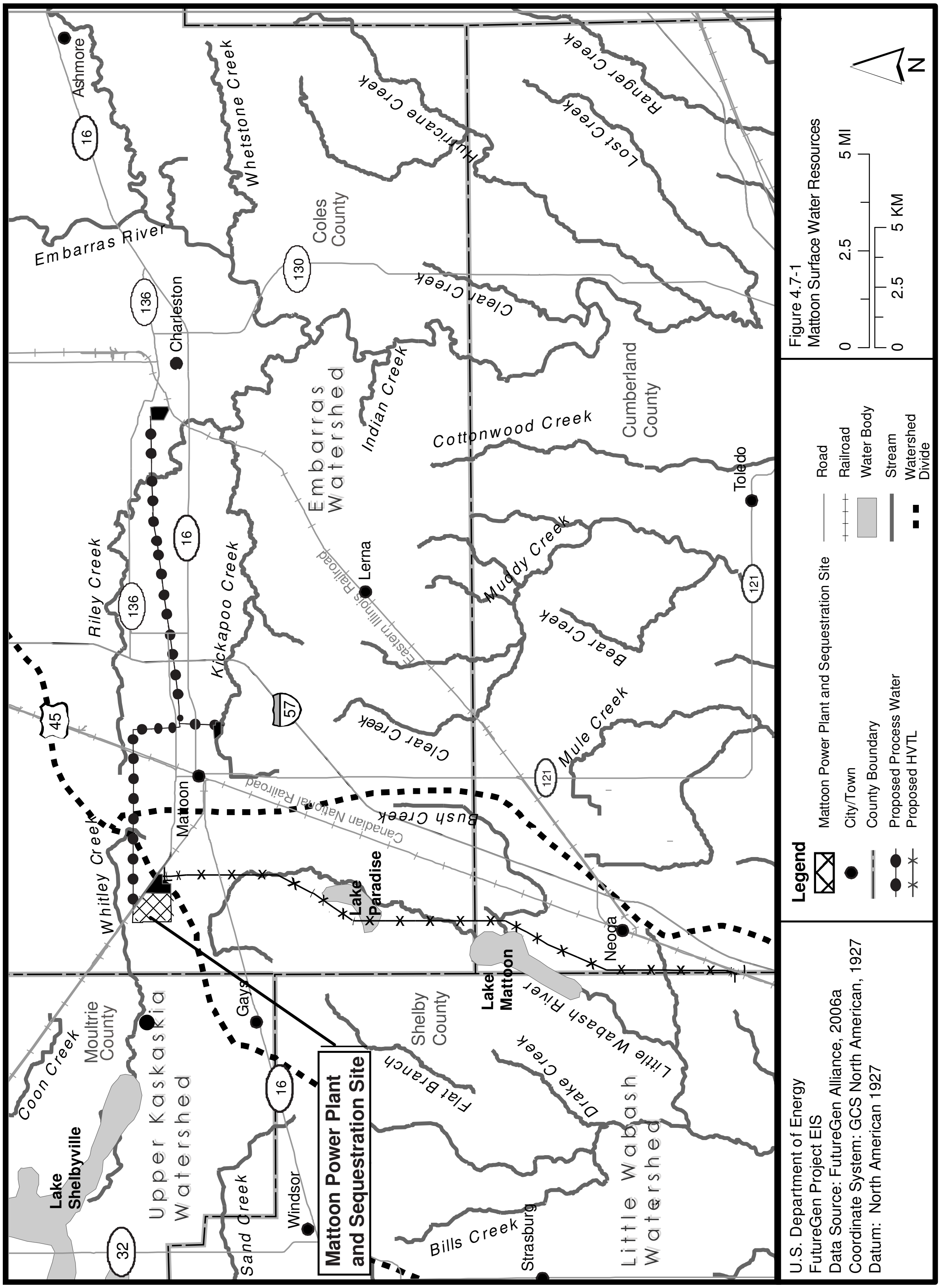

Figure 4.7-1
Mattoon Surface Water Resources

Utility Corridors

The proposed water supply line corridor is located within the Embarras River watershed. Surface runoff within the ROI for the pipeline flows into the Embarras River via Cassell Creek, Riley Creek, and their tributaries. The proposed pipeline would cross ***up to*** five surface water bodies: Cassell Creek, Riley Creek, and three tributaries to Riley Creek. There is one pond within the ROI for the pipeline, located near the crossing of the proposed pipeline corridor with Interstate 57 (see Figure 4.7-1). Riley Creek is designated to be used for aquatic life purposes and is impaired for pH and total nitrogen (Table 4.7-1) (IEPA, 2006). Cassell Creek is listed as impaired ***due to fish kills*** (IEPA, 2006).

The 138-kilovolt (kV) transmission corridors are located within the Kaskaskia River watershed and the Little Wabash River watershed. Surface waters within the ROI include Lake Mattoon and Lake Paradise, the Little Wabash River, Whitley Creek and tributaries, and roadside ditches.

Transportation Corridors

Because no new transportation corridors are proposed outside of the power plant site, this section does not include a description of the affected surface waters. Any potential upgrades to existing transportation corridors are anticipated to occur in existing maintained ROWs.

4.7.2.1 Surface Water Quality

There are limited water quality and quantity monitoring data for surface waters within the ROI because many of the surface waterbodies have intermittent flows. Surface water quality and quantity data are not collected on the roadside ditches and unnamed tributaries within the ROI. Whitley Creek, the nearest surface water to the proposed plant and sequestration site, has been assessed by the IEPA and has been determined to meet its designated use (e.g., not impaired) for aquatic life propagation. Insufficient data are available to determine if Whitley Creek meets other designated uses, including fish consumption, primary and secondary, and aesthetic quality (IEPA, 2006).

Surface waters near the proposed Mattoon Power Plant and Sequestration Site that are on the IEPA's list of impaired waters are presented in Table 4.7-1 (IEPA, 2006). IEPA assigns a category (Cat.) for each water body, based on the level of support for each designated use and the causes of impairment. Applicable categories listed in Table 4.7-1 are defined as follows (IEPA, 2006):

- Category 2. Attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened.
- Category 4C. Impaired or threatened for one or more designated uses but does not require the development of a total maximum daily load (TMDL); impairment is not caused by a pollutant.
- Category 5. The water quality standard is not attained.

Table 4.7-1. Water Resources Within ROI Listed on State of Illinois 2006 303(d) List

Segment Name	Assessment Unit ID	Cat.	Segment Length (Miles [Kilometers])	Cause of Impairment	Source(s) of Impairment
Upper Kaskaskia Watershed					
Whitley Creek[1]	IL_OZZS-01	2	13.4 (21.5)	n/a	n/a
Kaskaskia River	IL_O-02	5	13.2 (21.2)	PCBs[2], Fecal Coliform	Unknown
	IL_O-15	5	11.6 (18.7)	PCBs, Fecal Coliform	Unknown
	IL_O-13	5	8.8 (14.2)	PCBs	Unknown
	IL_O-17	5	10.96 (17.6)	Impairment Unknown	Unknown
	IL_O-31	5	5.2 (8.4)	PCBs	Unknown
	IL_O-35	5	15.1 (24.3)	PCBs	Unknown
	IL_O-37	5	7.8 (12.6)	PCBs	Unknown
Embarras Watershed					
Cassell Creek	IL_BENC-01	4C	8.2 (13.1)	Fish Kills	Other Spill Related Impacts
Kickapoo Creek	IL_BEN-01	5	1.3 (2.1)	Nitrogen (total), pH	Urban Runoff/Storm Sewers, Crop Production
	IL_BEN_02	2	13.5 (21.8)	n/a	n/a
Riley Creek	IL_BENA-01	5	1.3 (2.1)	Nitrogen (total), pH	Other Spill Related Impacts, Urban Runoff/Storm Sewers, Crop Production
	IL_BENA-02	5	8.1 (13.0)	Nitrogen (total)	Urban Runoff/Storm Sewers, Crop Production
Little Wabash Watershed					
Little Wabash	IL_C-12	5	9.4 (15.1)	Total Suspended Solids, Sedimentation/ Siltation	Crop Production
	IL_C-21	5	31.1 (50.1)	Fecal Coliform, Manganese	Unknown
Lake Paradise	IL_RCG	5	176 (283.2)	Phosphorus (Total), Nitrogen (Total), Sedimentation/ Siltation	Crop Production, Other Recreational Pollution Sources, Runoff from Forest/Grassland/Parkland, Municipal Point Source Discharges, Unknown, Hydrostructure Flow Regulation/ Modification
Lake Mattoon	IL_RCF	5	765 (1,231)	Phosphorus (Total), Total Suspended Solids	Crop Production, Other Recreational Pollution Sources, Runoff from Forest/Grassland/Parkland, Littoral/ Shore Area Modifications (Non-riverine)

[1] Whitley Creek is not impaired. All other water resource segments exhibit some level of impairment.
[2] PCBs = polychlorinated biphenyls.
Source: IEPA, 2006.

4.7.2.2 Process Water Supply and Quality

The proposed process water sources to support the operations of the proposed power plant are the combined effluents from the Mattoon WWTP and possibly the addition of the Charleston WWTP. Based on effluent data collected from January 1, 2004 through December 31, 2005, the WWTPs have average effluent flows of 4.4 million gallons per day (MGD) (16.7 million liters per day [MLD]) for Mattoon, and 2.6 MGD (9.8 MLD) for Charleston (FG Alliance, 2006a). The proposed power plant requires 3,000 gallons per minute (11,356 liters per minute) or 4.3 MGD (16.4 MLD). To supplement the facility needs during periods of low-flow from the combined wastewater effluents, the proposed facility plans could include an on-site 7-acre (2.8-hectare), 25 million-gallon (95 million-liter) surface water storage reservoir to store excess combined wastewater effluent and stormwater runoff from the proposed power plant site. Depending on future design studies, the reservoir may or may not require lining. If effluent from the Mattoon WWTP is the only source of process water, then a reservoir with a capacity of 200 million gallons (757 million liters) would be required. This could be accomplished with a reservoir at least 40 acres (16.2 hectares) in size.

In 2000, IEPA commissioned a diagnostic-feasibility study of Lake Mattoon, including Lake Paradise, to evaluate the suitability of Lake Mattoon as a drinking water source (City of Mattoon and IEPA, 2001). Lake Paradise and Lake Mattoon provide public drinking water supply for the residents of Mattoon, Humboldt, Negoa, and for Lake Land College. The main inflow tributary is the Little Wabash River. Areas of concern identified in this study were siltation and nutrient loading, attributed to agricultural and residential practices in the watershed, residential development along a large portion of the shoreline, and the presence of rough fish.

Monitoring data are available for the effluents of the Mattoon and Charleston WWTPs for the years 2006 and 1996, respectively. Monitoring data are also available from U.S. EPA's STORET Web Interface for the Kaskaskia River near Cooks Mill, Illinois. Table 4.7-2 summarizes water quality data available for the effluents, which are the proposed process water sources (FG Alliance, 2006a; FG Alliance, 2007; USGS, 2006). Process water sources would likely require pre-treatment to meet the design values for the proposed power plant.

Table 4.7-2. Water Quality Data Summary

Constituent	Formula	Units	Design Value	Mattoon WWTP Sept. 2006	E Charleston[1] Aug. 1996	Kaskaskia River at Cooks Mills, USGS Gage 05591200[2]
Calcium	Ca	mg/L	75	43	34	70
Magnesium	Mg	mg/L	16	16	17	31
Potassium	K	mg/L	3	17	9.5	2
Sodium	Na	mg/L	20	71	52	22
Bicarbonates	HCO_3	mg/L	240	53	-	238
Chlorides	Cl	mg/L	25	-	-	34
Silica	SiO_2	mg/L	4	6.8	-	-
Sulfates	SO_4	mg/L	58	67	-	52
Nitrate	NO_3	mg/L	7	26	-	-

Table 4.7-2. Water Quality Data Summary

Constituent	Formula	Units	Design Value	Mattoon WWTP Sept. 2006	E Charleston[1] Aug. 1996	Kaskaskia River at Cooks Mills, USGS Gage 05591200[2]
TDS	TDS	mg/L	460	530	362	211
TOC	TOC	mg/L	3	7.7	7.3	5
Temperature	-	°F	60	-	73.2	57
pH	pH	-	8.0	-	7.1	7.4

[1] Sampling point within stream at discharge of effluent into Cassell Creek.
[2] Values shown are averages for period of record; Period of Record 01-01-1990 to 09-30-2006.
mg/L = milligrams per liter; °F = degrees Fahrenheit.
Sources: FG Alliance, 2006a; FG Alliance, 2007; and USGS, 2006.

Average and Low-Flow Volumes

The total combined effluent from the Mattoon and Charleston WWTPs has an average daily flow of 7 MGD (26.5 MLD) from January 2004 through December 2005 (Patrick Engineering, 2006a). Table 4.7-3 provides the effluent flow data for the two proposed sources for the calendar years 2004 and 2005. During this period, there were a total of 179 non-consecutive days when the combined daily effluent was less than 4.3 MGD (16.3 MLD).

The receiving streams for effluent discharges from the Mattoon and Charleston WWTPs are Kickapoo Creek and Cassell Creek, respectively. Hydrologically based design flow methods have been developed to answer questions relating to water quality and stream flows. Most states currently recognize hydrologically based design flow methods. The 7Q10 is the lowest 7-day average flow that occurs (on average) once every 10 years. The 7Q10 flow measurement above the Mattoon WWTP discharge point on Kickapoo Creek is 0.15 cubic feet per second (96,947 gallons per day [366,985 liters per day]) (Patrick Engineering, 2006b). The 7Q10 flow measurement above the Charleston WWTP discharge point on Cassell Creek is 0.0 cubic feet per second (0.0 gallons per day [0.0 liters per day]) (Patrick Engineering, 2006b). As noted above, a 7-acre (2.8-hectare), 25-million-gallon (95-million-liter) surface water storage reservoir is proposed to supplement the operational process water requirements during low-flow conditions. The proposed water storage reservoir would be constructed on the proposed power plant site.

Table 4.7-3. Effluent Flow Data from the Mattoon and Charleston WWTPs

	Mattoon WWTP						Charleston WWTP					
	Maximum		Minimum		Average		Maximum		Minimum		Average	
	MGD	MLD	MGD	MLD	MGD	MLD	MGD	MLD	MGD	MLD	MGD	MLD
2004	10.74	40.65	0.80	30.28	4.90	18.55	8.59	32.52	0.33	1.25	3.08	11.66
2005	10.70	40.50	1.30	49.21	3.91	14.80	5.19	19.65	0.41	1.55	2.22	8.40

MGD = million gallons per day; MLD = million liters per day.
Source: FG Alliance, 2006a.

4.7.3 IMPACTS

4.7.3.1 Construction Impacts

Water would be required during construction for dust suppression and equipment washdown and would most likely be trucked to the site; no water would be withdrawn from surface waters. BMPs would be used to contain water used for dust suppression and equipment washdown, minimizing the impacts to surface waters to the extent practicable. This activity would be addressed in a NPDES Permit. Proposed grades in paved areas and for building first floor elevations would be as close to existing grade as feasible to minimize side slopes, limiting potential erosion. All temporarily disturbed areas would be seeded to re-establish vegetative cover after construction.

Because there would be over 1 acre (0.4 hectare) of disturbance, the construction contractor would need to apply for a general NPDES Permit No. ILR10 from the IEPA, which requires the preparation of a Storm Water Pollution Prevention Plan (SWPPP). The general NPDES permit includes erosion control and pollution prevention requirements and refers to the IEPA Urban Manual for specific construction standards, material specifications, planning principles, and procedures. The plans are required to include site-specific BMPs. Operating stormwater pollution prevention restrictions and BMPs would be dictated by the NPDES permit.

A **Storm Water Pollution Prevention Plan** consists of a series of phases and activities to characterize the site and then select and carry out actions to prevent pollution of surface water drainages.

Impacts due to construction activities would likely include erosion due to equipment moving, surfacing and leveling activities, and alteration of surface structures resulting in effects to local hydrology. In addition, Section 404 of the CWA (hereafter referred to as Section 404) requires permits for jurisdictional waterbody (wetland) crossings, which would be implemented before construction. Section 404 permits require the use of BMPs during and after construction and often times include mitigation measures for unavoidable impacts.

Power Plant and Sequestration Site

There are currently no surface water reservoirs, lakes, or ponds within the ROI for the proposed power plant and sequestration site (FG Alliance, 2006a). The only surface water resource located within the ROI is Whitley Creek, and no process or potable water would be drawn from the creek. Once constructed, increases in impervious surfaces would decrease the available surface area to allow infiltration from precipitation. Area soils have low to moderate surface water runoff due to soil permeability and slopes (ISWS, 2004). Implementation of BMPs to address, mitigate, and control stormwater runoff would minimize to the extent practicable any potential impacts to downstream surface water resources such as Whitley Creek, the Kaskaskia River, and the Little Wabash River.

Utility Corridors

Pipelines

The proposed corridors for the process water supply lines would run from the Charleston and Mattoon WWTPs to the proposed site. The proposed effluent line from the Charleston WWTP to the Mattoon WWTP would parallel a current bike path and former railway line. The proposed corridor is located within the Embarras River watershed. Surface runoff within the ROI for the pipeline flows into the Embarras River via Cassell Creek, Riley Creek, and their tributaries. The proposed pipeline would cross ***up to*** five surface water bodies: Cassell Creek, Riley Creek, and three tributaries to Riley Creek. There is one pond within the ROI for the pipeline, located near the crossing of the proposed pipeline corridor with Interstate 57 (see Figure 4.7-1). Riley Creek is designated to be used for aquatic life purposes and is impaired for pH and total Nitrogen (Table 4.7-1) (IEPA, 2006). Cassell Creek is listed as impaired ***due to fish kills*** (IEPA, 2006).

Temporary impacts to surface waters from the construction of the process water pipeline and other underground utility lines using trenching methods could include stream diversion/piping flows around the crossing, increased turbidity and sedimentation during construction, streambed disturbance, and removal of streambank vegetation. Directional drilling under surface waters would avoid these impacts. Construction conducted near surface water resources could indirectly create sedimentation from runoff and could increase water turbidity as a temporary impact. BMPs that could be required under Section 404 of the CWA permitting would be implemented both during and after construction. The BMPs would help reduce temporary impacts by controlling sedimentation and turbidity, restoring stream crossings to their original grade, and stabilizing streambanks after construction.

The construction of new pipelines along the utility corridors would require hydrostatic testing of the lines to certify the material integrity of the pipeline before use. These tests consist of pressurizing the pipelines with water and checking for pressure losses due to pipeline leakage. Hydrostatic testing would be performed in accordance with U.S. Department of Transportation (DOT) pipeline safety regulations. Withdrawal of hydrostatic test water could temporarily affect downstream users and aquatic organisms (primarily fish) if the diversion constitutes a large percentage of the source's total flow or volume. Potential impacts include temporary disruption of surface water supplies, temporary loss of habitat for aquatic species, increased water temperatures, depletion of dissolved oxygen levels, and temporary disruption of spawning, depending on the time of withdrawal and current downstream users. These impacts could be minimized by obtaining hydrostatic test water from bodies of water with sufficient flow or volume to supply required test volumes without significantly affecting downstream flow.

Although no source has been specified, the water for the hydrostatic test could be provided by the intake on the Upper Kaskaskia River or by the City of Mattoon public water supply. Both of these sources would likely have sufficient capacity to enable these tests. The amount of water required to complete these tests on all newly constructed pipelines is unknown until preliminary designs for the proposed power plant and utilities have been completed to scale the appropriate size pipe.

Water used for hydrostatic testing is required to be pumped to a lined on-site pit or leak free above ground container. No hydrostatic testing or well testing water may be discharged to the surface (62 IAC 240.530). No chemical additives would be introduced to the water used to hydrostatically test the new pipeline, and no chemicals would be used to dry the pipeline after the hydrostatic testing. Hydrostatic testing would be conducted in accordance with applicable permits.

Power Transmission Corridor

An existing 138-kV transmission line lies 0.5 mile (0.8 kilometer) east of the proposed power plant site. If this existing line were used, a new corridor would run 0.5 mile (0.8 kilometer) east of the site to the existing line. This corridor is located within the Kaskaskia River watershed, near the Kaskaskia/Little Wabash watershed divide. Other than roadside ditches, there are no surface water bodies along this corridor. Surface water runoff along this corridor would drain to the Kaskaskia River via overland flow, existing roadside ditches, unnamed tributaries to Whitley Creek, and into Whitley Creek itself.

If a 345-kV transmission line is required, its proposed corridor would run south of the site to the Neoga substation. The proposed corridor is located within the Little Wabash River watershed and parallels an existing 138-kV transmission line (Figure 4.7-1). Surface runoff along the corridor would drain to the Little Wabash River via overland flow, unnamed tributaries, and Lake Mattoon and Lake Paradise. The proposed transmission line would cross several unnamed tributaries, Lake Mattoon, and the Little Wabash River itself. The Little Wabash River is designated to be used for aquatic life, primary contact recreation, and public water supply purposes (IEPA, 2006). Lake Mattoon is designated to be used for its aesthetic resources, while Lake Paradise is designated to be used for its aesthetic resources and aquatic life (IEPA, 2006). Both these water bodies are currently impaired (see Table 4.7-1).

Transportation Corridors

No new transportation corridors are proposed; however, only upgrades to existing roads and new transportation spurs within the proposed power plant footprint could occur. As such, the potential impacts from project construction are discussed under the proposed power plant site. Any unforeseen major upgrades or new transportation corridors would require a separate analysis.

4.7.3.2 Operational Impacts

Potential operational impacts would consist largely of surface water runoff from the proposed power plant site and potential spills (i.e., fuel, chemicals, grease, etc.). Potentially, the site could discharge sanitary sewer waste. The method of on-site waste systems has not been determined (see discussion in Section 4.15). Appropriate permits would be secured before any discharges. Discharge frequency, quantity, and quality would be subject to permit requirements. Mitigation of runoff, recycling of materials, and pollution prevention measures would reduce or eliminate the potential for operational impacts to surface waters. A pollution prevention program would be implemented to reduce site spills (i.e., fuel, paint, chemicals, etc.). Adherence to applicable laws, regulations, policies, standards, directives, and BMPs would avoid or limit any potential adverse operational impacts to surface waters.

Stormwater runoff from the proposed power plant and sequestration site would be expected to have minimal impact on surface water resources. Stormwater could be collected and recycled into the process water to support the operations of the proposed power plant. The following discussion details the impacts specific to the location of operations.

Power Plant and Sequestration Site

The nearest major surface water bodies to the proposed power plant and sequestration site are Lake Paradise and the Upper Kaskaskia River. Lake Paradise is 4 miles (6.4 kilometers) south of the proposed plant site in the Little Wabash watershed. The Upper Kaskaskia River is located 4 miles (6.4 kilometers) north of the proposed plant site in the Upper Kaskaskia River watershed. During heavy rains, this river can overflow and cause localized flash floods. The NOAA database shows that, between 1999 and 2006, 18 floods have occurred in Coles County. Seven of these floods were county-wide and seven were mainly in the Mattoon region, only one of which caused significant damage primarily in the Mattoon region. The nearby presence of the Kaskaskia River and the relative flat topography of the region contribute to potential flood conditions in the region (FG Alliance, 2006a). As noted in Section 4.8.2.2, the proposed power plant site and sequestration areas are not in the 100-year or 500-year floodplains.

The State of Illinois operates under a common law water rights system. There are no allocated water rights associated with this project. The proposed power plant would use 3,000 gallons per minute (11,356 liters per minute) or 4.3 MGD (16.4 MLD) of process water during normal operations. Process water would be supplied by the effluent from the Mattoon WWTP and possibly the Charleston WWTP, and the on-site ZLD system. Based on effluent data collected from January 1, 2004 through December 31, 2005, the WWTPs have average effluent flows of 4.4 MGD (16.7 MLD) for Mattoon, and 2.6 MGD (9.8 MLD) for Charleston (FG Alliance, 2006a). The average combined effluent of the WWTPs is 7.0 MGD (26.5 MLD).

An analysis of monthly effluent data from these two plants indicated that there were 179 nonconsecutive days over 24 months (2004 and 2005) where the combined daily effluent amount was below 4.3 MGD (16.3 MLD) (FG Alliance 2006a). Supplemental water could be available from the City of Mattoon to augment effluent flows below 4.3 MGD (16.3 MLD). In addition, treated water (including water from any pretreatment) from the power plant could also be used to supplement periods of lower flows. The establishment of an on-site storage reservoir would reduce the need to augment operational flows with water from the City of Mattoon.

Use of treated effluent for process water supply would reduce the amount of wastewater discharged by both WWTPs to area surface water bodies. The estimations of flow apportionment to each WWTP have yet to be determined. This could have a positive impact by reducing water quality impairments, such as temperature and nitrogen. Recognized hydrologically-based design flow methods, such as the 7Q10 flow, are used to estimate stream flows. The 7Q10 is the lowest 7-day average flow that occurs (on average) once every 10 years. The 7Q10 flow measurement above the Mattoon WWTP discharge point on Kickapoo Creek is 0.15 cubic feet per second (96,947 gallons per day [366,985 liters per day]), indicating sufficient upstream water to maintain stream flow even in dry conditions (Patrick Engineering, 2006b). The 7Q10 flow measurement above the Charleston WWTP discharge points on Cassell Creek is 0 cubic feet per second (0 gallons per day [0 liters per day]), indicating the possibility of intermittent flow in dry conditions (Patrick Engineering, 2006b). However, only a small portion of the Charleston WWTP discharge is proposed to be diverted to the proposed power plant for process water. The Mattoon WWTP would likely supply the bulk of the required processed water, with the Charleston WWTP supplying backup process water in times of shortfall. It is unlikely that the entire effluent flow from either WWTP would be diverted.

The Charleston WWTP discharge into Cassell Creek is 0.6 mile (1.0 kilometer) upstream from the confluence of Cassell Creek with the larger Riley Creek (Patrick Engineering, 2006b). The majority of Cassell Creek (7.5 miles [12.1 kilometers]) is upstream of the outfall and the diversion of a portion of the effluent would have minimal impact on Cassell Creek, and even less impact on Riley and Kickapoo Creeks (Patrick Engineering, 2006b). Although the diversion of effluent from Cassell and Kickapoo Creeks would result in lower flow conditions in these water bodies, diverting the effluent discharge would return these creeks to more natural flows and conditions.

The City of Mattoon receives its water supply from Lake Paradise and Lake Mattoon, which are located in the Little Wabash River Basin. The Mattoon WWTP discharges into Kickapoo Creek, which is part of the Embarras River Basin. Use of the WWTP effluent by the proposed power plant would minimize the amount of water that is transferred from the Little Wabash to the Embarras River Basin (Patrick Engineering, 2006b). Sufficient water resources exist to sustain operations of the proposed power plant; therefore, no effects to downstream users are anticipated as a result of operations of the proposed power plant.

During operations, slag and coal piles would be stored on site. Although, the actual configuration has yet to be determined, for the purposes of this analysis, it is presumed that these storage areas would be stored in open air, lined areas. Implementation of BMPs and a stormwater management system would capture the runoff from the coal piles, and direct it to the ZLD system for on-site treatment. Further mitigation could include covering the slag and coal pile areas to prevent contact with precipitation and eliminate stormwater runoff. Minimal effects to downstream surface water resources would be anticipated because the proposed power plant would be a zero emissions facility.

Increases in impervious surfaces would decrease the available surface area to allow infiltration from precipitation. Runoff from the site due to industrial activities would require implementing a stormwater management program to reduce or eliminate any potential surface water quality impacts. The general NPDES permit would include erosion control and pollution prevention requirements. Operating stormwater pollution prevention restrictions and BMPs would be dictated by the NPDES permit.

The proposed sequestration reservoir is located below the proposed power plant and sequestration site. A short pipeline (0.5 mile or less) would connect the plant to the primary and back-up injection wells. Overland tributaries and intermittent flows from the proposed site flow into Whitley Creek in the Kaskaskia River watershed. Whitley Creek to the north, in the Upper Kaskaskia River watershed, and Little Wabash River to the south, in the Little Wabash Watershed, cross the projected sequestration plume.

In surface waters lacking buffering capacity, such as freshwater and stably stratified waterbodies, the pH could be significantly altered by increases in CO_2 (Benson et al., 2002). The persistence and amount of CO_2 being leaked are primary factors which determine the severity of the impacts from increased CO_2 in the soil and surface water (Damen et al., 2003). The risk of a CO_2 leak from the sequestration reservoir is dependent upon the reservoir and other site specific variables, such as the integrity of the well and cap rock and the CO_2 trapping mechanism (Reichle et al., 1999). CO_2 sequestration is maintained via a sealed caprock, which can be compromised via, rapid release of CO_2 through natural events or unplugged wells, or slow leaks of CO_2 through rock fractures and fissures. These are influenced by the characteristics (e.g., porosity) of the caprock material. As discussed in Section 4.4, the potential for CO_2 leakage from the proposed Mattoon Sequestration Reservoir is small, but it could occur. A risk analysis was completed to assess the likelihood of such failures occurring, as discussed in Section 4.17 (Tetra Tech, 2007).

Although the risk of a CO_2 leak is minimal, a CO_2 leak from the pipeline transporting the CO_2 to the injection site can increase concentration of CO_2 in the soil, which would lower the pH and negatively affect the mineral resources in the affected soil (***Damen et al., 2003***). This, in turn would lower the pH of the surface waters in the affected area, potentially resulting in calcium dissolution and altering the concentration of trace elements in the surface water (Damen et al., 2003; Benson et al., 2002). Seepage of sequestered gases from the reservoir would not impact surface water because the solubility of the CO_2 in the gases in water would keep the concentration of CO_2 less than 0.2 percent (Tetra Tech, 2007).

The persistence and amount of CO_2 being leaked are primary factors that determine the severity of the impacts from increased CO_2 in the soil and surface water (Damen et al., 2003). In the unlikely event of a major CO_2 pipeline rupture above a waterbody, the extent of impact would be limited to a minimal and localized decrease in pH of the affected waterbody. A monitoring program would be implemented to detect CO_2 leaks, should they occur. Mitigating actions would be implemented immediately to reduce the likelihood of adverse impacts to surface water bodies.

Utility Corridors

Normal operations of the power transmission corridors and pipelines for the proposed site would not affect surface water resources. Occasional maintenance may require access to buried portions of the utilities; however, BMPs would be used to avoid any indirect impacts (e.g., sedimentation and turbidity) to adjacent surface waters.

Transportation Corridors

Operation of the power plant would use existing transportation corridors, and therefore, would have no impact on surface water resources. Any upgrades to existing corridors would require a separate analysis.

4.8 WETLANDS AND FLOODPLAINS

4.8.1 INTRODUCTION

This section discusses wetlands and floodplains identified in the affected environment that may be affected by the construction and operation of the proposed FutureGen Project at the Mattoon Power Plant and Sequestration Site and related corridors. This section also provides the required floodplain and wetland assessment for compliance with 10 CFR Part 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements," and Executive Orders 11988, "Floodplain Management," and 11990, "Protection of Wetlands (May 24, 1977)."

4.8.1.1 Region of Influence

The ROI for wetlands and floodplains of the proposed Mattoon Power Plant and Sequestration Site includes the proposed power plant and the area within 1 mile (1.6 kilometers) of the boundaries of the proposed power plant and sequestration site, and utility and transportation corridors.

4.8.1.2 Method of Analysis

DOE reviewed research and studies in the Mattoon EIV (FG Alliance, 2006a) to characterize the affected environment. Additionally, DOE received correspondence from the IDNR (IDNR, 2006) that provided site-specific information regarding wetlands and potential mitigation measures (see Appendix A). DOE also conducted site visits in August 2006, which provided additional information related to the affected environment.

DOE assessed the potential for impacts based on whether the proposed FutureGen Project would:

- Cause construction of facilities in, or otherwise impede or redirect flood flows in, the 100- or 500-year floodplain or other flood hazard areas;
- Conflict with applicable flood management plans or ordinances; and
- Cause filling of wetlands or otherwise alter drainage patterns that would affect wetlands.

4.8.2 AFFECTED ENVIRONMENT

4.8.2.1 Wetlands

Executive Order 11990 requires federal agencies to avoid short and long-term impacts to wetlands if no practicable alternative exists. In addition, all tributaries to Waters of the U.S., as well as wetlands contiguous to and adjacent to those tributaries, are subject to federal jurisdiction and potential permitting constraints under Section 404. These resources are ***federally jurisdictional, or regulated by the United States Army Corps of Engineers (USACE)***. To be contiguous or tributary, there must be a continuous surface water connection between the surface water bodies. This surface water connection can be either surface flowing water at regular intervals of time, or a continuum of wetlands between the two areas. Open water features (e.g., upland stock ponds) within the Federal Emergency Management Agency (FEMA) designated 100-year floodplain that have associated emergent vegetation fringe are also jurisdictional Waters of the U.S. Isolated wetlands (those that have no apparent regulatory connection to Section 404 resources) are not jurisdictional unless protected under a bylaw ***discussed below***.

IDNR has the authority to regulate wetlands under the Interagency Wetland Policy Act of 1989 (IWPA) for projects that receive funding or technical assistance from the state. The IWPA defines federal money that passes through a state agency as state funding. Isolated, farmed, and USACE jurisdictional wetlands are state jurisdictional wetlands under the IWPA. IDNR accepts the procedures outlined in the 1987 USACE Wetland Delineation Manual for delineating wetlands. The IWPA requires mitigation for all adverse impacts regardless of the size of the impacted area or the wetland quality.

The local USACE Regulatory Branch makes jurisdictional determinations. Activities such as mechanized land clearing, grading, leveling, ditching, and redistribution of material require a permit from the USACE to discharge dredged or fill material into wetlands. Permit applicants must demonstrate that the activity avoided wetlands and minimized the adverse effects of the project to the extent practicable. Compensation is generally required to mitigate most impacts that are not avoided or minimized.

Specialized Ecological Services conducted wetland delineations for jurisdictional wetlands and Waters of the U.S. during the week of August 19, 2006, using procedures outlined in the 1987 USACE Wetland Delineation Manual (USACE, 1987). A review of generally recognized wetland texts and manuals, field investigations, and online database searches was also performed to support and document wetland presence (FG Alliance, 2006a). Based on the IDNR site survey and a review of available resources, several wetland areas subject to Section 404 and IWPA jurisdiction exist within the proposed Mattoon Power Plant and Sequestration Site and related areas of new construction, particularly the utility corridors. Wetlands encountered during field surveys were listed by size, National Wetlands Inventory (NWI) classification, vegetation community quality, and jurisdiction, and are discussed below. Eight of the 18 wetland areas (1, 6, 7, 11, 12, 13, 16, and 17) in Table 4.8-1 are subject to Section 404 and were reported to the IDNR as newly mapped, meaning they did not appear on any preliminary references consulted, but were identified as jurisdictional wetlands during the field survey (FG Alliance, 2006a). Table 4.8-1 provides several NWI wetland categories and mapped wetlands by type, using the Cowardin et al. classification scheme (Cowardin et al., 1979). Figure 4.8-1 shows the general location of mapped wetlands identified using the Cowardin et al. classification scheme (Cowardin et al., 1979).

Power Plant Site

A small man-made pond (Wetland Area 7) located in the northeast corner of the ROI is the only wetland area subject to jurisdiction on the proposed Mattoon Power Plant and Sequestration Site. The palustrine unconsolidated bottom wetland type occurs in various water regimes from permanently flooded to intermittently flooded, and is characterized by the lack of large stable surfaces for plant and animal attachment. Though shrubby willows and isolated silver maple were present, the wetland is dominated by herbaceous species such as barnyard grass, *Amaranthus* sp., rice cutgrass, and pinkweed.

Sequestration Site

Wetland Area 18 was identified near the site, but not within the ROI. This wetland is included in the analysis due to its size and proximity to the ROI and an adjacent tributary to Whitley Creek. This wetland type is typically characterized by riparian forest habitats dominated by trees greater than 20 feet (6 meters) tall that are regularly inundated by normal high-water flows.

Table 4.8-1. Summary of Delineated Wetlands Within the Proposed Mattoon Power Plant Project ROI

Wetland Areas	Size (acres [hectares])	Class/Cover Type	Vegetation Community Quality[1]	Description	Location
1	0.01 (0.004)	PFO1B	Low	Drainage ditch	Primary process water corridor
2	0.01 (0.004)	PEMA	Low	Drainage channel	Primary process water corridor

Table 4.8-1. Summary of Delineated Wetlands Within the Proposed Mattoon Power Plant Project ROI

Wetland Areas	Size (acres [hectares])	Class/Cover Type	Vegetation Community Quality[1]	Description	Location
3	0.01 (0.004)	PSS1A	Low	Drainage channel	Primary process water corridor
4	0.2 (0.08)	PFO1A	Moderate	Forested floodplain	Primary process water corridor
5	0.01 (0.004)	PFO1F	Moderate	Forested drainageway	Primary process water corridor
6	Less than 0.01 (0.004)	PEMA	Low	Drainage channel	Primary process water corridor
7	0.05 (0.02)	PUB_X	Low	Farm pond	Power plant site
8	0.07 (0.03)	PFO1A	Low	Forested branch of Copperas Creek	Transmission line corridor
9	0.1 (0.04)	PFO1A	Low	Forested branch of Copperas Creek	Transmission line corridor
10	0.1 (0.04)	PFO1A	Low	Main channel of Copperas Creek	Transmission line corridor
11	0.03 (0.01)	PFO1A	Low	Forested periphery of Lake Mattoon	Transmission line corridor
12	4.7 (1.9)	PFO1A	Moderate	Forested floodplain	Transmission line corridor
13	1.8 (0.7)	PFO1A	Moderate	Forested floodplain	Transmission line corridor
14	0.07 (0.03)	PEME	Low	Unnamed tributary to the Little Wabash River	Transmission line corridor
15	0.02 (0.008)	PSSA-PFO1A	Low	Unnamed branch of the Little Wabash	Transmission line corridor
16	22.0 (8.9)	PFO1A	Moderate	Forested floodplain	Transmission line corridor
17	0.06 (0.02)	PSSA-PFO1F	Low	Little Wabash River crossing	Transmission line corridor
18	25 (10)	PFO1A	Moderate	Forested wetland associated with unnamed tributary of Whitley Creek; not within the ROI	Adjacent to power plant and sequestration site

[1] Wetlands quality descriptors have been assigned based on the NWI using the vegetation communities present.
PFO1B = Palustrine Forested, Broad-leaved Deciduous, Saturated; PEMA = Palustrine Emergent, Temporarily Flooded.
PSS1A = Palustrine Scrub-Shrub, Broad-leaved Deciduous, Temporarily Flooded; PFO1A = Palustrine Forested, Broad-leaved Deciduous, Temporarily Flooded; PFO1F = Palustrine Forested, Broad-leaved Deciduous, Semipermanently Flooded.
PUBx = Palustrine Unconsolidated Bottom, Man-made; PEME = Palustrine Emergent, Seasonally Flooded/Saturated.
PSSA = Palustrine Scrub-Shrub, Temporarily Flooded.
Source: FG Alliance, 2006a.

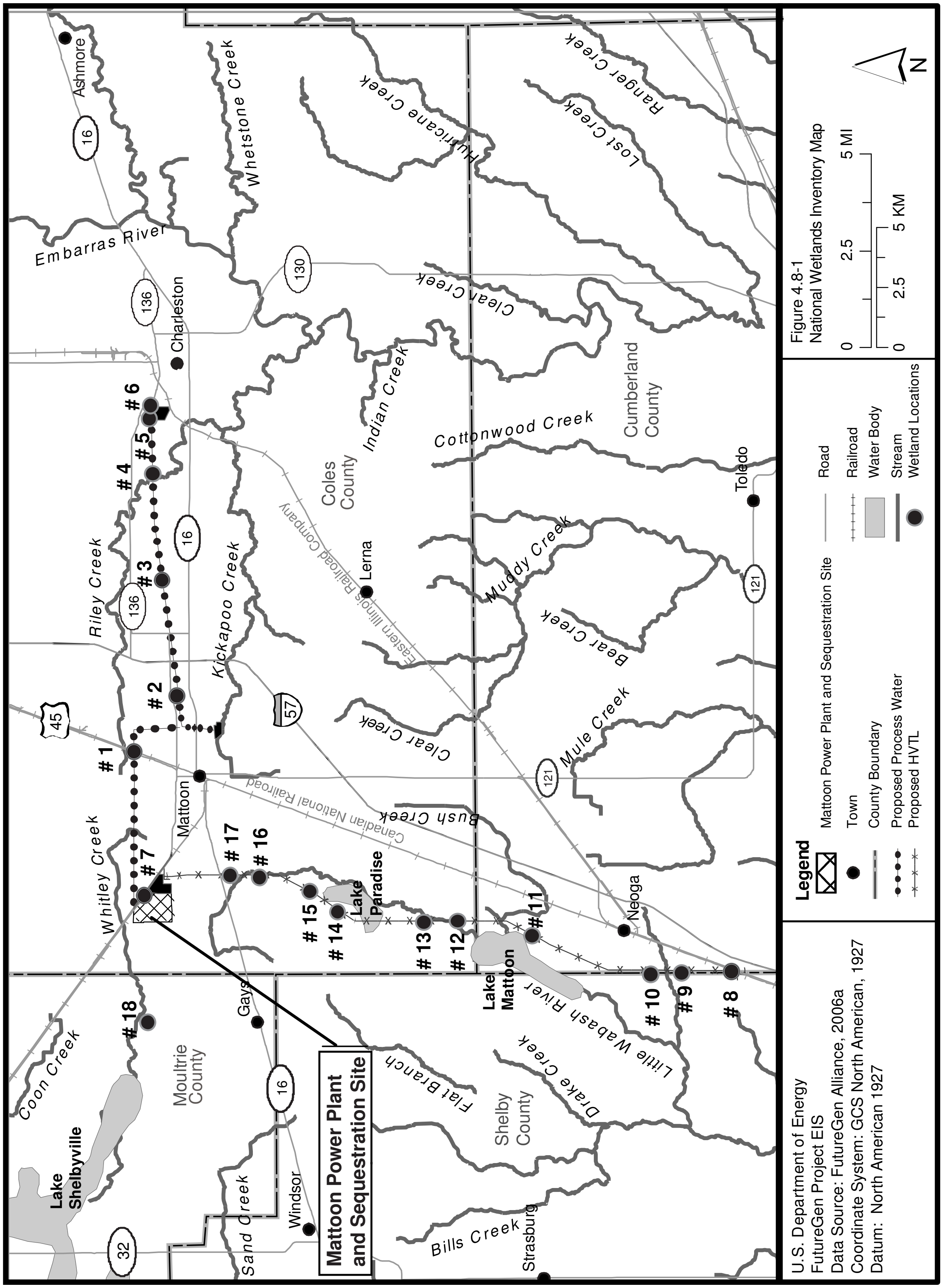

Figure 4.8-1
National Wetlands Inventory Map

Utility Corridors

Field investigations verified the presence of jurisdictional forested floodplains in the 345-kV transmission line corridor. Wetland Areas 1 through 6 were identified along the process water corridor. Wetland Areas 8 through 17 were identified along the transmission line corridor. Four wetland cover types, palustrine forested, palustrine emergent, palustrine unconsolidated bottom, and palustrine scrub-shrub, were identified within the utility corridors. The majority of wetlands encountered throughout the ROI are categorized as palustrine forested wetlands, which are described in the Power Plant and Sequestration Site sections above. The palustrine emergent wetland type includes meadows, marshes, and vegetated ponds. Emergent wetlands are characterized by erect, rooted, and herbaceous hydrophytes that are usually present for most of the growing season. The palustrine scrub-shrub wetland type includes areas dominated by woody vegetation less than 20 feet (6 meters) tall, such as small willows.

Wetlands identified within the utility corridors include forested floodplains and drainage ways associated with numerous creeks and tributaries. Wetland Areas 1 and 4 are associated with Riley Creek and are characterized by tree species such as box elder (*Acer negundo),* green ash *(Fraxinus pennsylvanica),* honey locust (*Gleditsia triacanthos),* red mulberry *(Morus rubra),* American elm (*Ulmus americana),* common hackberry (*Celtis occidentalis*), and black walnut (*Juglans nigra*). Herbaceous vegetation includes Canada clearweed (*Pilea pumila*), great ragweed (*Ambrosia trifida*), marshpepper smartweed (*Polygonum hydropiper),* Virginia wild rye (*Elymus virginicus),* stinging nettle (*Urtica dioica*)*,* small-spike false-nettle (*Boehmeria cylindrical*)*,* and white avens (*Geum canadense*). Recorded sightings of the protected eastern sand darter (*Ammocrypta pellucida*) have occurred near Wetland Area 4 and the nearby Riley Creek Natural Area.

Wetland Area 5 is a forested drainageway associated with Cassell Creek. The dominant species of this forested wetland include black willow (*Salix nigra*), eastern cottonwood (*Populus deltoides*), common hackberry*,* Canada clearweed*,* ivy-leaf morning glory (*Ipomea hederaceae*)*,* Virginia wild rye*,* stinging nettle, and rice cutgrass (*Leerzia orzoides*).

Wetland Areas 8 and 9 are forested branches of Copperas Creek, and Wetland Area 10 is adjacent to the main channel of the creek. The dominant species of these forested wetlands include black willow, green ash, American sycamore, eastern cottonwood, and common hackberry. Herbaceous vegetation includes Virginia wild rye, creeping water primrose (*Jussiaea repens),* Asiatic dayflower (*Commelina communis*)*,* dotted smartweed (*Polygonum punctatum),* marsh muhly (*Muhlenbergia glomerata*), lesser burdock (*Arctium minus*)*,* Canada clearweed, and white snakeroot (*Eupatorium rugosum*).

Wetland Area 11 is located in the forested periphery of Lake Mattoon. Wetland hardwood vegetation at this site is dominated by pin oak (*Quercus palustris),* eastern cottonwood*,* and green ash. Herbaceous vegetation includes Virginia wild rye*,* Frank's sedge (*Carex frankii*)*,* marshpepper smartweed*,* and white avens.

Wetland Areas 12, 13, and 16 are forested floodplains associated with the Little Wabash River. These wetlands are dominated by hardwood vegetation such as American sycamore*,* black willow*,* post oak (*Quercus stellata*)*,* black walnut*,* eastern cottonwood*,* osage orange (*Maclura pomifera),* common hackberry, and green ash*.* Herbaceous vegetation includes dotted smartweed*,* marshpepper smartweed*,* pinkweed (*Polygonum pensylvanicum),* reed canary grass *(Phalaris arundinacea),* barnyard grass (*Echinochloa crusgalli),* Japanese bristle grass (*Setaria faberi),* Canada clearweed*,* poison ivy (*Toxicodendron radicans),* white avens*,* chufa sedge (*Cyperus esculentus*)*,* and rice cutgrass.

Wetland Area 18 is an unconfirmed forested wetland associated with an unnamed tributary of Whitley Creek located west of the proposed Mattoon Power Plant Site. This area is not located within the ROI, but due to its size (25 acres [10 hectares]) and potential hydrological connection to Wetland Area 7 and Whitley Creek, it has been included in this analysis. Based on the NWI and USGS topographic maps, bottomland hardwood vegetation is probably the dominant community type. Typical species observed in similar wetlands of the region include common hackberry, green ash, black walnut, osage orange, white mulberry (*Morus alba),* eastern cottonwood, American elm, and black willow. Herbaceous vegetation observed in similar wetlands includes Asiatic dayflower, chufa sedge, Virginia wild rye, white avens, Canada clearweed, marshpepper smartweed, poison ivy, and stinging nettle.

Wetland Areas 2 and 6 are palustrine emergent drainage channels that flow into Riley and Cassell creeks, respectively. The wetlands are vegetated with prairie cordgrass (*Spartina pectinata),* great ragweed, poison ivy, broad-leaf cattail (*Typha latifolia),* pinkweed, Frank's sedge, and common milkweed (*Asclepias syriaca)*.

Wetland Area 14 is an emergent wetland associated with an unnamed tributary to the Little Wabash River. Though the stream has a closed tree canopy due to adjacent upland forest species, the wetland itself is only vegetated with sparse herbaceous species including stinging nettle, Canada clearweed, and smoother sweetcicely (*Osmorhiza longistylis*).

Wetland Area 3 is a palustrine scrub-shrub drainage channel that flows into Riley Creek and is vegetated with reed canary grass, Frank's sedge, and field bindweed (*Convolvulus arvensis*). Shrubby black willow is also present. Wetland Areas 15 and 17 are palustrine scrub-shrub communities associated with the Little Wabash River and its crossing. The dominant species of this scrub-shrub wetland include black willow, eastern cottonwood, white mulberry, honey locust, American sycamore, black cherry (*Prunus serotina*), and common hackberry. Herbaceous species of the wetland include Virginia wild rye, Canada clearweed, white vervain (*Verbena urticifolia),* coral-berry (*Symphoricarpos orbiculatus*), reed canary grass, poison ivy, and fowl manna grass (*Glyceria striata*).

Transportation Corridors

Because no new transportation corridors are proposed outside of the proposed power plant and sequestration site, this EIS does not provide further description of wetlands. Any potential upgrades to existing transportation corridors are anticipated to occur in existing maintained ROWs.

4.8.2.2 Floodplains

A review of FEMA flood insurance rate maps for unincorporated Coles County, digitized by the ISWS, indicates that the proposed Mattoon Power Plant and Sequestration Site does not lie within a 100- or a 500-year floodplain (Figure 4.8-2) (FEMA, 2006 ***and FG Alliance, 2006a***). The site is located approximately on the divide between the Ohio and Mississippi River basins. Though the sites are not located within the 100- or 500-year floodplains, within the last 7 years, several floods have occurred in the Mattoon region, with one flood causing significant damage. It is expected that a 500-year flood would marginally extend the inundation areas of the transmission and cooling water corridors compared to the 100-year inundation areas.

Two locations along the proposed 345-kV transmission line are located within the 100-year floodplain for the Little Wabash River. Two locations along the proposed wastewater effluent pipeline from Charleston to Mattoon are within the 100-year floodplain for Riley and Cassell creeks.

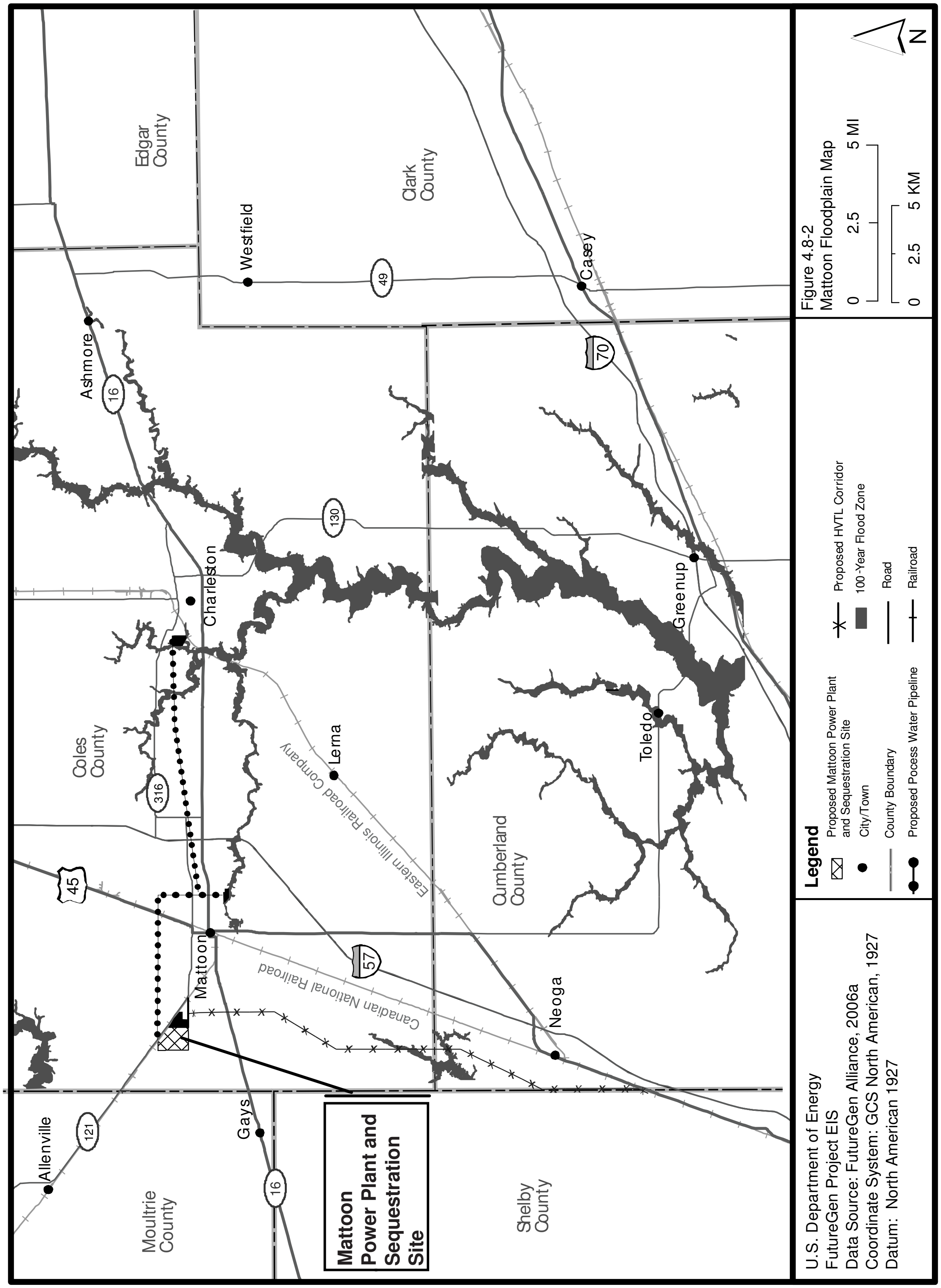

Figure 4.8-2
Mattoon Floodplain Map

4.8.3 IMPACTS

4.8.3.1 Construction Impacts

Direct impacts to wetland habitats would be related to heavy equipment and construction activities, and could include soil disturbance and compaction, dust, vegetation disturbance and removal, root damage, erosion, and introduction and spread of non-native species. The addition of silt, resuspension of sediment, or introduction of pollutants (e.g., fuels and lubricants) related to, and in the immediate vicinity of, construction activities could degrade the quality of native wetlands.

The proposed FutureGen Project could result in some localized, direct, and adverse construction impacts to wetlands. Filling or modifying portions of wetlands, if avoidance is not feasible, would permanently alter hydrologic function and wetland vegetation, and result in direct habitat loss. Potential habitat degradation of wetlands and waters downstream could also occur if flow into adjacent areas is reduced. Construction impacts would be minimized by limiting the areas disturbed and preventing runoff from entering wetlands during construction. Section 404 jurisdiction would also be required for permit approval.

The amount of mitigation required for the proposed power plant site and other project components (e.g., utility corridors) is not known at this time. Ratios have been established by the USACE regarding mitigation. For example, a 2:1 ratio would require 2.0 acres (0.8 hectares) of wetland creation for every acre (0.4 hectare) of wetland loss. Typical mitigation ratios for unavoidable impacts to wetlands would be 1:1 for open water and emergent wetlands, 1.5:1 for shrub wetlands, and up to 2:1 for forested wetlands. The appropriate type and ratio of mitigation would be determined through the Section 404 permitting process. ***Mitigation required by IWPA could be as high as a 5.5:1 ratio, but is unlikely to be any higher than a 4.0:1 ratio. Tables 3-13 and 3-14 in Section 3.4 provide potential mitigation measures and best management practices to avoid, minimize, and offset impacts to wetlands.***

Power Plant and Sequestration Site

The potential area of impact for Wetland Area 7, located within the proposed Mattoon Power Plant Site, is about 0.05 acre (0.02 hectare) and is considered a low quality farm pond. Permanent wetland habitat loss could result from vegetation clearing or filling, although it is likely that this wetland could be avoided during construction of the proposed power plant. If the pond area were to be cleared of vegetation or filled during construction, then the proposed mitigation would be to replace the wetland area at a ratio consistent with USACE and IWPA requirements. Mitigation could be designed to establish emergent wetlands that could satisfy the replacement requirement. No impacts to the 100-year or 500-year floodplain would occur due to the construction of the proposed Mattoon Power Plant.

Wetland Area 18 is not located within the proposed site or the related areas of new construction and, therefore, would not be impacted. If inadvertently impacted due to revisions in final site design and layout, the wetland would be mitigated in-place, in-kind by replacing soil and planting vegetation. Potential impacts to wetlands could be minimized by locating any proposed facilities outside of any identified wetland locations. No impacts to the 100-year or 500-year floodplain would occur due to the construction of the proposed sequestration site.

Utility Corridors

Construction of both the proposed 345-kV transmission line and the process water supply pipelines could affect up to 29.2 acres (11.8 hectares) of wetlands. The majority of wetlands in the transmission line corridor are currently forested wetlands (28.9 acres [11.7 hectares]). During transmission line construction, Wetland Areas 8 through 17 would be altered. Temporary disturbances would result from vegetation removal and subsequent soil compaction for construction equipment access and placement of transmission lines. Transmission line poles would be located outside wetland areas; therefore, no permanent impacts are anticipated.

The effect to wetlands along the transmission line corridor would be minimized by limiting the areas disturbed if, based upon the results of the Midwest Independent System Operator (MISO) study (see Section 4.15), it is determined that existing corridors could be used to parallel or upgrade existing lines. Direct impacts to Wetland Areas 12 and 13 could be reduced from 6.5 acres (2.6 hectares) to approximately 0.3 acre (0.1 hectare), if the proposed transmission line follows the corridor of a nearby gas pipeline. Additionally, by relocating the proposed transmission line corridor to the west, the impacts associated with Wetland Area 16 could be reduced from 22.0 acres (8.9 hectares) to approximately 0.3 acre (0.1 hectare). Impacts would also be minimized if the MISO confirms that connection can take place at existing 138-kV substation 2 miles (3 kilometers) south. No wetlands would be impacted in this scenario. Additionally, impacts to Wetland Areas 2, 3, 4, and 5 could be completely avoided by constructing a larger reservoir on the proposed power plant site to eliminate the need for the Charleston leg of the water supply pipeline. Potential impacts to wetlands located along the transmission line corridor that could not be avoided by use of existing corridors could be mitigated in-place, in-kind by replacing soil and planting appropriate vegetation at a ratio consistent with USACE and IWPA requirements. The permanent conversion of forested wetlands to emergent wetlands would require mitigation at a ratio consistent with federal and state requirements.

The process water supply corridor also uses existing ROWs for much of its length, minimizing the amount of vegetation to be disturbed. Wetland Areas 1 through 6, including a small forested wetland area (0.2 acre [0.8 hectare]), and 0.03 acre (0.01 hectare) of emergent and scrub-shrub wetland types, would be altered during construction. Temporary disturbances would result from construction equipment access and trenching of underground utilities. Any impacts to wetlands located along the primary process water corridor that could not be avoided by use of existing corridors or directional drilling could be mitigated in-place, in-kind by replacing soil and planting appropriate vegetation. Impacts to Wetland Areas 4 and 5 should be avoided due to recorded sightings of the protected eastern sand darter in the vicinity. Riley Creek Natural Area is also a concern with regard to affecting these wetland areas because it may support the eastern sand darter. To minimize potential impacts on the eastern sand darter and the Riley Creek Natural Area, wetlands and waterways should be directionally drilled if they are crossed. A more detailed discussion of the potential impacts to the eastern sand darter can be found in Section 4.9. These impacts could be avoided by choosing to construct a larger reservoir and eliminating pipeline construction.

The process water pipeline construction would be in accordance with the IDNR Office of Water Management's "State Wide Permit #8-Underground Pipelines & Utility Crossings" to reduce impacts to mapped floodplain areas. The locations along the proposed transmission line that cross a mapped 100-year floodplain would be regulated under the IDNR Office of Water Resources, and would be covered under a statewide permit.

Temporarily adding or excavating fill during construction within the floodplain would have no permanent impact on the lateral extent, depth, or duration of flooding in the floodplain areas traversed. Construction within floodplain areas would not result in increases of the 100-year flood elevation by any measurable amount because the floodway is unconstrained and there are no barriers to floodflow passage. This area has experienced several flood events over the last 7 years. The site is located approximately on the divide between the Ohio and Mississippi River basins, which precludes the possibility that the site lies within a 500-year floodplain. A 500-year flood would be expected to marginally extend the inundation areas of the transmission corridor and cooling water corridor compared to the 100-year inundation areas.

Depending upon final design and construction activities, other federal, state, and local authorities may have jurisdiction over dredging, filling, grading, paving, excavating, or drilling in the floodplain that would require permits. The USACE has authority to regulate the discharge of dredged or fill materials into waterways and adjacent wetlands through Section 404. The IEPA provides water quality certification as required by Section 401 of the CWA. Concurrent with its review of the proposed FutureGen Project to determine appropriate National Environmental Policy Act (NEPA) requirements, DOE would also determine the applicability of the floodplain management and wetlands protection requirements contained within 10 CFR Part 1022.

Transportation Corridors

No new transportation corridors are proposed outside of the proposed power plant site footprint. As such, the potential impacts from project construction are discussed under the proposed power plant site. Any unforeseen upgrades or new transportation corridors would require a separate analysis.

4.8.3.2 Operational Impacts

Power Plant and Sequestration Site

Operations at the proposed power plant and sequestration site would have no impact on wetlands or floodplains. All activities associated with the proposed power plant would occur on previously disturbed surfaces outside of wetland and floodplain areas.

Utility Corridors

The proposed transmission line corridor would be maintained without trees to provide maintenance access and safety. Forested wetlands that experienced tree removal during construction of the utilities would be permanently converted to emergent wetlands, and tall-growing vegetation would be cut and maintained at a height low enough to prevent interference with the conductors. No additional wetland conversion would result from operations. The resulting wetland and other vegetation communities in the corridor would be similar to those on other transmission line ROWs in the vicinity. Maintenance would likely be conducted using mechanical (e.g., cutting and mowing) and chemical (e.g., herbicides) means. Applying certain herbicides in proximity to streams and wetlands could be a potentially damaging indirect effect on vegetation and aquatic resources. Following approved herbicide usage instructions, however, would likely reduce this concern. The proposed process water corridor would be allowed to revegetate and there would be no additional impacts to wetlands or floodplains.

Transportation Corridors

Operation of the proposed power plant would use existing transportation corridors and, therefore, would have no impact on wetlands or floodplains. Any upgrades to existing corridors would require a separate analysis.

4.9 BIOLOGICAL RESOURCES

4.9.1 INTRODUCTION

This section discusses both aquatic and terrestrial vegetation and habitat, as well as threatened, endangered, and protected species***, including migratory birds,*** identified in the affected environment that may be impacted by the construction and operation of the proposed FutureGen Project.

4.9.1.1 Region of Influence

The ROI for biological resources is defined as 5 miles (8 kilometers) surrounding the proposed power plant and sequestration site and utility corridors.

4.9.1.2 Method of Analysis

DOE reviewed the results of research and studies compiled in the Mattoon EIV (FG Alliance, 2006a) to characterize the affected environment. This information included data on wetland, aquatic, and threatened and endangered species. In addition, DOE reviewed information on the aquatic resources and potential impacts of process water diversions from Kickapoo and Cassell creeks (Patrick Engineering, 2006). DOE also conducted site visits in August 2006, which provided additional information related to the affected environment.

DOE assessed the potential for impacts based on whether the proposed FutureGen Project would:

- Cause displacement of terrestrial communities or loss of habitat;
- Diminish the value of habitat for wildlife or plants;
- Cause a decline in native wildlife populations;
- Interfere with the movement of native resident or migratory wildlife species;
- Conflict with applicable management plans for wildlife and habitat;
- Cause the introduction of noxious or invasive plant species;
- Alter drainage patterns causing the displacement of fish species;
- Diminish the value of habitat for fish species;
- Cause a decline in native fish populations;
- Interfere with the movement of native resident or migratory fish species;
- Conflict with applicable management plans for aquatic biota and habitat;
- Cause loss of a wetland habitat;
- Cause the introduction of non-native wetland plant species;
- Affect or displace special status species; and
- Cause encroachment on or affect designated critical habitat.

4.9.2 AFFECTED ENVIRONMENT

4.9.2.1 Vegetation

Aquatic

Power Plant and Sequestration Site

Whitley Creek drains the proposed Mattoon Power Plant and Sequestration Site westward into the Kaskaskia River, which flows into the Mississippi River. However, the proposed power plant site has no surface water resources with the exception of a small farm pond in the property's northeast corner. This pond is a human-made impoundment, and surface water was present during field investigation. Although shrubby willows (*Salix interior*) and isolated maple (*Acer saccharinum*) are present along the pond border, the predominant vegetation is herbaceous. Barnyard grass (*Echinochloa crusgalli*), amaranths (*Amaranthus* spp.), rice cutgrass (*Leersia oryzoides*), and Pennsylvania smartweed (*Polygonum pennsylvanicum*) are typical herbaceous species observed along the fringe of the pond. Two types of wetland communities are present within the ROI: emergent waterway and forested waterway/floodplain. Small rivers and farm ponds are also present. These wetland areas are discussed in greater detail in Section 4.8.

The sequestration site is located on the same property as the proposed power plant site; therefore, descriptions of the power plant site also apply to the sequestration site. The sequestration plume does, however, extend beyond the perimeter of the proposed power plant site. The aquatic habitat within this portion of the sequestration plume site is limited to a small section of a tributary to Whitley Creek. No information was available, and neither DOE nor the Site Proponent conducted surveys regarding the presence of in-stream aquatic vegetation. Typical species whose presence is expected along the creek include common hackberry (*Celtis occidentalis*), green ash (*Fraxinus pennsylvanica*), black walnut (*Juglans nigra*), Osage orange (*Maclura pomifera*), white mulberry (*Morus alba*), eastern cottonwood (*Populus deltoides*), American elm (*Ulmus americana*), and black willow (*Salix nigra*). Herbaceous vegetation observed in adjacent wetlands included *Aster* sp., Asiatic dayflower (*Commelina communi*s), yellow nutsedge (*Cyperus esculentus*), Virginia wild rye (*Elymus virginicus*), white avens (*Geum canadense*), clearweed (*Pilea pumila*), marshpepper knotweed (*Polygonum hydropiper*), poison ivy (*Toxicodendron radicans*), and stinging nettle (*Urtica dioica*).

Utility Corridors

Within the proposed project area, the proposed utility corridors contain the most aquatic vegetation. Any drainage from the proposed process water supply corridor flows into Kickapoo Creek and the Embarras River via Riley Creek. The Embarras River flows into the Wabash River, Ohio River, and ultimately the Mississippi River. Riley Creek and its tributaries have zero 7-day, 10-year low flows (7Q10 flows), whereas the Embarras River (nearest its confluence with Kickapoo Creek) and Kickapoo Creek have 4.6 cubic feet (0.13 cubic meters) per second and 2.0 cubic feet (0.06 cubic meters) per second 7Q10 flows, respectively. In the vicinity of the proposed process water supply corridor, Riley Creek is approximately 50 feet (15.2 meters) wide with 5- to 10-foot (1.5- to 3-meter) banks.

The lands within the proposed 345-kV transmission line corridor drain into the Little Wabash, Wabash, Ohio, and Mississippi rivers. The Little Wabash River and its tributaries have zero 7Q10 flows. In the vicinity of the proposed 345-kV transmission line corridor, the Little Wabash River ranges from less than 10 feet (3.0 meters) wide to approximately 30 feet (9.1 meters) wide with 5- to 10-foot (1.5- to 3.0-meter) banks. The proposed 0.25-mile (0.4-kilometer) long natural gas pipeline, 1-mile

(1.6-kilometer) long potable water pipeline, and 1.25-mile (2-kilometer) long wastewater main would be constructed within existing ROWs that do not contain any aquatic habitat.

No information was available, and neither DOE nor the Alliance conducted surveys regarding the presence of in-stream aquatic vegetation. Dominant canopy species adjacent to the creeks and river include white ash (*Fraxinus americanus)*, black walnut, common hackberry, and American elm. Herbaceous vegetation in the area includes clearweed, marshpepper knotweed, Virginia wild rye, stinging nettle, false nettle (*Bohmeria cylindrical)*, and white avens. Riley Creek was clear of vegetation during the site proponent's field work in August 2006. Pasture, residential area, wooded area, and row crops occur in the vicinity of the proposed 345-kV transmission line corridor.

Transportation Corridors

Because no new transportation corridors are proposed outside of the power plant site, this section does not include a description of the affected aquatic environment. Any potential upgrades to existing transportation corridors are anticipated to occur in existing maintained ROWs.

Terrestrial

Power Plant and Sequestration Site

The terrestrial landscape within the proposed project area consists predominantly of agricultural land dedicated to the production of corn and soybean crops. These croplands are typically managed to support single plant species in rotation, and management of the monoculture precludes the establishment of non-agricultural native vegetation. There are areas of woodland near the west edge of the site containing typical upland species such as oak (*Quercus* spp.), hickory (*Carya* spp.), and white ash. Natural terrestrial habitat within the ROI is limited predominantly to the riparian corridors along the Kaskaskia River, Riley Creek, Little Wabash River, and their tributaries, as discussed above.

Utility Corridors

The terrestrial habitat along the proposed corridors for electric transmission, natural gas, potable water, and process water consist predominantly of monotypic stands of row crops. Occasional grassed waterways, constructed to drain water quickly from the cropland, are generally planted with non-native vegetation. The riparian corridor associated with Riley Creek and the Little Wabash River contains some native tree and herbaceous species, as previously discussed, that may provide habitat for a variety of animal species. However, due to the intensive agricultural history of the region, these areas are ecologically degraded. The riparian corridor is limited to a narrow band of non-agricultural vegetation, which can only support a limited number of species. Additional terrestrial areas within the related areas in or near the proposed utility corridors include a golf course and farmsteads with landscaped lawns. No known aquatic plant and animal management plans exist for the project area.

Riparian areas are those located on the banks of a natural course of water (i.e., adjacent to a river or stream).

Transportation Corridors

Because no new transportation corridors are proposed outside of the power plant site, this section does not include a description of the affected terrestrial environment. Any potential upgrades to existing transportation corridors are anticipated to occur in existing maintained ROWs.

4.9.2.2 Habitats

Aquatic

Because no permanent aquatic habitats occur within the proposed power plant site, the site does not contain fish or aquatic invertebrates. Neither DOE nor the site proponent has conducted surveys to identify fish and macroinvertebrates present in any of the streams and rivers that the 345-kV line and process water supply line would potentially cross, nor above the sequestration reservoir. However, typical fish species found in streams and rivers in the area include bluntnose minnow (*Pimephales notatus*), sand shiner (*Notropis ludibundus*), highfin carpsucker (*Carpiodes velifer*), red shiner (*Cyprinella lutrensis*), and striped shiner (*Luxilus chrysocephalus*) (FG Alliance, 2006a). Proposed transmission line configuration and location would not be determined until further study is completed. As such, the exact locations of stream crossings, if any, and therefore descriptions of aquatic habitat in those locations, are unknown at this time. However, general descriptions were included in Section 4.9.2.1.

Terrestrial

The proposed power plant and sequestration site, 345-kV transmission line corridor, and process water supply line corridor are all predominantly monotypic agricultural croplands. As such, with the exception of riparian corridors along Riley Creek and Little Wabash River and their tributaries, wildlife found within the proposed project areas would be limited to common species such as raccoons (*Procyon lodor*), white-tailed deer (*Odocoileus virginianus*), skunks (*Mephitus mephitus*), and various rodents. The riparian corridors contain upland tree species such as white oak (*Quercus alba*), white ash, basswood (*Tillia americana*), honey locust (*Gleditsia triacanthos*), and hickory, with floodplain species such as red maple (*Acer rubrum*), silver maple, and eastern cottonwood in lower areas adjacent to the river.

4.9.2.3 Federally Listed Threatened and Endangered Species

According to the U.S. Fish and Wildlife Service (FWS) (FWS, 2006), the only federally listed species that may occur within the proposed project vicinity is the endangered Indiana bat (*Myotis sodalis*). This species occupies caves and abandoned mines during the winter and uses tree cavities for roosting the remainder of the year. Potential habitat within the project area for the Indiana bat is limited to wooded riparian habitat and the woodland area on the western edge of the proposed sequestration site.

4.9.2.4 Other Protected Species

One state-listed fish species, the threatened eastern sand darter (*Ammocrypta pellucida*) may occur in Riley Creek and its tributary, Cassell Creek, located near the Riley Creek Natural Area and the proposed process water supply line. The proposed process water supply could divert water from the WWTP effluent of the Cities of Charleston and Mattoon, reducing the discharge into Cassell Creek and Kickapoo Creek, respectively. The closest known location of the eastern sand darter is approximately 2.6 miles (4.2 kilometers) downstream of the confluence of Kickapoo Creek and the Embarras River. The eastern sand darter does not normally inhabit this section of Riley Creek because of competition with and predation by other native fish populations; however, a fish kill in 2001 allowed the sand darter to move into the area (Patrick Engineering, 2006).

The state-listed threatened Kirtland's snake (*Clonophis kirtlandii*) has been found 1 mile (1.6 kilometers) from the proposed process water supply line corridor, near the City of Charleston. Kirtland's snake occurs in damp habitats, such as wet meadows and wet prairies, near water bodies.

Because most of the project area is cropland, the only potential habitat occurs within riparian areas along the proposed 345-kV transmission line and process water supply corridors.

Coordination with the FWS and IDNR did not identify any migratory bird populations that could be affected by the project. However, habitat (i.e., wetlands, forest, riparian corridors) for these populations is present. Therefore, a likelihood exists that migratory birds could use habitat within the area as stopovers during migration.

4.9.3 IMPACTS

4.9.3.1 Construction Impacts

Power Plant and Sequestration Site

Placement of fill during construction could directly impact a small farm pond at the proposed power plant and sequestration site. This would result in the loss of aquatic habitats and species; however, this impact would be minimal due to the pond's low-value aquatic habitat. The pond does not provide any habitat for federally or state-listed rare, threatened, or endangered species and similar habitat is plentiful in the project vicinity. ***This pond could provide stopover habitat for migrating waterfowl; however, abundant other ponds and aquatic habitat exist in the region.*** Furthermore, the Alliance could likely avoid this pond during the site layout and planning process. Project construction would not directly impact any other permanent streams or ponds. Standard stormwater management practices for construction activities (e.g., placement of silt fencing around disturbed areas) would prevent indirect impacts, such as sedimentation to off-site surface waters.

Project construction could require the removal of up to 200 acres (81 hectares) of cropland to accommodate the power plant envelope (plant buildings and associated structures). Because this cropland does not provide high-quality wildlife habitat and similar agricultural land is prevalent in the area, effects on wildlife and displacement of terrestrial communities would be minimal. Some small, less mobile species that inhabit the cropland, such as rodents, could be lost during construction; however, these species are plentiful and the loss of a few individuals would not affect the overall population. The proposed power plant site does not contain habitat for any federally or state-listed rare, threatened, or endangered species. Additionally, construction at the proposed power plant site is unlikely to cause a proliferation of noxious weeds because the disturbed area would become an industrial facility with little vegetation.

While construction of the injection wells would alter up to 10 acres (4 hectares) at the sequestration site, this would not alter additional habitat, as the injection wells would be located at the proposed power plant site. Temporary impacts to vegetation would result from truck access during the required seismic surveys of the sequestration site, before injection well construction. Although no known federally or state-listed rare, threatened, or endangered species occur within the proposed power plant and sequestration site, potential habitat for the federally listed Indiana bat occurs in the woodland at the western edge of the sequestration site. The proposed injection well, and any associated habitat disturbance, would be localized and sited away from this area. As such, no potential Indiana bat habitat would be disturbed during construction.

Utility Corridors

Removal of vegetation during construction of the proposed utility corridors could affect riparian habitat by increasing the potential for soil erosion in newly disturbed areas. The potential for this impact would be related to the corridor lengths, the habitat that they traverse, and the type of utility (i.e., aboveground versus belowground). Generally, the use of existing ROWs would reduce the potential for these impacts.

The length of the electric transmission line corridor would vary between 0.5 and 16 miles (0.8 and 25.7 kilometers) for the 138-kV line (Option 1) or 345-kV line (Option 2), respectively. The results of on-going studies by MISO, the regional transmission authority, would determine the selection of electric transmission options. Option 1 would require between 0.5 and 2.5 miles (0.8 and 4.0 kilometers); however, up to 2 miles (3.2 kilometers) would be an existing ROW that has been acquired by the City of Mattoon. Option 2 would require 16 miles (25.7 kilometers) of new line and ROW to connect the power plant with the substation. The vegetation within the corridor would require periodic trimming for corridor maintenance, thereby permanently removing areas of forest within the corridor. Tree cover loss would be minimized by paralleling existing transmission lines, upgrading existing transmission lines, or using existing maintained ROWs. Direct impacts to aquatic communities, including streams and wetlands, would be avoided. Transmission lines would be above ground, limiting earth disturbance and fill activities to the pole locations. Poles supporting the electric transmission lines would also be located outside of sensitive habitats such as streams and wetlands. Indirect impacts, such as increased stream temperatures due to loss of riparian tree canopy, could result from clearing of trees along the stream within the electric transmission line corridor; however, this impact would be considered minimal as the majority of the corridors are located in agricultural areas with limited stream shading.

The proposed process water pipelines would be 6.2 miles (10.0 kilometers) long and 8.1 miles (13.0 kilometers) long to connect to the Mattoon and Charleston WWTPs, respectively. The proposed 8.1-mile (13.0-kilometer) pipeline from the Charleston WWTP to Mattoon would parallel a ROW for the Lincoln Prairie Grass Bike Trail/former railway line. The pipeline would continue on the bike trail ROW into Mattoon. The 6.2-mile (10.0-kilometer) long process water pipeline from the Mattoon WWTP would be on existing public ROW for all but 2 miles (3.2 kilometers), which would require construction in new ROW. These pipelines would be built using standard pipeline construction techniques and directional drilling under sensitive areas such as wetlands, streams, and rivers. In addition, the proposed potable water and sanitary wastewater mains (1 mile [1.6 kilometers] and 1.25 miles [2.0 kilometers], respectively) would be built within existing ROWs. The proposed natural gas pipeline (0.25 mile [0.4 kilometer]) would be built on agricultural land adjacent to the proposed power plant. After construction, the land above the pipelines would be revegetated with native species, maintaining wildlife habitat similar to current conditions and limiting the proliferation of noxious weeds. Overall, due to the small amount of vegetation expected to be disturbed, impacts would be minimal.

Construction activities would temporarily displace wildlife species using these corridors. The use of open cuts to cross Riley Creek and the Riley Creek Natural Area for the proposed process water supply line could affect the state-listed eastern sand darter by causing sedimentation into Riley Creek and its tributary, Cassell Creek. The IDNR recommends that pipelines under Riley Creek and Cassell Creek be directionally drilled to avoid these impacts (IDNR, 2006a).

Although there are no known occurrences of any federally or state-listed rare, threatened, or endangered species within the proposed utility corridors, habitat for both the federally listed Indiana bat and the state-listed Kirtland's snake occurs within the riparian areas of the proposed transmission line and process water supply corridors.

If the Indiana bat is present, the species could be directly impacted through temporary loss of habitat or casualty. Bats typically would inhabit older trees with cavities. Construction during the breeding season (April 1 to September ***30***) would potentially affect the bat by removing trees and disturbing breeding and roosting bats. Construction in these areas outside of the breeding season would not likely affect the Indiana bat. Potential disturbance would be minimized by placing the lines within existing

ROWs, thereby eliminating the need to remove trees. If the proposed Mattoon Power Plant Site was selected, an Indiana bat survey conducted before construction would avoid the loss of bats or preferred habitat.

If Kirtland's snake is present, the species could be directly impacted through temporary loss of habitat or casualty. To minimize potential impacts to Kirtland's snake, IDNR recommends that the following measures would be incorporated into construction plans: (1) construction crews would be educated to identify the snake and relocate any individuals encountered to appropriate off-site habitat; (2) trenches would be backfilled immediately after piping is installed, if possible; (3) if trenches must be left open, they would be covered with plywood or similar material at the end of the day and covered with enough dirt to keep snakes from entering; and (4) trenches that have not been backfilled would be inspected for the snake at the beginning of each day, and an IDNR biologist would be contacted to capture and release any snakes trapped in the open trench. These measures would minimize the potential for impacts to Kirtland's snake. Should Mattoon host the FutureGen Project, consultation with IDNR would ensure that proper protection measures are in place before construction.

Construction of the utility corridors could result in temporary impacts to aquatic habitat utilized by migratory birds. Clearing of forests to accommodate utilities would result in a permanent loss of forested terrestrial habitat utilized by migratory birds. This permanent loss of forested habitat would have a minimal affect on migratory bird species as comparable habitat is available in the overall region. If land clearing were to occur during the nesting season (April 1 – July 31), individual birds could be lost.

Transportation Corridors

No new transportation corridors are proposed; only upgrades to existing roads and new transportation spurs within the proposed power plant footprint. As such, the potential impacts from project construction are discussed under the proposed power plant site. Any unforeseen major upgrades or new transportation corridors would require a separate analysis.

4.9.3.2 Operational Impacts

Power Plant and Sequestration Site

Operating the proposed power plant, injection wells, and utilities would have minimal effect on biological resources. Noise during proposed project operations would be slightly elevated in the absence of mitigation (see Section 4.14). However, wildlife species that are found near the proposed power plant and sequestration site, such as white-tailed deer, skunks, and raccoons, are adapted to the noise found in areas of human development. Air emissions due to routine operation would result in small increases in ground-level pollutant concentrations that should be below levels known to be harmful to wildlife and vegetation or affect ecosystems through bio-uptake and biomagnification in the food chain (see Section 4.2). Because there are no high-quality or sensitive aquatic or wildlife receptors near the proposed power plant and sequestration site, air emissions would not impact biological communities.

A limited number of site characterization seismic surveys would be required during operation of the sequestration site, resulting in temporary impacts to vegetation due to truck access within the survey plots.

Microbes occurring approximately 0.9 mile (1.4 kilometers) under ground within the sequestration reservoir could be affected by sequestration. Microbes are likely to exist in almost every environment, including the proposed sequestration reservoirs, unless conditions prevent their presence. CO_2

sequestration has the potential to destroy these localized microbial communities by altering the pH of the underground environment. However, it is also possible that CO_2 sequestration would not harm microbial communities (IPCC, 2005). The potential loss of localized microbial populations within the sequestration reservoir would not constitute an appreciable difference to the world's total microbial population.

No additional impacts are anticipated during normal operations. Plants ***and animals*** are not predicted to be impacted by gradual CO_2 release from the reservoir, although effects in the immediate vicinity of the injection wells could result from a rapid CO_2 release (see Section 4.17). ***If there were upward migration of the sequestered gas, the H_2S within the gas would diffuse in the subsurface and react with the rock formations, which would minimize or eliminate its release to the atmosphere. Therefore, migration of H_2S into shallow soils at concentrations harmful to burrowing animals and other ecological receptors is not likely.***

Utility Corridors

The proposed transmission line and process water supply corridors would be maintained without trees to provide maintenance access and for safety reasons. Corridor maintenance would likely use both mechanical (e.g., cutting and mowing) and chemical (e.g., herbicides) means. Applying certain herbicides in close proximity to streams and wetlands could be potentially damaging. Following approved herbicide usage instructions would eliminate this concern. The proposed process water, potable water, and wastewater mains, as well as the natural gas pipeline, would be allowed to revegetate once construction is complete; therefore, no impacts would be likely during operations.

If a leak or rupture in the CO_2 pipeline occurred, respiratory effects to biota due to atmospheric CO_2 concentrations would be limited to the immediate vicinity along the pipeline where the rupture or leak occurred. While heat generated from the supercritical fluid in the CO_2 pipeline could potentially affect surface vegetation, pipeline construction techniques that would contain the heat through insulation and installation depth would prevent this impact. Soil gas concentrations vary depending on soil type; therefore, effects on soil invertebrates or plant roots could occur close to the segment of the pipeline that ruptured or leaked (see Section 4.17).

The proposed transmission line could potentially affect raptors and waterfowl located near the line due to collision or electrocution. Designing the line in accordance with current guidelines (APLIC, ***200***6) would minimize the potential for these effects.

Diverting the Mattoon and Charlestown WWTP discharges from Kickapoo and Cassell creeks would reduce the flow in these streams. The effects of diverting these discharges on surface water quality and quantity are discussed in Section 4.7.3. The 7Q10 flow measurements above the discharge points are 0.15 cubic feet (0.004 cubic meters) per second and 0.0 cubic feet (0.0 cubic meters) per second in Kickapoo and Cassell creeks, respectively (Patrick Engineering, 2006). This indicates that, in drier conditions, it is possible that Cassell Creek could be intermittent downstream of the discharge point if all of the Charleston WWTP effluent were diverted. The Charleston WWTP effluent would be the backup process water supply, with only a portion being diverted in times of shortfall from the Mattoon WWTP effluent. As such, it is unlikely that the entire effluent discharge would ever be diverted from Cassell Creek.

The confluence of Cassell Creek with the larger Riley Creek is 0.6 mile (1.0 kilometer) downstream of the discharge location. In the most extreme conditions, 0.6 mile (1.0 kilometer) of Cassell Creek would be dry, adversely affecting aquatic conditions. Because Riley Creek flows are greater than those for Cassell Creek, the impact of the reduced effluent discharge on Riley Creek would be minimal. Diverting the effluent discharge from Kickapoo Creek would also reduce the flow downstream from the discharge point, although the impact on aquatic resources would likely be less extreme than that on Cassell Creek because stream flow would be maintained even in dry conditions. The existing flows in Kickapoo and Cassell creeks just below the discharge points are unknown and, therefore, it is not possible to conduct an analysis to determine the percentage of aquatic habitat that would be affected. It is known that the Kickapoo Creek 7Q10 flow just upstream of its confluence with Riley Creek is 2.0 cubic feet (0.06 cubic meters) per second. This is several miles downstream of the discharge location, so it is unknown how much of this flow is the result of effluent discharge versus tributaries. Although the diversion of effluent from Cassell and Kickapoo creeks would result in lower flow conditions in these streams, diverting the effluent discharge would return these streams to more natural flows, and potentially more natural aquatic conditions.

As discussed previously, the 2001 fish kill allowed the eastern sand darter to populate these sections of Kickapoo and Riley creeks, most likely due to lack of competition. As the ecosystem recovers and fish populations return to previous levels, it is possible that the eastern sand darter would disappear from Riley Creek. Additionally, the nearest known location of the sand darter is approximately 2.6 miles (4.2 kilometers) downstream of the confluence of Kickapoo Creek and the Embarras River. Although diverting the effluent discharges from the Kickapoo and Cassell creeks would reduce the flow downstream, the effects of the reduced flow on aquatic habitat in the larger Kickapoo Creek and Embarras River is expected to be minimal. Because it is unlikely that the eastern sand darter naturally occurs in Cassell Creek, where reduced effluent discharge would have the greatest impact, any impacts to the species would be minimal. IDNR sent a letter to the Illinois Department of Commerce and Economic Opportunity concurring with this determination (IDNR, 2006b) (see Appendix A).

Transportation Corridors

Other than a potential minimal increase in road kill, there would be no impact to biological resources due to increased traffic on existing roads and the new transportation spurs located at the proposed power plant and sequestration site.

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4.10 CULTURAL RESOURCES

4.10.1 INTRODUCTION

Section 106 of the National Historic Preservation Act of 1966 (NHPA) and its implementing regulations at 36 CFR Part 800 (incorporating amendments effective August 5, 2004) require federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings.

Historic properties are a specific category of cultural resources. Cultural resources are any resources of a cultural nature (King, 1998). As defined at 36 CFR 800.16[l][1], a historic property is a cultural resource that is any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the Secretary of the Interior. Historic properties include artifacts, records, and remains related to and located within such properties, as well as properties of traditional religious and cultural importance to Native American tribes or Native Hawaiian organizations, and properties that meet National Register criteria for evaluation (36 CFR 60.4).

> The **National Historic Preservation Act** of 1966 (16 USC 470), establishes a program for the preservation of historic properties throughout the Nation.
>
> The **National Register** criteria for evaluation states that:
>
> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
>
> (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (b) that are associated with the lives of persons significant in our past; or
>
> (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> (d) that have yielded, or may be likely to yield, information important in prehistory or history.

36 CFR Part 800 outlines procedures to comply with NHPA Section 106. At 36 CFR Part 800(a), federal agencies are encouraged to coordinate Section 106 compliance with any steps taken to meet NEPA requirements. Federal agencies are to also coordinate their public participation, review, and analysis to meet the purposes and requirements of both the NEPA and the NHPA in a timely and efficient manner. The Section 106 process has been initiated for this undertaking with the intent of coordinating that process with DOE's obligations under NEPA regarding cultural resources.

For purposes of this document, cultural resources are:

- Archaeological resources, including prehistoric and historic archaeological sites;
- Historic resources, including extant standing structures;
- Native American resources, including Traditional Cultural Properties (TCPs) important to Native American tribes; or
- Other cultural resources, including extant cemeteries and paleontological resources.

Participants in the Section 106 process include an agency official with jurisdiction over the FutureGen Project, the ACHP, consulting parties, and the public. Consulting parties include the State Historic Preservation Officer; Native American tribes and Native Hawaiian organizations; representatives of local government; and applicants for federal assistance, permits, licenses, and other approvals. Additional consulting parties include individuals and organizations with a demonstrated interest in the proposed FutureGen Project due to their legal or economic relation to the undertaking or affected properties, or their concern with the effects of the undertakings on historic properties. In Illinois, the State Historic Preservation Officer is the Director of Historic Preservation within the Illinois Historic Preservation Agency (IHPA).

The NHPA Section 106 process is paralleled by the Illinois Section 707 process. The Section 707 process is embodied in the Illinois State Agency Historic Resources Preservation Act (20 ILCS 3420) governing projects under the direct or indirect jurisdiction of a state agency, or licensed or assisted by a state agency. The Archaeological and Paleontological Resources Protection Act (20 ILCS 3435) applies to all Illinois public lands and contains criminal sanctions for those who disturb burial mounds, human remains, shipwrecks, and other archaeological resources or fossils on public lands. Human burials are afforded additional protection under the Human Skeletal Remains Protection Act (20 ILCS 3440), forbidding disturbance of human skeletal remains and grave markers in unregistered cemeteries, including isolated graves and burial mounds, that are at least 100 years old. Younger graves and registered cemeteries are protected under the Cemetery Protection Act (765 ILCS 835).

The IHPA (20 ILCS 3410) establishes and maintains the Illinois Register of Historic Places that parallels the NRHP. Under the IHPA, a Comprehensive Statewide Historic Preservation Plan prepared in 1995 and updated in 2005 broadly outlines historic preservation in the state.

4.10.1.1 Region of Influence

The ROI for cultural resources includes (1) the proposed power plant and sequestration site and area within 1 mile (1.6 kilometers) of the proposed power plant site boundaries; (2) all related areas of new construction and those within 1 mile (1.6 kilometers) of said areas; and (3) the land area above the proposed sequestration reservoir(s). NHPA Section 106 states the correlate of the ROI is the Area of Potential Effects (APE).

> The **Area of Potential Effects** is the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if such properties exist (36 CFR 800.16[d]).

Adverse effects to archaeological, paleontological, and cemetery resources are generally the result of direct impacts from ground disturbing activities. Therefore, the APE for such resources coincides with those areas where direct impacts from the construction and operation of the proposed facility would occur. Adverse effects to historic resources (i.e., standing structures) may occur through direct impacts that could change the character of a property's use or physical features within a property's setting that contribute to its historic significance. Adverse effects may also occur through indirect impacts that could introduce visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features. For historic resources, the APE encompasses the ROI as defined. TCPs may be subject to both direct and indirect impacts.

4.10.1.2 Method of Analysis

DOE reviewed the results of research and studies performed by the Alliance to determine the potential for impacts based on the following criteria:

- Archaeological Resources – Cause the potential for loss, isolation, or alteration of an archaeological resource eligible for NRHP listing.
- Historic Resources – Cause the potential for loss, isolation, or alteration of the character of a historic site or structure eligible for NRHP listing. Introduce visual, audible, or atmospheric elements that would adversely affect a historic resource eligible for NRHP listing.

- Native American Resources – Cause the potential for loss, isolation, or alteration of Native American resources, including graves, remains, and funerary objects. Introduce visual, audible, or atmospheric elements that would adversely affect the resource's use.
- Other Cultural Resources
    - Paleontological Resources – Cause the potential for loss, isolation, or alteration of a paleontological resource eligible for listing as a National Natural Landmark (NNL).
    - Cemeteries – Cause the potential for loss, isolation, or alteration of a cemetery.

The Alliance conducted archival research to determine whether archaeological and historic resources are known to exist or may exist within the APE/ROI. This research included review of the Illinois Archaeological Survey site files and the IHPA Historic Architectural and Archaeology Resources Geographic Information System (HAARGIS). The Alliance also consulted with personnel at IHPA (FG Alliance, 2006a). A Phase I archaeological survey of the ROI that included supplemental archival research, a pedestrian survey, and shovel testing in areas of the ROI with poor surface visibility was also conducted (Finney, 2006).

To identify Native American tribes that potentially have TCPs within the ROI, the Alliance used the National Park Service (NPS) Native American Consultation Database (FG Alliance, 2006a).

The Alliance used FAUNMAP to determine the potential for paleontological resources in the proposed project area. FAUNMAP is a database of the late Quaternary distribution of mammal species in the U.S., as well as the histories of Coles and Cumberland counties. Though paleontological resources are generally geological in nature rather than cultural, several environmental regulations have been interpreted to include fossils as cultural resources. The Antiquities Act of 1906 refers to historic or prehistoric ruins or any objects of antiquity situated on lands owned or controlled by the U.S. Government, but the term "objects of antiquity" has been interpreted by the NPS, Bureau of Land Management (BLM), U.S. Forest Service (USFS), and other federal agencies to include fossils. An area rich in important fossil specimens can be a NNL as defined in the NPS National Registry of Natural Landmarks (NRNL) (36 CFR 62.2). Paleontological resources are not analyzed under NHPA Section 106 unless they are recovered within culturally related contexts (e.g., fossils included within human burial contexts, a mammoth kill site).

4.10.2 AFFECTED ENVIRONMENT

4.10.2.1 Archaeological Resources

Review of the Illinois Archaeological Survey site files identified 13 previously recorded archaeological sites in the Mattoon/Charleston area (FG Alliance, 2006a), six of which are within the FutureGen Project's ROI. Table 4.10-1 lists the six sites within the project ROI, their cultural or temporal affiliation, and specific ROI within which they are located.

An archaeological survey was conducted of areas that would be subject to direct impact from construction, including the proposed power plant and sequestration site, electrical transmission line corridor south from the plant site to Highway 16, and process water corridor extending from the plant site along the north and east sides of Mattoon (Finney, 2006). The electrical transmission line corridor south of Highway 16 and the process water corridor east to Charleston did not require a survey as the transmission corridor is an existing transmission line that would be upgraded, and the process water corridor is in an existing, disturbed public ROW.

Table 4.10-1. Previously Recorded Archaeological Sites Within ROI

Site Number	Site Type	ROI
RIP-Co-1H	Historic, late 19th – early 20th century	Electrical transmission line corridor
11Co9	Prehistoric, indeterminate age	Process water corridor
11Co122	Historic, late 19th – early 20th century	Process water corridor
11Co129	Prehistoric, Early Archaic	Process water corridor
11Co130	Prehistoric, Early Archaic	Process water corridor
11Co139	Prehistoric Late Archaic and historic late 19th – early 20th century	Process water corridor

Source: FG Alliance, 2006a.

Background research before the survey indicated no previously recorded archaeological sites or isolated finds within the survey area, but three archaeological sites (11Co9, 11Co129, and 11Co130) are within 1 mile (1.6 kilometers) of the survey area (Finney, 2006). The remaining three archaeological sites within the ROI are within the utility corridor ROIs that were not surveyed (FG Alliance, 2006a).

Five isolated finds were identified during the survey, all within the proposed power plant and sequestration site area. The isolated finds include two prehistoric chert flakes and three historic ceramic whiteware fragments (Finney, 2006). No prehistoric or historic archaeological sites were identified by the survey and it was recommended that the project area be cleared from an archaeological perspective (FG Alliance, 2006a). IHPA concurrence has been received and no further investigations are needed (see Appendix A).

4.10.2.2 Historic Resources

The HAARGIS database shows seven historic properties in Mattoon and 10 historic properties in Charleston listed in the NRHP (FG Alliance, 2006a). Three of those 17 properties are within the project ROI. The Briggs and Alexander House located in downtown Charleston is within the ROI for the process water corridor. In Mattoon, the U.S. Post Office and a nine-block section of Brick Street that follows Oklahoma Avenue and 15th Street are within the ROI for the process water corridor.

4.10.2.3 Native American Resources

No publicly documented TCPs are known to exist within the ROI for the proposed power plant site, related areas of new construction, or in the land above the sequestration reservoir. DOE initiated consultation with federally recognized Native American tribes that may have an interest in the project area on December 6, 2006 (see Appendix A). The following tribes received consultation letters:

- Kickapoo Tribe of Kansas
- Kickapoo Tribe of Oklahoma
- Miami Tribe of Oklahoma
- Prairie Band of the Potawatomi Nation
- Peoria Tribe of Indians of Oklahoma

Regional Directors for the Bureau of Indian Affairs in the Southern Plains and Eastern Oklahoma Regions also received copies of the consultation letter. The Bureau of Indian Affairs South Plains and Eastern Oklahoma Regional offices both responded that they do not have jurisdiction over the alternative sites in Illinois (see Appendix A). The Eastern Oklahoma Regional Office has provided notice of the FutureGen Project to the Bureau of Indian Affairs Eastern Region Office, which does have jurisdiction. A response has not yet been received. To date, no Native American tribes have responded.

4.10.2.4 Other Cultural Resources

There are no registered cemeteries and no known paleontological resources within the project ROI.

4.10.3 IMPACTS

4.10.3.1 Construction Impacts

Construction impacts to cultural resources would primarily be direct and result in earth-moving activities that could destroy some or all of a resource. There are no known cultural resources in areas where earth moving would take place. Therefore, no direct or indirect impacts would occur on known cultural resources. The potential for the discovery or disturbance of an unknown cultural resource exists, particularly in areas where there has been no prior land disturbance. Although consultation with Native American tribes has not revealed the presence of TCPs in areas where disturbance could take place, this consultation is ongoing (see Appendix A) and the presence of these resources remains somewhat uncertain. However, before construction, previously unsurveyed areas with a potential for the cultural resources would be surveyed. Potential impacts to cultural resources discovered during construction would be mitigated through avoidance or through other measures, including those identified through consultation with the IHPA or the respective Native American tribes.

Power Plant Site

There are no known cultural resources in areas that would be disturbed by construction at the proposed power plant site. Therefore, no direct or indirect impacts would occur on known cultural resources. On January 30, 2007, IHPA concurrence was received stating that no significant historic, architectural, and archaeological resources are located in the proposed project area (see Appendix A).

Sequestration Site

Because the proposed sequestration site is co-located on the proposed power plant site, potential impacts would be the same as described for the power plant site.

Utility Corridors

There are no known cultural resources within the electrical transmission line corridor south from the proposed power plant site to Highway 16 and the process water corridor along the north and east sides of Mattoon. Therefore, no direct or indirect impacts would occur on known cultural resources. Corridor construction in new or previously undisturbed ROW would have a higher potential for impacting undocumented cultural resources. IHPA concurrence stated no further investigations are needed (see Appendix A).

Transportation Corridors

Because improvements to CH 13 have not yet been designed, potential impacts to cultural resources are unknown. However, if improvements take place within previously disturbed ROW, there would be no anticipated direct or indirect impacts to cultural resources. There would be a potential for affecting cultural resources if construction takes place outside of previously disturbed ROW. The IHPA would need to be consulted regarding the need for cultural resource investigations before improvements construction.

Because the rail spur is co-located on the proposed power plant site, potential impacts would be the same as described for the power plant site.

4.10.3.2 Operational Impacts

The potential for impacts to cultural resources related to the proposed FutureGen Project operations would be limited to indirect impacts that could alter the historic character of a resource or its setting. There is minimal potential for direct impacts (e.g., a historic façade becoming coated with dust or ash) as a result of operations. Because there are no known cultural resources in areas where the proposed FutureGen Project operations would take place, no direct or indirect impacts are anticipated. The U.S. Post Office and Brick Street in Mattoon, as well as the Briggs and Alexander House in Charleston, are outside of the ROI for the power plant and no indirect impacts would be expected to those historic resources.

4.11 LAND USE

4.11.1 INTRODUCTION

This section identifies land uses that may be affected by the construction and operation of the proposed FutureGen Project at the Mattoon Power Plant and Sequestration Site, and related corridors. It addresses the existing land use environment as well as potential effects on land uses and land ownership, relevant local and regional land use plans and zoning, airspace, public access and recreation sites, identified contaminated sites, and prime farmland. It also addresses potential effects related to subsurface rights for the land area above the proposed Mattoon Sequestration Reservoir.

4.11.1.1 Region of Influence

The ROI for land use includes the area within 1 mile (1.6 kilometers) of the boundary of the proposed Mattoon Power Plant and Sequestration Site and of all related areas of new construction (i.e., utility and transportation corridors). The CO_2 injection wells would be located within the power plant site boundary, although the plume footprint would extend beyond the site boundary.

4.11.1.2 Method of Analysis

DOE reviewed information provided in the Mattoon EIV (FG Alliance, 2006a) and relevant land use data, including the Coles County Comprehensive Plan (Coles County, 2006), City of Mattoon Zoning Ordinance (Ordinance No. 96-4835), Federal Aviation Administration (FAA) regulations, and various databases related to contaminated sites. DOE also reviewed aerial photographs and made site visits to note site-specific land use characteristics.

DOE assessed the potential impacts based on whether the proposed FutureGen Project would:

- Introduce structures and uses that are incompatible with land uses on adjacent and nearby properties;
- Introduce structures or operations that require restrictions on current land uses on or adjacent to a proposed site;
- Conflict with a jurisdictional zoning ordinance; and
- Conflict with a local or regional land use plan or policy.

4.11.2 AFFECTED ENVIRONMENT

The proposed Mattoon Power Plant and Sequestration Site consists of a 444-acre (180-hectare) parcel of land located in Mattoon Township, Coles County, Illinois. It is situated 1 mile (1.6 kilometers) west and outside of the Mattoon city limits. It is located 180 miles (290 kilometers) south of Chicago; 115 miles (185 kilometers) west of Indianapolis, Indiana; and 130 miles (209 kilometers) northwest of St. Louis, Missouri. The proposed plant site and area within 1 mile (1.6 kilometers) are relatively flat and consist of primarily farm crops and a small percentage of public rights-of-way (ROWs), rural residential development, and woodlands. The proposed plant site and lands within 1 mile (1.6 kilometers) are privately owned, excluding areas of public ROWs. The entire site is currently used for agricultural row crops.

According to the 2000 U.S. Census, Coles County had a population of 53,196 in 2000, and the City of Mattoon had a population of 18,291 (Coles County, 2006). Coles County includes 325,760 acres (131,830.4 hectares) of land, of which 93 percent is designated as farm land (Coles County, 2006).

4.11.2.1 Local and Regional Land Use Plans

The City of Mattoon does not have a current comprehensive plan, but does have current land use mapping available with its City of Mattoon Zoning Ordinance (see Section 4.11.2.2).

The Coles County Regional Planning and Development Commission has an approved Comprehensive Plan and land use map dated November 14, 2006. This plan includes County development recommendations with respect to issues such as farmland preservation, transportation, and utilities. The proposed Mattoon Power Plant Site falls within the Coles County Enterprise Zone, which was established to identify and prepare suitable sites for potential economic development (Coles County, 2006). Figure 4.11-1 depicts the Coles County Future Land Use Map (Coles County, 2006).

The City of Charleston, located approximately 5 miles (8 kilometers) east of Mattoon, has a Comprehensive Plan that was adopted December 7, 1999. This plan was developed to serve as a decision-making tool for long-range planning, setting recommended guidelines, and improving communications**.** This plan enables the city to explore and provide guidance for issues currently facing Charleston, such as economic development, planning/land use issues, housing, historic preservation issues, transportation (circulation and access), infrastructure and facilities, parks and recreation, and aesthetics and beautification (City of Charleston, 1999).

Part of the proposed process water pipeline would originate at the Charleston WWTP, which is located just within the city limits in a designated industrial district. However, once the process water pipeline corridor leaves the City of Charleston property at the Charleston WWTP, it crosses out of the Charleston city limits.

The southern 6.5 miles (10.5 kilometers) of one of the electrical transmission line options extends into Cumberland and Shelby counties. Those counties do not have comprehensive plans.

4.11.2.2 Zoning

The City of Mattoon Zoning Ordinance is intended to ensure orderly growth in the developed and underdeveloped areas of Mattoon, including residential, business, commercial, industrial, agricultural, and complementary developments. The City of Mattoon's zoning jurisdiction includes a 1.5-mile (2.4-kilometer) "extra-territorial" area past the city limits (Ordinance No. 96-4835). The city has the discretion to enforce its zoning ordinances within the extra-territorial area (see Figure 4.11-1). ***On May 15, 2007, the city rezoned the portion of the proposed FutureGen site that lies within the 1.5-mile (2.4-kilometer) extra-territorial area from the existing rural-suburban use to industrial use.*** Most of the proposed utility corridors are located within Coles County and the City of Mattoon. A portion of the proposed process water supply would come from the Charleston WWTP, and a pipeline would be located on City of Charleston property from the Charleston WWTP to the ROW of the Lincoln Prairie Grass Bike Trail (see Section 4.11.2.4). The City of Charleston has a Unified Development Code that contains its zoning ordinance. As mentioned above, the area around the Charleston WWTP is zoned as an industrial district and once the process water pipeline corridor leaves the City of Charleston property at the Charleston WWTP, it continues beyond the Charleston city limits.

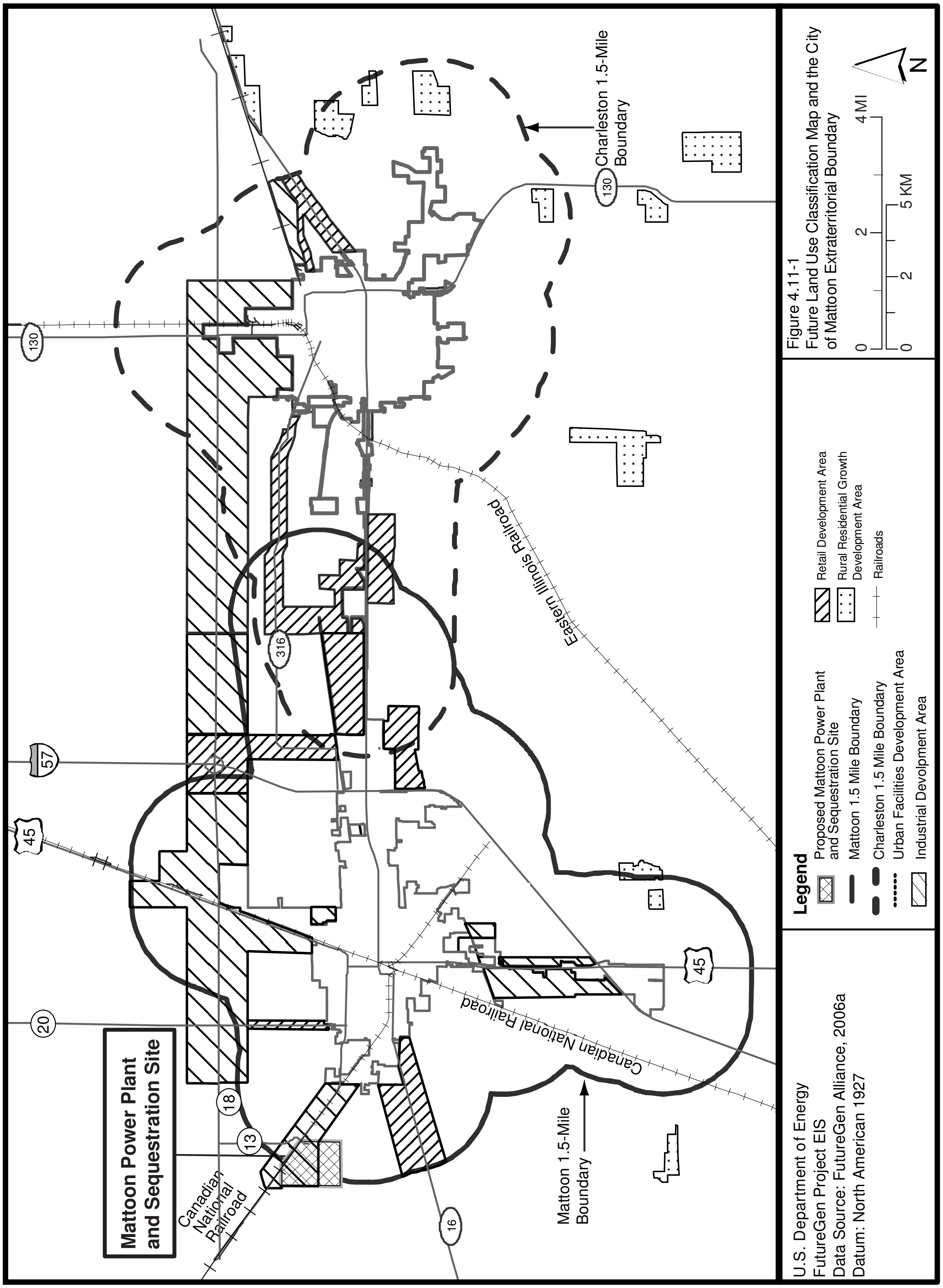

Figure 4.11-1
Future Land Use Classification Map and the City of Mattoon Extraterritorial Boundary

4.11.2.3 Airspace

The Coles County Memorial Airport is approximately 8 miles (13 kilometers) east of the proposed plant site and approximately 0.3 mile (1.1 kilometers) south of the process water pipeline corridor, the closest proposed project feature. Because the proposed project would include a 250-foot (76-meter) heat recovery steam generator stack and 250-foot (76-meter) flare stack, DOE reviewed FAA regulations to determine their applicability to the project. In administering 14 CFR Part 77—Objects Affecting Navigable Airspace—the prime objectives of FAA are to promote air safety and the efficient use of the navigable airspace. Pursuant to 14 CFR Part 77, the FAA must be notified if any of the following construction or alteration is being examined:

(1) Any construction or alteration of more than 200 feet (61 meters) in height above the ground level at its site.
(2) Any construction or alteration of greater height than an imaginary surface extending outward and upward at one of the following slopes:
    (i) 100 to 1 for a horizontal distance of 20,000 feet (6,096 meters) from the nearest point of the nearest runway of each airport specified in paragraph (a)(5) of this section with at least one runway more than 3,200 feet (975 meters) in actual length, excluding heliports.
    (ii) 50 to 1 for a horizontal distance of 10,000 feet (3,048 meters) from the nearest point of the nearest runway of each airport specified in paragraph (a)(5) of this section with its longest runway no more than 3,200 feet (975 meters) in actual length, excluding heliports (14 CFR Part 77).

4.11.2.4 Public Access Areas and Recreation

Wolf Creek State Park is the closest public access area to the proposed Mattoon Power Plant Site, at a distance of approximately 11.7 miles (18.8 kilometers). Lake Shelbyville, operated by the USACE as a flood control project on the Kaskaskia River, is located approximately 8 miles (12.9 kilometers) west of the proposed site. The lake provides camping, hiking trails, boating access, and picnicking facilities.

Lake Mattoon is located approximately 6 miles (10 kilometers) south of the City of Mattoon and approximately 7 miles (11 kilometers) south of the proposed Mattoon Power Plant Site. Owned by the City of Mattoon, Lake Mattoon is located in Coles, Shelby, and Cumberland counties. Its primary use is supplying water to the City of Mattoon. The lake has a maximum depth of 35 feet (11 meters), an average depth of 10.5 feet (3.2 meters), and a surface area of 1,050 acres (425 hectares). The City of Mattoon owns approximately 53 percent of the 55.5-mile (89.3-kilometer) shoreline, along with 348.5 acres (141.0 hectares) of surrounding property. Lake Mattoon is fed by the Little Wabash River and is a popular recreation spot for boating, fishing, and camping. Approximately 1,042 boat permits are issued every year (City of Mattoon, 2006).

Lake Paradise is located approximately 3 miles (5 kilometers) south of the City of Mattoon and approximately 4 miles (6 kilometers) south of the proposed Mattoon Power Plant Site. Owned by the City of Mattoon, Lake Paradise is the City of Mattoon's primary source of drinking water, and in an average year the City pumps 800 million gallons (3,028 million liters) of water out of Lake Paradise into the water system. Lake Paradise is zoned as a no wake and no swimming area. There is no limit on motor size, and the lake has been known for its bass and crappie fishing (City of Mattoon, 2006).

The Charleston WWTP portion of the proposed process water line for the project would parallel a ROW for the Lincoln Prairie Grass Bike Trail, which is located on a former railway ROW. The paved bike trail, owned by the cities of Charleston and Mattoon, is 12.6 miles (20.3 kilometers) long. The ROW is 100 feet (30 meters) wide, and the bike trail surface is 10 feet (3 meters) wide (FG Alliance, 2006a).

4.11.2.5 Contaminated Sites

DOE's review of the IEPA databases (IEPA, 2006) for the proposed Mattoon Power Plant Site indicates that it is not associated with cleanup under regulations related to voluntary site remediation program units, leaking underground storage tanks, the Resource Conservation and Recovery Act, permitted activities, or solid waste landfills.

DOE's review of the CERCLIS Database for Coles County, Illinois, revealed one site, The Young Radiator Company (U.S. Environmental Protection Agency (EPA) ID ILD005078571) located in the City of Mattoon approximately 3.5 miles (5.6 kilometers) east of the proposed site. The site is not on the National Priorities List (EPA, 2006).

> The Comprehensive Environmental Response, Compensation and Liability Information System (**CERCLIS**) Database contains general information on sites across the nation and U.S. territories, including location, contaminants, and cleanup actions taken (CERCLIS, 2006).

4.11.2.6 Land Ownership and Uses

Power Plant and Sequestration Site

The proposed Mattoon Power Plant Site includes several parcels of land that are currently under purchase options (FG Alliance, 2006a). The site is predominantly in agricultural use. The land uses surrounding the proposed Mattoon Power Plant Site within 1 mile (1.6 kilometers) include primarily agricultural use, two residences adjacent to the site on the north and east sides, two additional residences within 0.25-mile (0.4-kilometer), about 20 additional residences between 0.25-mile (0.4-kilometer) and 1 mile (1.6 kilometers) from the site, and one small commercial entity (antiques dealer) (see Figure 4.11-2).

The City of Mattoon and Coles County have both agreed to provide access to all municipally and county-owned property and ROWs needed for the proposed plant. Mineral rights for the site are intact and would be conveyed with the property (see Section 4.4 for more discussion concerning mineral rights). The proposed Mattoon Power Plant Site is adjacent to the Mattoon city limits, which allows for annexation and timely extension of municipal utilities under municipal authority included in the Illinois Compiled Statutes. Police and fire protection, as well as a full range of other emergency services, also would be provided upon annexation by the City of Mattoon (FG Alliance, 2006a).

Agriculture is the predominant use of land within 1 mile (1.6 kilometers) of the proposed Mattoon Power Plant Site. Approximately 3,735 acres (1,512 hectares) (in excess of 93 percent of the land) are used for farming or farm-related activities (farm outbuildings or pastures). As noted above, there are approximately 24 single-family residences in the 1-mile (1.6-kilometer) radius. The closest residential development to the proposed Mattoon Power Plant Site is located off Western Avenue approximately 1 mile (1.6 kilometers) southeast of the site. There are no hospitals, schools, or nursing residences within 1 mile (1.6 kilometers) of the proposed Mattoon Power Plant and Sequestration Site, although Riddle Elementary School is just beyond the 1-mile (1.6-kilometer) radius.

Mineral rights of the 444-acre (180 hectares) Mattoon Site are intact and would be conveyed if chosen as the host site (FG Site Proposal [Mattoon, Illinois, 2006]).

Utility Corridors

Potable water from the City of Mattoon public potable water system would serve the proposed Mattoon Power Plant Site. The proposed 1-mile (1.6-kilometer) pipeline would be placed on the public ROW of CR 800N.

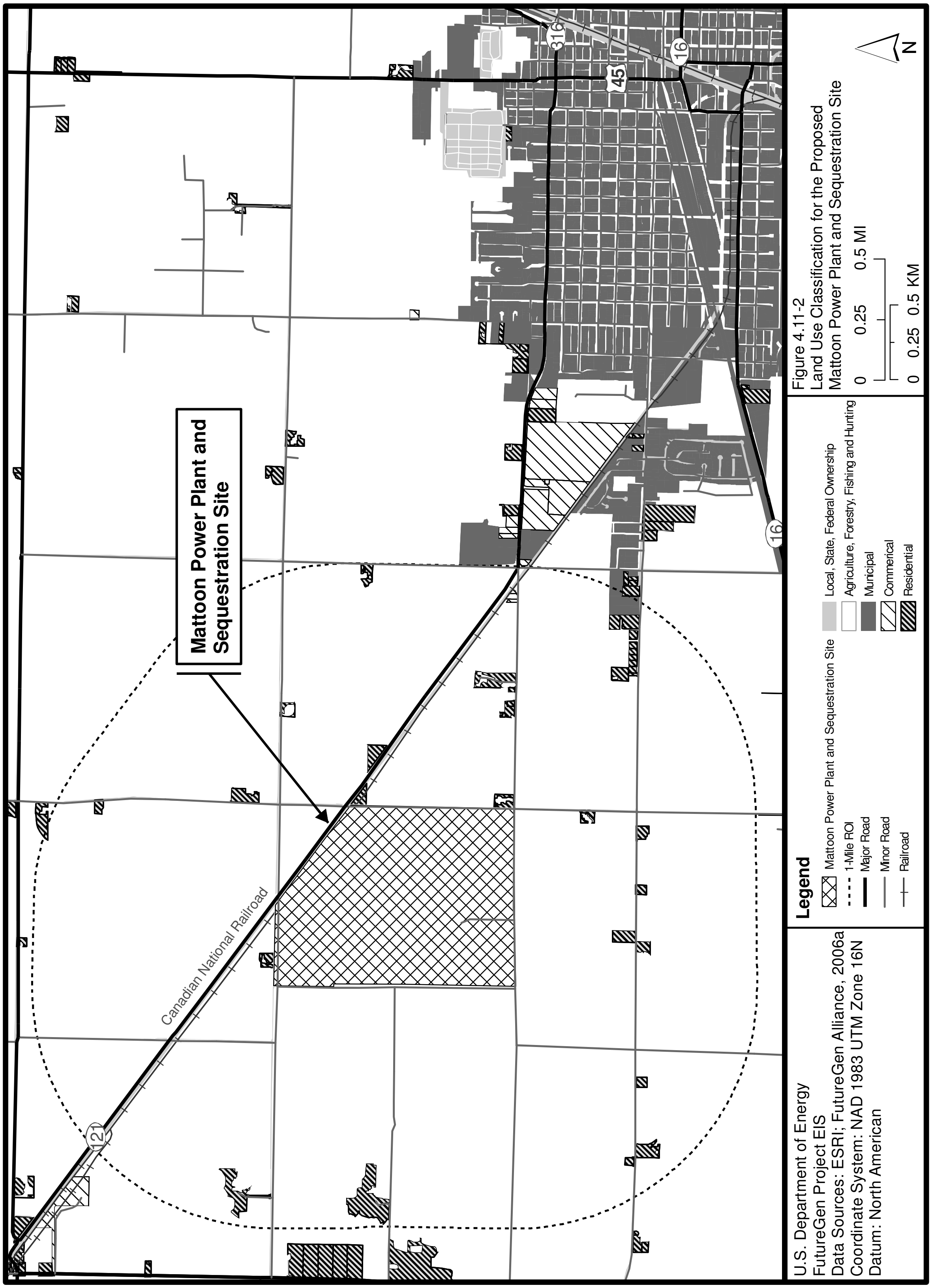

Figure 4.11-2
Land Use Classification for the Proposed
Mattoon Power Plant and Sequestration Site

The City of Mattoon proposes to supply sanitary sewer service through an extension of the City's existing public wastewater system. A 1.25-mile (2.0-kilometer) wastewater force main would be constructed in the ROW of SR 121 from the proposed Mattoon Power Plant Site to an existing sanitary lift station in the northeast quadrant of SR 121 and 43rd Street (County Road 300E). SR 121 has an existing ROW width of 100 feet (30 meters). IDOT has control of the ROW and has committed to allowing the wastewater force main to be placed on the ROW (FG Alliance, 2006a). The Riddle Elementary School on Western Avenue is just over 1 mile (1.6 kilometers) southeast of the proposed power plant site and about 0.5 mile (0.8 kilometer) from the point where proposed potable water and sanitary sewer lines would tie into existing corridors.

The proposed corridors for the process water supply lines would run from the Charleston and Mattoon WWTPs to the proposed Mattoon Power Plant Site and the corridors would total 14.3 miles (23.0 kilometers). The proposed 8.1-mile (13.0-kilometer) line from Charleston to Mattoon would parallel the ROW for the Lincoln Prairie Grass Bike Trail, which follows a former railway ROW. The process water line would continue on the bike trail ROW into Mattoon. The bike trail ROW is 100 feet (30 meters) wide, while the bike trail surface is 10 feet (3 meters) wide. The bike trail ROW has existing 138-kV overhead electric lines running its entire length. Buried fiber optic cable is also in the ROW. On the east side of I-57, the proposed Charleston corridor is within 1 mile (1.6 kilometers) of the Charleston Country Club, and Sarah Bush Health Center. West of I-57, the corridor is within 1 mile (1.6 kilometers) of Peterson Park (FG Alliance, 2006a).

The 6.2-mile-long (10-kilometer-long) process water pipeline from the Mattoon WWTP would be on existing public ROW for all but 2 miles (3.2 kilometers). The existing public ROW varies in width. As the line heads north out of the Mattoon WWTP, the corridor is an existing utility easement that is at least 30 feet (9 meters) wide. The corridor then follows the Mattoon Street ROW through the town to the northern edge of Mattoon. The street ROW is a minimum of 70 feet (20 meters) wide. North ***and west*** of the Mattoon city limits, the corridor lies on private property for ***5.5*** miles (***8.9*** kilometers). Three property owners own the ***first*** 2 miles (3.2 kilometers) of ROW, which would require new easements in an area that appears to be primarily farm land. For the last 3.5 miles (5.6 kilometers) of the corridor, the pipeline would be placed on the public ROW of CR 900N. ***The ROW is proscribed rather than dedicated, and therefore, new easements would be required from the current land owner. Option contracts have been secured to purchase two of the three necessary easements from the property owners in the first 2 miles (3.2 kilometers). Negotiations continue for the remaining easements.*** The proposed Mattoon process water corridor is within 1 mile (1.6 kilometers) of two nursing residences and three schools near the Mattoon WWTP (FG Alliance, 2006a).

There is access to a natural gas pipeline owned by Trunkline Gas Company less than 0.25 mile (0.4 kilometer) from the proposed Mattoon Power Plant Site. The Trunkline Gas mainline is located approximately 1,325 feet (403 meters) east of the site, between the site and the City of Mattoon. An option has been secured for additional land adjacent to the proposed pipeline ROW, which is currently primarily farmland (FG Alliance, 2006a). Construction of the proposed natural gas pipeline would include horizontal directional drilling to run the natural gas pipeline under CR 13.

An existing 138-kV transmission line lies 0.5 mile (0.8 kilometer) east of the proposed site. If this existing line is used, the corridor would run from the proposed Mattoon Power Plant Site over the additional optioned farmland to the existing 138-kV line corridor.

The optional corridor for a 345-kV transmission line, if required, runs 16 miles (26 kilometers) south from the proposed Mattoon Power Plant Site to the Neoga substation. The corridor is parallel to an existing 138-kV transmission line through a primarily agricultural area. The proposed transmission line would cross Lake Mattoon and the Little Wabash River. The southern 6.5 miles (10.5 kilometers) of the proposed electric utility corridor's ROI is in Cumberland and Shelby counties. Those counties do not have current land use mapping available, although the land use characteristics are substantially similar to Coles County land uses.

4.11.2.7 Prime Farmland

> The U.S. Department of Agriculture (**USDA**) Natural Resource Conservation Service's (**NRCS**) website defines prime farmland as land that has the best combination of physical characteristics for producing food, feed, forage, and oilseed crops and is available for these uses (NRCS, 2000).

Illinois had 20,894,000 acres (8,455,502 hectares) of soils classified as prime farmland in 1997. About 18,679,800 (7,559,447 hectares) (89.4 percent) of this land area was used as cropland. The remaining amount was used for pastureland, forestland, Conservation Reserve Program (CRP) land, and other rural land. Between 1982 and 1997, 409,500 acres (165,719 hectares) of prime farmland were lost (approximately 27,060 acres [10,951 hectares] per year) (NRCS, 2000).

The Farmland Protection Policy Act (FPPA) of 1981 directs all federal agencies to evaluate their programs and projects, and to modify their actions so as to produce the least impact on farmland. The FPPA also seeks to ensure that federal programs are administered in a manner that, to the extent practicable, will be compatible with state and local government goals, as well as private programs and policies, to protect farmland. The Illinois Department of Agriculture (ILDOA) reviews programs, projects, and activities of federal agencies for compliance with the Farmland Preservation Act (state law) and the FPPA. The review is a systematic procedure to assist in determining which proposed governmental action would incur the least harm to the agricultural environment. ILDOA established the Land Evaluation and Site Assessment (LESA) system as a tool to use in making such evaluations. The NRCS also uses the LESA system to evaluate the viability of farmland proposed for non-agricultural use by a federally-sponsored project (ILDOA, 2001).

On the 444-acre (180-hectare) proposed Mattoon Power Plant and Sequestration Site, 427 acres (172 hectares) have been identified as prime farmland and unique farmland that is currently producing major crops of corn, soybean, wheat, and hay. According to the LESA scale, the total relative value of the site's farmland was assigned 98 points out of 100 possible points. The total site assessment was assigned 157 points out of a possible 200 points, totaling 255 LESA points out of a possible 300 (FG Alliance, 2006a). Within the proposed utility corridors, several of the soil types have been identified as prime farmland or would be prime farmland if drained. DOE did not conduct a formal farmland conversion impact rating for utility corridors because they are on existing utility ROWs or because they would not result in conversion of significant areas of soil to non-agricultural uses. Since the pipelines would be buried and the electrical transmission lines would be elevated, agricultural use of the land could continue following construction on any new ROWs.

4.11.3 IMPACTS

4.11.3.1 Construction Impacts

Power Plant Site

The 444-acre (180-hectare) proposed Mattoon Power Plant Site and area within 1 mile (1.6 kilometers) consists of 93 percent farm crops and 3 percent public ROW, with the remaining percentage being rural residential. The proposed project would require a laydown area for construction equipment and materials and would require construction of a power plant, rail loop, parking area, coal storage site, visitor center, process pond, research and development center, and injection well for carbon sequestration. Project construction would have a major, long-term impact on the current mainly agricultural land use of the 444-acre (180-hectare) parcel. Up to 200 acres (81 hectares) would be disturbed during construction. More than half of the parcel (that is, the remaining 244 acres [99 hectares] could be available for continued farming under a lease agreement. Project construction would have a direct impact to two small residential properties located adjacent to the north and east borders of the proposed power plant site on CR 900N and CR 200E, because of the proximity of the residential property to an industrial construction site.

The Coles County Illinois Comprehensive Plan and future land use map designates the area of the proposed Mattoon Power Plant Site as an Enterprise Zone best suited for industrial development. Therefore, construction of the proposed Mattoon Power Plant would fall within the parameters drafted by Coles County for land use and would be compatible with the land use plan. ***In addition, the May 15, 2007, rezoning of the 1.5-mile (2.4-kilometer) extra-territorial area to industrial use allows the proposed Power Plant site to be compatible with the zoning ordinance.***

The proposed Mattoon Power Plant Site is well outside the 20,000-foot (6,096-meter) radius within which FAA Part 77 Airspace Obstruction Analysis would be required, and there is no military restricted use airspace in the vicinity of the proposed site (FG Alliance, 2006a). Project construction would therefore have no notable effect on the use of airspace, although signal lights would be required atop the heat recovery steam generator and flare stacks. FAA regulations (14 CFR 77) require such lighting for any structure more than 200 feet (61 meters) high.

As noted above, construction of the proposed facilities would convert up to 200 acres (81 hectares) of prime farmland to industrial use. This would represent 0.7 percent of the approximate 27,060 acres (10,951 hectares) of prime farmland the NRCS reports as lost annually in the State of Illinois. The proposed Mattoon Power Plant Site's LESA score of 255 points exceeds the 225-point threshold for lands that, under the Illinois LESA System, should be reevaluated so that the site could be retained for agricultural use. However, such conversions are not prohibited, and as noted in Section 4.11.2.1, the Coles County Comprehensive Plan identifies the site as suitable for potential economic (that is, non-agricultural) development.

Sequestration Site

The injection wells would be placed within the Mattoon Power Plant. The impacts on land use are included in the above discussion of impacts at the power plant site.

Utility Corridors

Construction in the proposed pipeline corridors would have temporary, minor effects on land use (bike path, agriculture, roads, etc.) during the actual construction period due to trenching, equipment movement, and material laydown. After construction is complete, the areas would be regraded, revegetated, or otherwise treated in accordance with conditions of applicable permits, and all original land uses such as farming, road and utility ROWs, and bike paths would continue.

Construction of the proposed new 0.5-mile (0.8-kilometer) long transmission line between the proposed Mattoon Power Plant Site and the existing 138-kV transmission line corridor would have temporary, minor effects on the primarily agricultural land use during the actual construction period due to the installation of new poles, equipment movement, and material laydown. If a 345-kV transmission line is required, construction along the proposed 16-mile (25.7-kilometer) corridor would temporarily interrupt the existing land uses along the corridor, including agricultural use. Once the construction is completed, all of the disturbed areas would be regraded and vegetated in accordance with conditions of the applicable permits, and a majority of the original land uses would continue. There would be some long-term minor impacts on land use within the transmission line corridor due to routine vegetative maintenance.

Transportation Corridors

IDOT has committed to improve CH 13 to a Class II truck route from CH 18 to the entrance of the proposed Mattoon Power Plant Site, including the intersection with SR 121, if the site is selected for the FutureGen Project. This new construction would consist of 1.25 miles (2.0 kilometers) of roadway widening and resurfacing with new shoulders and ditches. The intersection of SR 121 and CH 13 would be rebuilt so that CH 13 approaches SR 121 at right angles. In addition, a turn lane would be built on SR 121 (FG Alliance, 2006a). The upgrading of CH 13 and the intersection of SR 121 and CH 13 near the proposed Mattoon Power Plant Site is a direct project effect for this proposal. This construction, if confined to the existing ROW, would have very little effect on nearby land uses, simply expanding the footprint of the existing transportation infrastructure.

The existing Canadian National – Peoria Subdivision rail line immediately adjacent to the northeast boundary of the proposed Mattoon Power Plant Site connects with the Canadian National/Illinois Central mainline 3.5 miles (5.6 kilometers) from the site. The proposed rail for the site would not require any additional ROW other than the proposed site itself, and therefore would have no effect on surrounding land uses.

4.11.3.2 Operational Impacts

Power Plant Site

As noted in Section 4.11.3.1, construction of the proposed Mattoon Power Plant would permanently remove at least 200 acres (81 hectares) of the site from its current agricultural use. The remainder of the site (244 acres [99 hectares]) could be leased for continued crop production, although it could also be developed at some future date. Such development is a reasonably foreseeable event in terms of defining potential cumulative impacts, but is not proposed as part of the FutureGen Project. The introduction of industrial operations adjacent to residential property would permanently alter the land use mix of the area, particularly with respect to the two residences adjacent to the site (one across CR 900N and one across CR 200E), two additional residences within 0.25 mile (0.4 kilometer) of the site, and 20 additional residences located within 1 mile (1.6 kilometers) of the site.

The option contracts include all mineral rights for approximately 444 acres (180 hectares). Obtaining mineral rights from any additional landowners over the expected 30-year sequestration time frame (there may be additional landowners if subsurface rights are needed to the 0.25-mile [0.4-kilometer] buffer) may be required, and in Coles County this historically has not been difficult or uncommon. In addition, there are no economic mineral deposits known to exist in the Mt. Simon sandstone and surrounding formations; therefore, mining would most likely not occur over this formation (FG Site Proposal [Mattoon, Illinois], 2006).

Sequestration Site

The operational impacts of the sequestration site would occur within the Mattoon Power Plant Site. The impacts on land use are included in those described above for the power plant site. Mineral rights would need to be obtained from landowners over the expected 30-year sequestration plume. There are no economic mineral deposits known to exist in the Mt. Simon sandstone and surrounding formations; therefore, mining would most likely not occur over this formation.

Utility Corridors

Once the utility pipelines were in place, the lands would be returned to their pre-existing land use, such as roadways, cropland, or utility corridor. There would be no permanent change in the existing land use, although the presence of underground utilities would preclude future development of the ROWs for incompatible uses.

Over the long term, the presence of the electrical transmission line would permanently eliminate the locations of towers as land for agricultural production or other uses, but the remainder of the ROW could continue in its current, primarily agricultural, use. There could be some long-term minor impacts on land use within the transmission line corridor due to routine vegetative maintenance in areas where crops are not grown. The transmission line ROW would permanently preclude future development of incompatible uses, such as residential construction, within the ROW.

Transportation Corridors

The only change to the existing ROW would be at CH 13 and the intersection of SR 121. The intersection would be rebuilt so that CH 13 would approach SR 121 at right angles. A turn lane would be constructed on SR 121. The Illinois Department of Transportation would be responsible for the proposed construction and related cost.

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4.12 AESTHETICS

4.12.1 INTRODUCTION

This section identifies viewsheds and scenic resources that may be affected by the construction and operation of the proposed FutureGen Project at the Mattoon Power Plant and Sequestration Site and related corridors. It addresses the appearance of project features from points where those features would be visible to the general public, and takes into account project characteristics such as light and glare. The distance from which the proposed power plant and associated facilities would be visible depends upon the height of the structures associated with the facilities, including buildings, towers, and electrical transmission lines, as well as upon the presence of existing intervening structures and local topography. Effects on visual resources can result from alterations to the landscape, especially near sensitive viewpoints, or an increase in light pollution.

4.12.1.1 Region of Influence

The ROIs for aesthetic resources include areas from which the proposed Mattoon Power Plant and Sequestration Site and all related areas of new construction would be visible. The ROIs are defined as 10 miles (16.1 kilometers) surrounding the proposed power plant and sequestration site, 1 mile (1.6 kilometers) on either side of the proposed electrical transmission line corridor, and immediately adjacent to the proposed underground utility corridors.

4.12.1.2 Method of Analysis

DOE identified land uses and potential sensitive receptors in the ROIs of the proposed power plant and sequestration site and utility corridors based on site visits, information in the Mattoon EIV (FG Alliance, 2006a), and a review of aerial photography. DOE used two approaches to assess the potential impacts of the proposed FutureGen Project on aesthetic resources. First, DOE applied Geographic Information Systems (GIS)-based terrain modeling, combined with height information associated with the proposed project facilities (i.e., the 250-foot [76-meter] HRSG stack and 250-foot [76-meter] flare stack), to determine the distance from which the facilities could be seen if there were no intervening structures or vegetation to screen the view. Secondly, DOE considered two artistic concepts of the proposed FutureGen Power Plant to depict a range of aesthetic approaches to the project. One concept is of a typical power plant with minimal screening and architectural design, while the second concept includes extensive screening and architectural design. DOE compared and contrasted the two concepts to assess the relative level of visual intrusiveness for each concept.

DOE assessed the potential for impacts based on whether the proposed FutureGen Project would:

- Affect a national, state, or local park or recreation area;
- Degrade or diminish a federal, state, or local scenic resource;
- Create visual intrusions or visual contrasts affecting the quality of a landscape; and
- Cause a change in a BLM Visual Resource Management classification.

4.12.2 AFFECTED ENVIRONMENT

4.12.2.1 Landscape Character

Natural and human-created features that give the landscape its character include topographic features, vegetation, and existing structures. The landscape of the proposed Mattoon Power Plant and

Sequestration Site, shown in Figure 4.12-1, is typical of farmland throughout the area, which is primarily used for row crop production of corn and soybeans. The topography of the site is relatively flat; however, slight natural and human-made drainages exist along the western and northern sections of the site. The drainages on the site collect at a drainage structure located approximately 0.25 mile (0.4 kilometer) south of the intersection of CRs 900N and 130E. There is a gradual elevation change of approximately 30 feet (9.1 meters) from the highest point of the site to the lowest point, located at the drainage structure. This change in elevation occurs over a distance of approximately 0.25 mile (0.4 kilometer; average approximated slope of 0.02 percent) (FG Alliance, 2006a).

The areas surrounding the proposed Mattoon Power Plant and Sequestration Site consist of CR 900N, a railroad, SR 121, and farmland to the north beyond SR 121; CR 130E, farmland, and a wooded fencerow to the west; farmland and CR 800N to the south; and CR 200E and farmland to the east. There are two residences across the street from the site on the north and east sides, two additional residences within 0.25 mile (0.4 kilometer), and about 20 additional residences within 1 mile (1.6 kilometers) of the site, for a total of about 24 residences in the ROI, including a group of residences on Western Avenue near the perimeter of the 1-mile (1.6-kilometer) ROI.

There are no known archaeological or historic resources within 1 mile (1.6 kilometers) of the proposed Mattoon Power Plant and Sequestration Site, although two historic properties, the U.S. Post Office in Mattoon and a nine-block section of brick street in Mattoon, are within approximately 3 miles (4.8 kilometers) of the site (see Section 4.10).

Source: FG Alliance, 2006a

Figure 4.12-1. Proposed Mattoon Power Plant and Sequestration Site

The landscape of the proposed underground utility corridors includes industrial lands, typical farmland used for row crop production, a bike path, city streets, and some adjacent residences. Figures 4.12-2 and 4.12-3 show two examples of the proposed process water pipeline corridor. Figure 4.12-2 is along the Prairie Grass Bike Trail, and Figure 4.12-3 is along 1st Street. The majority of the proposed process water pipeline corridor would run through flat terrain except near the Charleston WWTP, where the terrain changes to rolling woodlands. An unknown number of residences are adjacent to the proposed process water pipeline corridor, most in the vicinity of 1st and 2nd Streets and Lafayette Avenue, where the line would follow the city streets.

One option for the proposed electrical transmission line corridor follows an existing 138-kV transmission line that crosses farmland areas and periodically runs through slightly rolling small woodlots. Another option would require a new 16-mile (25.7-kilometer) ROW that crosses primarily farmland areas, as shown in Figure 4.12-4. Both options would be within 0.25 mile (0.4 kilometer) of just a few residences because most of the area is farmland.

As noted in Section 4.10, there are six archaeological sites within the ROIs of the utility corridors (one near the transmission line corridor and five near the process water pipeline corridor), and one historic site, the Briggs and Alexander House, near the process water pipeline corridor.

There are no BLM visual resource management classifications or designated scenic vistas within the ROIs of the proposed power plant and sequestration site or corridors (BLM, 2004).

4.12.2.2 Light Pollution Regulations

The ROIs for the proposed power plant and sequestration site and utility corridor are not regulated by any state or local light pollution abatement plans or goals (FG Alliance, 2006a).

Source: FG Alliance, 2006a

Figure 4.12-2. Proposed Mattoon Process Water Pipeline Corridor Along Prairie Grass Bike Trail

Source: FG Alliance, 2006a

Figure 4.12-3. Proposed Mattoon Process Water Pipeline Corridor Along 1st Street

Figure 4.12-4. Proposed Mattoon Electrical Transmission Line Corridor

4.12.3 IMPACTS

4.12.3.1 Construction Impacts

Power Plant Site

During construction at the proposed Mattoon Power Plant and Sequestration Site, the nearest neighbors, especially the two residences across the road from the site and the other (about 22) residences within a 1-mile (1.6-kilometer) radius, would have a nearly unobstructed view of the construction site and equipment moving on and off the site during the 44-month construction period, which would be a direct short-term impact.

As noted in Section 4.10, construction at the power plant site is not anticipated to have any direct or indirect effect on cultural resources in the ROI (see IHPA concurrence letter in Appendix A).

Sequestration Site

Because the proposed Mattoon Sequestration Site is on the proposed power plant site, there would be no additional impacts associated with construction at the sequestration site.

Utility Corridors

During construction along the proposed pipeline corridors, equipment used for trenching, pipe laying, and other construction activities would be visible only to viewers immediately adjacent to the pipeline corridors and construction laydown areas. This would constitute a direct short-term adverse impact on those nearest the corridors during the construction period, which is estimated at 4 to 6 months for the process water pipeline and 1 month each for the natural gas, potable water, and wastewater pipelines (FG Alliance, 2006a). Affected persons would include those using the Prairie Grass Bike Trail, which would share ROW with the proposed process water pipeline, and those in the vicinity of 1st and 2nd Streets and Lafayette Avenue, where the line would briefly follow the city streets.

Potential effects on cultural resources within the ROI are discussed in Section 4.10.

Construction along the electrical transmission line corridor would be visible within the 1-mile (1.6-kilometer) ROI. The length of the construction period would depend upon the results of transmission studies that would determine the transmission line option that should be pursued. Visual impacts would be greater if the optional 17-mile (27-kilometer) long new ROW were selected, although there are very few residences within the ROI in this rural area.

Transportation Corridors

If the Mattoon Power Plant and Sequestration Site is selected for the FutureGen Project, IDOT has committed to upgrading CH 13 to a Class II truck route from CH 18 to the entrance of the plant, including the intersection with IL 121. Construction along this route would be visible only to those immediately adjacent to the construction sites (e.g., motorists along the roadways) (FG Alliance, 2006a).

4.12.3.2 Operational Impacts

Power Plant Site

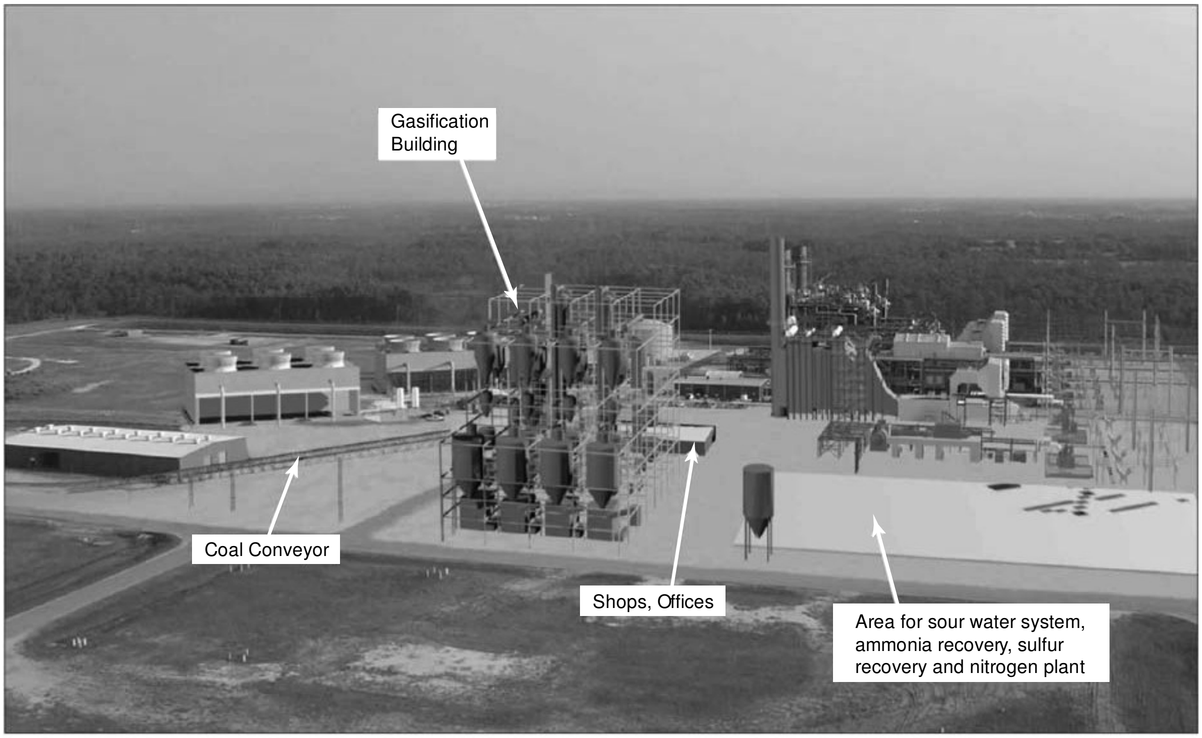
Major equipment for the power plant would include the gasifier and turbines, a 250-foot (76-meter) tall HRSG stack, a 250-foot (76-meter) tall flare stack, synthesis gas cleanup facilities, coal conveyance and storage systems, and particulate filtration systems. Additionally, the project would include on-site infrastructure, such as a rail loop for coal delivery, plant roads and parking areas, administration buildings, ash handling and storage facilities, water and wastewater treatment systems, and electrical transmission lines, towers, and a substation.

Once construction is complete, the tallest structures associated with the proposed Mattoon Power Plant Site would include the main building, stacks, and communication towers. The maximum proposed height of the facility is 250 feet (76 meters). The nearby residences noted in Section 4.12.2 (two adjacent to the site and fewer than 24 total residences within a 1-mile [1.6-kilometer] radius) would have a nearly unobstructed view of the Mattoon Power Plant. People at additional scattered residences located farther from the site, as well as people at public recreational sites such as Lake Mattoon and Lake Paradise, would also be able to see the plant because of the relatively flat topography and lack of structures, woodlands, or tree lines in the area. DOE's terrain analysis indicates that the facility would be visible for a distance of 7 to 8 miles (11.3 to 12.9 kilometers).

With respect to the site layout, the visual impact at nearby residences would be reduced if the facility were laid out so that the less intrusive features, such as administrative offices and similar buildings and parking areas, were located nearest the residences and the more industrial features and coal storage piles were located farthest from the residences.

For those viewing the proposed power plant from the adjacent roads or nearby residences or from a greater distance, the appearance of the facilities would depend upon the degree of architectural development and visual mitigation included in the design. Figures 4.12-5 and 4.12-6 show two points on a range of conceptual IGCC plant designs. Figure 4.12-5 is an artist's rendering of an IGCC facility proposed for Orlando, Florida (DOE, 2006a). This rendering shows a plant with minimal screening or enclosure of the facility components. Figure 4.12-6 is the artist's conceptual design of the proposed FutureGen Power Plant that was used during the scoping process for this EIS (DOE, 2006b). This rendering shows a plant with a high degree of architectural design, including enclosure of most of the plant features.

The proposed facility is still in the design stage, and decisions have not yet been made about the final configuration or appearance of the power plant. A plant design similar to Figure 4.12-5 would create a more industrial appearance. Although still very large in scale, a plant design similar to Figure 4.12-6 would have less of an industrial appearance, and would be visually less intrusive than the plant design shown in Figure 4.12-5. As noted above, the visual impact at nearby residences would be reduced if the facility were laid out so that the less intrusive features, such as administrative offices and similar buildings and parking areas, were located nearest the residences and the more industrial features and coal storage piles were located farthest from the residences.



Source: DOE, 2006a

Figure 4.12-5. Artist's Rendering of an IGCC Plant with Minimal Screening and Architectural Design Elements

Source: DOE, 2006b

Figure 4.12-6. Artist's Rendering of an IGCC Plant with Extensive Screening and Architectural Design Elements

Regardless of the final appearance of the proposed power plant, plant lighting and the flare would be highly visible at night, especially from nearby residences. Due to the relatively flat topography and lack of structures, woodlands, or tree lines in the area, it is likely that the plant, including the vapor plumes, would be visible both during the day and at night from scattered residences and other buildings as far as 7 to 8 miles (11.3 to 12.9 kilometers) away. Intervening buildings, vegetation, and topography would reduce the visibility of the plant from some vantage points.

Because there are no BLM visual resource management classifications or designated scenic vistas in the power plant and sequestration site or transmission line ROIs, the project would not have any effect on those classifications. Additionally, because there are no applicable light pollution standards in the area, the plant would create no conflict with such standards. Nonetheless, the choice of appropriate outdoor lighting and the use of various design mitigation measures (e.g., luminaries with controlled candela distributions, well-shielded or hooded lighting, directional lighting) could reduce the amount of nighttime glare associated with plant lighting. The plant is not anticipated to be visible from the two historic sites in Mattoon (see Section 4.10).

Sequestration Site

Because the proposed Mattoon Sequestration Site is on the proposed power plant site, no additional impacts on aesthetic resources would be associated with operating the CO_2 injection wells at the site.

Utility Corridors

Once construction is complete, the pipeline corridors would be returned to their pre-construction condition and would have essentially the same appearance as before construction. However, pump stations or compressor stations associated with proposed pipelines would be noticeable to those nearby, including those at nearby residences and those traveling on adjacent roadways.

On the proposed transmission line corridor, the visibility of the line would depend on which transmission line option is selected. This will not be known until certain transmission studies are completed. Any new line would be at least as visible as the existing 138-kV line that is proposed for interconnection, although there are very few residences in the rural area surrounding the proposed transmission line corridors. Any new substation would be very visible to those nearby.

Transportation Corridors

Once construction is complete and the power plant is in operation, the visual impacts would be similar to those for the power plant and sequestration site and utility corridors.

4.13 TRANSPORTATION AND TRAFFIC

4.13.1 INTRODUCTION

This section discusses the roadway and railroad networks that may be affected by the construction and operation of the proposed FutureGen Project at the Mattoon Power Plant and Sequestration Site.

4.13.1.1 Region of Influence

The ROI for the proposed Mattoon Power Plant and Sequestration Site includes a 50-mile (80.5-kilometer) radius around the site, as shown in Figure 4.13-1. The Mattoon Power Plant and Sequestration Site is located on SR 121 approximately 5 miles (8.0 kilometers) from the center of Mattoon and 8 road miles (12.9 kilometers) from the interchange of I-57 and SR 16. Because most vehicle trips to the site would be via SR 121 and SR 16 from the I-57 interchange, this analysis focuses on the 8-mile (12.9-kilometer) corridor from I-57, which passes through Mattoon. This analysis includes possible alternative routes using county roads, city streets, and US 45, thereby including Mattoon's city street network and the area north to (CH 18).

4.13.1.2 Method of Analysis

DOE reviewed information provided in the Mattoon EIV (FG Alliance, 2006a), which characterizes elements in the roadway hierarchy within the ROI based on function (e.g., city street and rural arterial), traffic levels, and observed physical condition. The EIV also contains traffic data obtained from the IDOT. The number of vehicle trips generated during construction and operations was based on data provided in the Mattoon EIV (FG Alliance, 2006a). DOE observed traffic conditions during site visits from October 11 to 12, 2006.

> **LOS** is a qualitative measure that describes operational conditions within a traffic stream, generally in terms of service measures as speed, travel time, freedom to maneuver, traffic interruptions, comfort, and convenience (TRB, 2000).

Traffic impacts were assessed using the planning methods outlined in: the Transportation Research Board's "2000 Highway Capacity Manual" (2000 HCM) (TRB, 2000), which assigns a level of service (LOS) to a traffic facility based on operational conditions within a traffic stream, generally in terms of service measures as speed, travel time, freedom to maneuver, traffic interruptions, comfort, and convenience (TRB, 2000); and The American Association of State Highway and Transportation Officials' (AASHTO) "A Policy on the Design of Highways and Streets" (the Green Book) (AASHTO, 2004), which describes LOS in more qualitative terms. The Green Book defers to the 2000 HCM to define LOS by facility type. The measures of effectiveness to assign LOS vary depending on the traffic facility. Highway Capacity Software Plus (HCS+) was used to perform capacity analysis.

For two-lane highways, the measure of effectiveness in assessing operations is the percent of time spent following another vehicle. LOS A through LOS F are assigned to a facility based on this measure of effectiveness. The LOS depends on the Highway Class (I or II), lane and shoulder widths, access-point density, grade and terrain, percent of heavy vehicles, and percent of no-passing zones within the analysis segment. Class I highways, according to the 2000 HCM, are highways where a motorist expects to travel at relatively high speeds. They are typically primary links in a state or national highway network and serve long-distance trips. A Class II highway typically operates at lower speeds and most often serves shorter trips. Class II also includes scenic or recreational routes. Table 4.13-1 defines each LOS category for Class I and II two-lane highways.

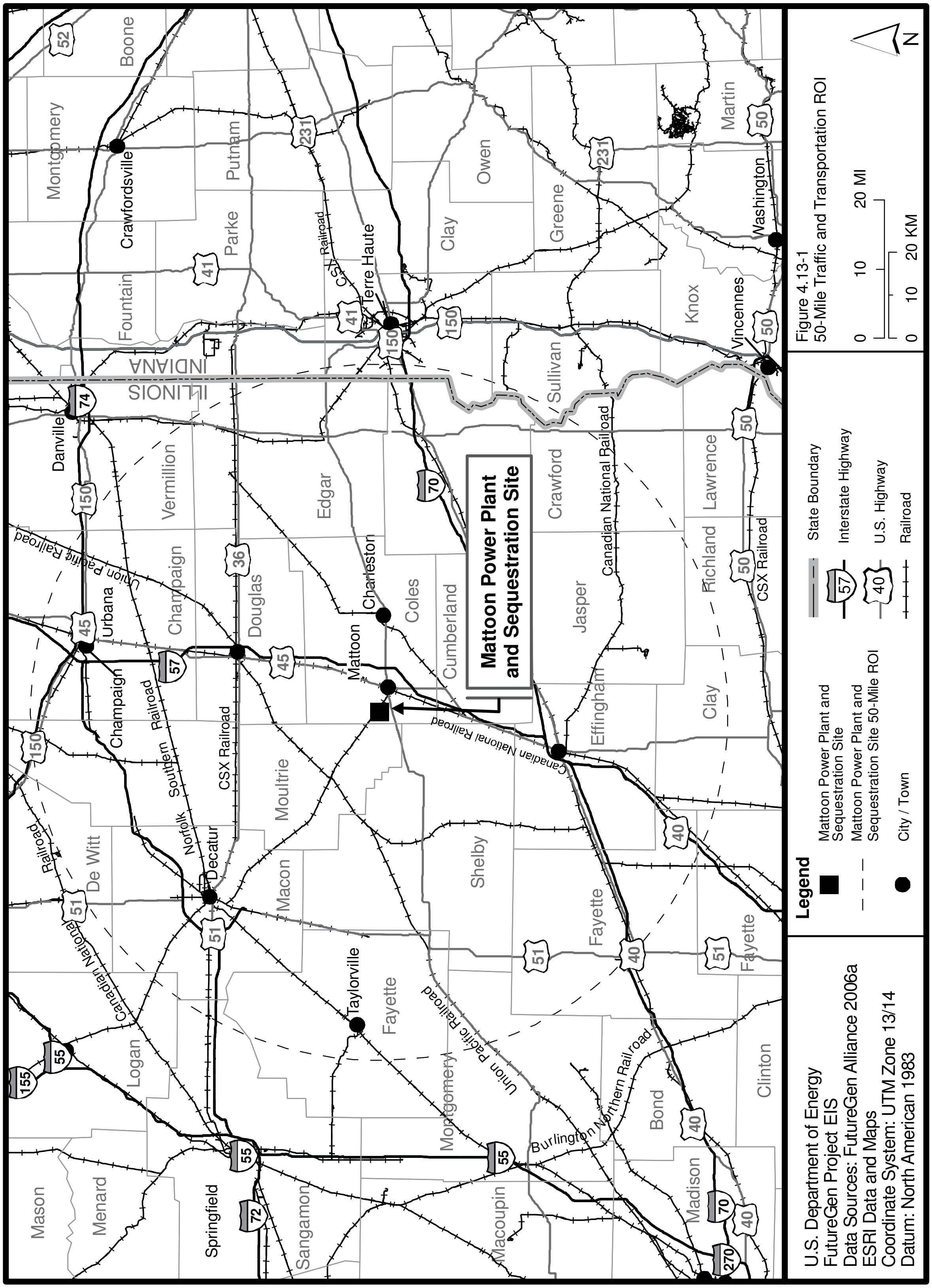


Figure 4.13-1
50-Mile Traffic and Transportation ROI

Table 4.13-1. Level of Service Criteria, Two-Lane Highways

LOS	Class I Two-Lane Highway		Class II Two-Lane Highway
	Percent Time Spent Following Another Vehicle	Average Travel Speed (mph [kmph])	Percent Time Spent Following Another Vehicle
A	< 35	>55 (88.5)	< 40
B	> 35 - 50	> 50 - 55 (80.5 – 88.5)	> 40 - 55
C	> 50 - 65	> 45 - 50 (72.4 – 80.5)	> 55 - 70
D	> 65 - 80	> 40 - 45 (64.4 – 72.4)	> 70 - 85
E	> 80	≤ 40 (64.4)	> 85

LOS F applies whenever the flow rate exceeds the capacity of the highway segment.
mph = miles per hour; kmph = kilometers per hour; LOS = Level of Service.
Source: TRB, 2000.

For multi-lane highways, the primary measure of effectiveness is density, measured in passenger cars per mile per lane. The traffic density is based on the free-flow speed, ranging from 45 to 60 mph (72.4 to 96.6 kmph). The LOS is dependent on the lane width, lateral clearance, median type, number of access points, free-flow speed, and percent of heavy vehicles. Table 4.13-2 defines the LOS criteria for each free-flow speed on a multi-lane highway.

Table 4.13-2. Level of Service Criteria, Multi-Lane Highways

Free-Flow Speed (mph [kmph])	Criterion	LOS				
		A	B	C	D	E
60 (96.6)	Maximum density (pc/mi/ln)	11	18	26	35	40
55 (88.5)		11	18	26	35	41
50 (80.5)		11	18	26	35	43
45 (72.4)		11	18	26	35	45

LOS F is not included in the table; vehicle density is difficult to predict due to highly unstable and variable traffic flow.
mph = miles per hour; kmph = kilometers per hour; LOS = Level of Service.
Source: TRB, 2000.

For basic freeway segments, the measure of effectiveness is density, measured in passenger cars per mile per lane. The LOS is dependent on the lane width, lateral clearance, number of lanes, interchange density, free-flow speed, and percent of heavy vehicles. Table 4.13-3 defines the LOS criteria for each free-flow speed.

The Green Book describes LOS in qualitative terms as follows: LOS A represents free flow, LOS B represents reasonably free flow, LOS C represents stable flow, LOS D represents conditions approaching unstable flow, LOS E represents unstable flow, and LOS F represents forced or breakdown flow (AASHTO, 2004).

Table 4.13-3. Level of Service Criteria, Basic Freeway Segments

LOS	Passenger Cars Per Mile Per Lane
A	0 – 11
B	>11 – 18
C	>18 – 26
D	>26 – 35
E	>35 – 45
F	>45

LOS = Level of Service.
Source: TRB, 2000.

No information is available for turning movements at specific intersections within the ROI. Therefore, intersection LOS has not been estimated for this analysis. However, DOE identified key intersections and evaluated the LOS qualitatively based on relative traffic volumes on intersecting roadways.

Though there are accident reduction factors that can be used to estimate a reduction in crashes based on a specific type of highway improvement, there are no methods available for estimating the increase in crashes due to increased roadway volume. In addition, specific recent accident data for the roadways around the proposed power plant and sequestration site are not available (IDOT, 2005a). DOE reviewed IDOT's Comprehensive Highway Safety Plan (IDOT, 2005b), which provides generic statistics and information about crashes at at-grade highway-railroad crossings and at intersections on a national and statewide basis. DOE qualitatively assessed potential safety impacts in this analysis.

DOE assessed the potential for impacts based on whether the proposed FutureGen Project would:

- Increase traffic volumes as to degrade LOS conditions on roadways;
- Alter traffic patterns or circulation movements;
- Alter road and intersection infrastructure;
- Conflict with local or regional transportation plans;
- Increase rail traffic compared to existing conditions on railways in the ROI; and
- Conflict with regional railway plans.

4.13.2 AFFECTED ENVIRONMENT

4.13.2.1 Roads and Highways

Figure 4.13-2 shows the local highway network in relationship to the regional network. Access to the proposed Mattoon Power Plant and Sequestration Site is primarily via I-57, approximately 3 miles (4.8 kilometers) east of the center of Mattoon and 8 road miles (12.9 kilometers) from the proposed Mattoon Power Plant and Sequestration Site. I-57 connects with I-70 approximately 25 miles (40.2 kilometers) to the south, and via I-70 to Indianapolis and St. Louis. US 45, a four-lane north-south highway, passes through the center of Mattoon and runs parallel with I-57. US 45 connects Mattoon with Effingham located approximately 25 miles (40.2 kilometers) to the south, and with Tuscola approximately 22 miles (35.4 kilometers) to the north.

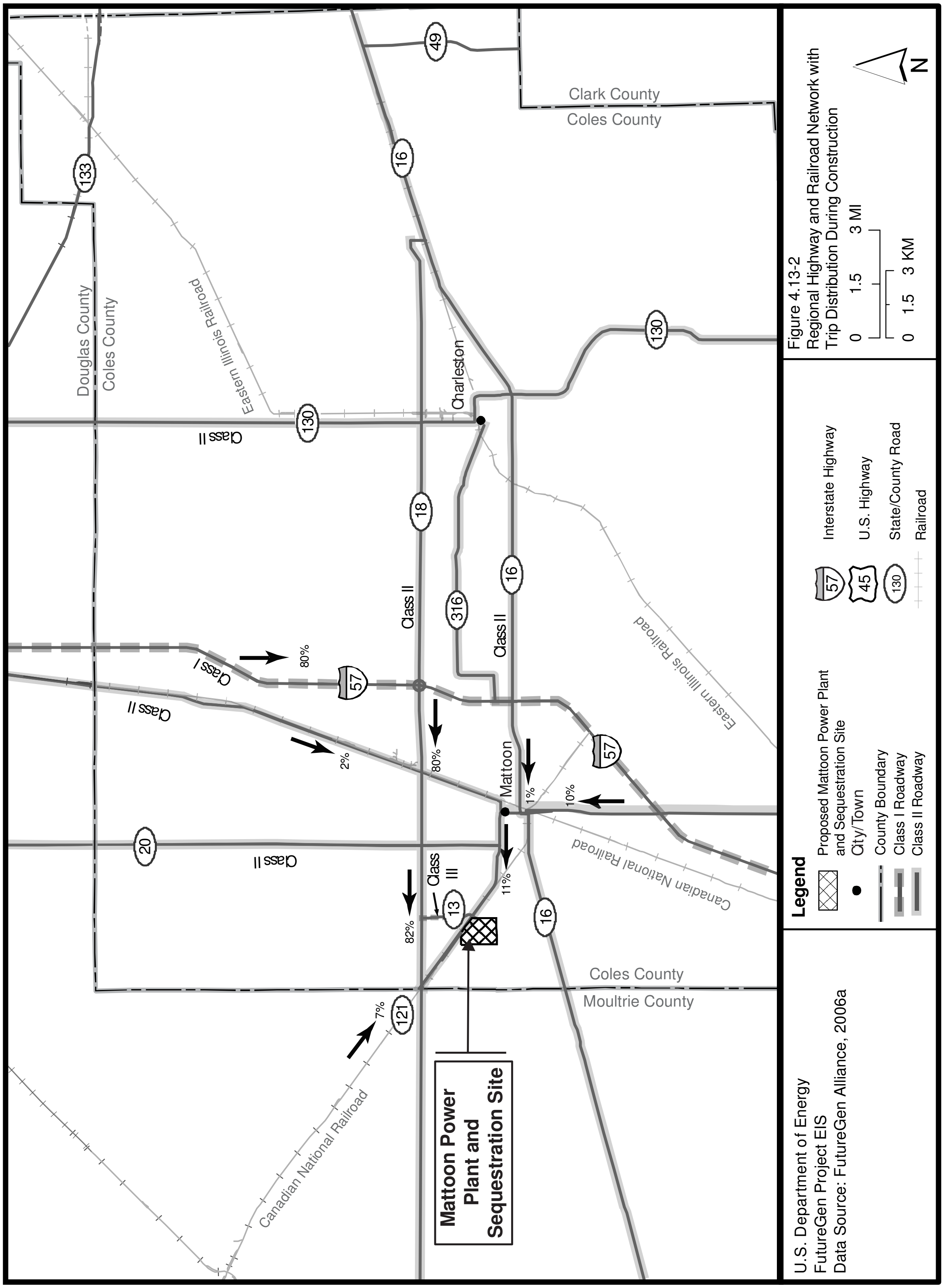


Figure 4.13-2
Regional Highway and Railroad Network with Trip Distribution During Construction

IDOT Highways

Marked and unmarked routes under the jurisdiction and maintenance of the IDOT are typically one of four types of pavement: full depth bituminous, bituminous pavement overlay on a rigid base, concrete pavement, or a combination of concrete and bituminous. These pavements would be "high quality" pavements and surface types. According to IDOT (as cited in FG Alliance, 2006a), there are no "sharp or hazardous curves" on any of the state-maintained roads.

Mattoon and all of East Central Illinois are served by a fully developed roadway system. Mattoon is located on I-57, which runs from I-55 in Missouri to I-94 in Chicago, Illinois. Mattoon is served by two existing interchanges on I-57 and a new interchange is currently under construction at CH 18. I-57 provides two lanes in each direction. Each lane is approximately 12 feet (3.7 meters) wide, and 10-foot (3.0-meter) shoulders are provided on the right side of each direction of travel. A median separates the northbound and southbound directions of travel. Within 50 miles (80.5 kilometers) of Mattoon, I-57 connects to I-70, I-72, and I-74. All three system interchanges are 25 to 45 miles (40.2 to 72.4 kilometers) from the proposed Mattoon Power Plant and Sequestration Site. In Illinois, all interstates are designated as Class I truck routes.

A **Class I truck route** is defined as a limited access, divided highway that can handle 5-axle tractor semi-trailers of any length, up to 8.5 feet (2.6 meters) wide and up to 13.5 feet (4.1 meters) high, and have a gross weight of up to 80,000 pounds (36,287 kilograms).

US 45 runs north-south through Mattoon and connects to I-57 south of Mattoon. US 45 provides two lanes in each direction plus a two-way turn lane (TWTL). The pavement is in good condition.

SR 16 runs east-west through Mattoon. SR 16 provides two lanes in each direction plus a TWTL. SR 16 connects to I-57 east of Mattoon. SR 16 also connects to US 45 at a signalized intersection. The roadway pavement is in good condition.

SR 121, which directly abuts the proposed power plant site, passes through Mattoon and continues northwest past the site to Decatur, Illinois. SR 121 is a four-lane highway that runs east-west six blocks north of SR 16. US 45 connects SR 16 and SR 121. SR 121 provides a direct route to the proposed site, at which point SR 121 becomes a two-lane roadway.

A **Class II truck route** is defined as a roadway that allows 80,000-pound (36,287-kilogram) vehicles up to 60 feet (18.3 meters) long with a width of 8.5 feet (2.6 meters).

US 45, SR 16, and SR 121 are all highways designated as Class II truck routes. The characteristics of each roadway class are shown in Table 4.13-4.

Table 4.13-4. Roadway Class Characteristics

Type of Highway or Street	Width (feet [meters])	Height (feet [meters])	Length (feet [meters])	Maximum Weight (pounds [kilograms])
Class I	8.5 (2.6)	13.5 (4.1)	any	80,000 (36,287)
Class II	8.5 (2.6)	13.5 (4.1)	60 (18.3)	80,000 (36,287)
Class III	8 (2.4)	13.5 (4.1)	55 (16.8)	80,000 (36,287)

Source: IDOT, ***undated***.

County Roads

CH 18 (also called CR 1000N) is a Class II roadway from US 45 to CH 13 (also called CR 200E). CH 18 provides one lane in each direction. The remaining portion of CH 18 from CH 13 to SR 121 west of the proposed power plant site is to be upgraded to a Class II truck route by Coles County in fiscal year 2008 (beginning July 1, 2007). CH 18 is also to be extended east to I-57 and west to SR 121 by 2008. The continuation of CH 18 is not related to the proposed FutureGen Project, as the extension will be constructed regardless of whether the proposed FutureGen Project takes place at the proposed power plant site.

CH 13 is a Class III truck route that connects CH 18 to SR 121 near the site. CH 13 provides one lane in each direction. CH 13 is paved with oil and chip.

Local Roads

Mattoon's street pattern is a grid of major and minor streets, as shown in Figure 4.13-3. Because SR 121 is six blocks north of SR 16, traffic from I-57 currently uses the city grid to reach SR 121 on its way to the vicinity of the proposed power plant site.

There are five key intersections in the vicinity of the proposed plant site. Turning movements for these intersections are not available; therefore, DOE used the LOS of adjacent road segments to estimate potential effects of the proposed FutureGen Project on these intersections:

- CH 18 and I-57 ramps
- SR 16 and US 45
- SR 16 and SR 121
- SR 121 and US 45
- SR 121 and CH 13

Programmed Transportation Improvements

IDOT has a Proposed Highway Improvement Program (HIP) for Fiscal Years 2007 to 2012 for each of its seven districts. The area within the ROI is covered in two district plans. Coles County and the southern half of the ROI are contained in District 7. The northern half of the ROI is part of District 5. Within the ROI, an interchange is currently under construction at I-57 and CH 18. The design includes a bridge over US 45 with connecting ramps. Other programmed improvements in the HIP within the ROI and the approximate distance from the proposed Mattoon Power Plant and Sequestration Site include:

- I-57 resurfacing, SR 16 to Douglas County Line (7 miles [11.3 kilometers]);
- US 45 over Canadian National Railroad, Mattoon, bridge beam replacement and re-decking (4 miles [6.4 kilometers]); and
- CH 18 resurfacing from SR 121 to 2 miles (3.2 kilometers) east of SR 121.

4.13.2.2 Railroads

There are four Class I railroads located within the ROI: CSX Transportation, Union Pacific, Canadian National, and Norfolk Southern. The Canadian National–Peoria spur borders the proposed power plant site at the north. This information is based on data provided by the Alliance (FG Alliance, 2006a). The railroads near the proposed Mattoon Power Plant and Sequestration Site are shown in Figure 4.13-3.

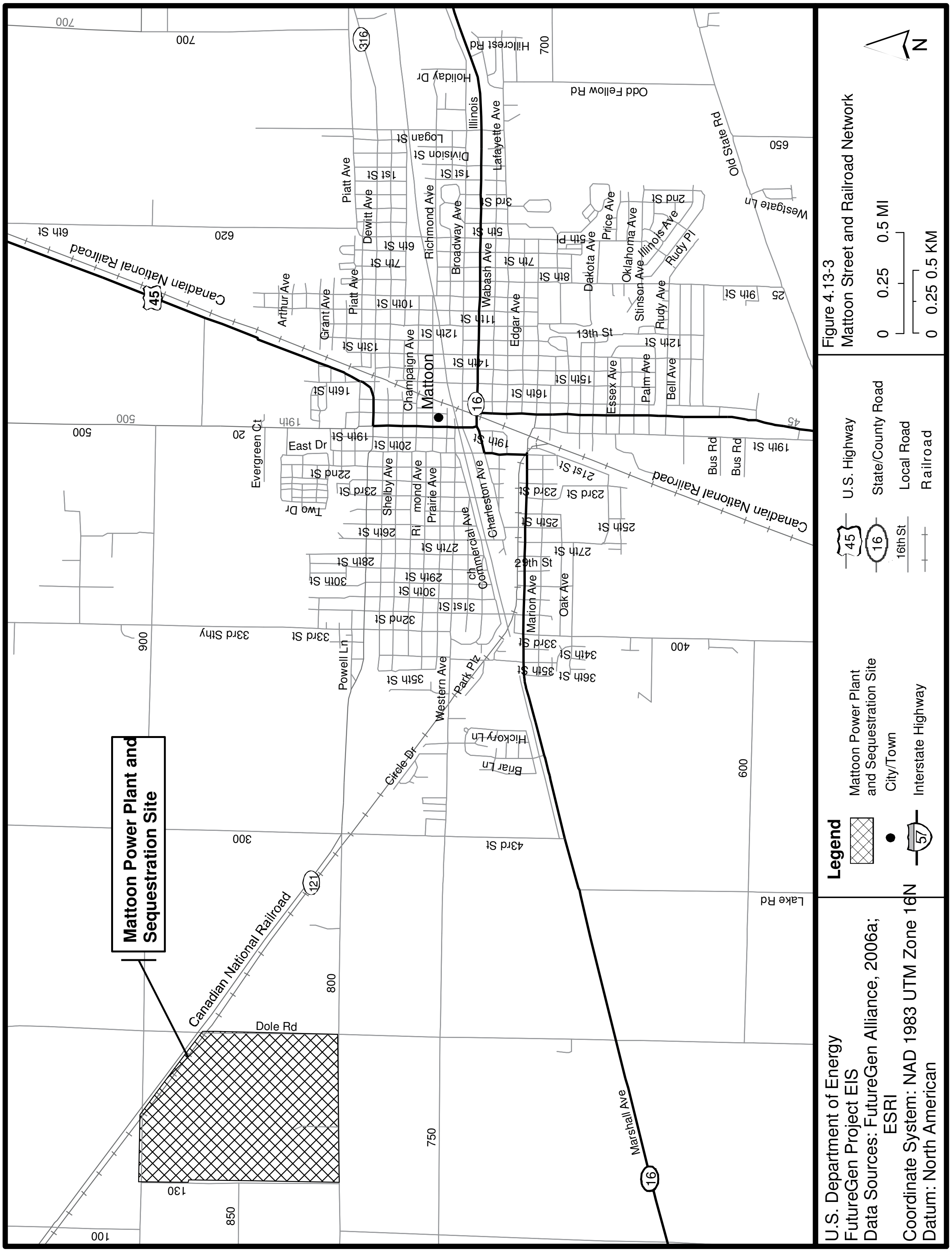


Figure 4.13-3
Mattoon Street and Railroad Network

The Surface Transportation Board categorizes rail carriers into three classes based upon annual earnings. The earnings limits for each class were set in 1991 and are adjusted annually for inflation.

Class I – Gross annual operating revenues of $277.7 million or more

Class II – Non-Class I railroad operating 350 or more miles and with gross annual operating revenues between $40 million and $277.7 million

Class III – Gross annual operating revenues of less than $40 million

CSX Transportation operates 1,044 miles (1,680 kilometers) of track in Illinois, provides service to 270 industries in Illinois, and employs 1,000 Illinois residents. CSX invested $7.5 million to maintain and upgrade its Illinois track in 2004. There are two CSX lines running east and west within approximately 30 miles (48.3 kilometers) of Mattoon. One line is north of Mattoon and the other is south.

Union Pacific operates the largest railroad in Illinois, having 2,247 miles (3,616 kilometers) of track and 4,000 employees in Illinois. Union Pacific's main line track connecting Chicago and St. Louis runs northeast to southwest approximately 20 miles (32.2 kilometers) from Mattoon. Daily freight train counts on this Union Pacific main line average 22 trains per 24-hour period. This Union Pacific main line has 286,000-pound (129,727-kilogram) weight capacity as coal trains currently use this line. In addition to providing access to the St. Louis gateway, this line goes south at Findlay, Illinois, and serves southern Illinois points. Lines from Mt. Vernon to Chester and Benton to Gorham have recently had substantial track work and provide additional links to Union Pacific's main line to Texas and the Gulf ports. This line has direct access to the St. Louis and Chicago gateways.

Canadian National operates the second largest railroad in Illinois, with 1,519 miles (2,445 kilometers) of track. Through the Chicago gateway, Canadian National tracks move traffic between Canada and the Mississippi Valley, the Gulf Coast, and Mexico. Two Canadian National lines run through Mattoon: the main line and the Peoria spur. The Canadian National main line between Effingham and Champaign, Illinois, passes through Mattoon and parallels US 45. The main line runs 12 freight trains service six days per week through Mattoon. There are also four Amtrak passenger trains classified at 79 mph (127.1 kmph) through Mattoon each day. The Canadian National–Peoria spur, which borders the northeast corner of the proposed Mattoon Power Plant Site, comes off the main line in Mattoon and parallels SR 121. The Canadian National runs two trains per day on the Peoria spur. The track is at grade and is classified as Federal Railroad Administration Class III, with a maximum freight speed of 40 mph (64.4 kmph) with service as needed.

Norfolk Southern operates 1,260 miles (2,028 kilometers) of track in Illinois. The Norfolk Southern main line between Decatur and Danville, Illinois, is the closest Norfolk Southern track to Mattoon. This section of track is a main line, with approximately 36 through trains per day. The track along that line can support car loadings up to 286,000 pounds (129,727 kilograms).

4.13.2.3 Local and Regional Traffic Levels and Patterns

Regional Traffic

According to IDOT (FG Alliance, 2006a), I-57 carried approximately 16,600 vehicles per day (vpd, also referred to as average daily traffic [ADT]) south of SR 16, and approximately 18,300 vpd north of SR 16 in 2005. US 45 carried approximately 3,350 vpd near CH 18 and 11,800 vpd near SR 16. SR 121 carried approximately 4,450 vpd in the vicinity the proposed Mattoon Power Plant and Sequestration Site, and SR 16 carried 6,200 vpd in the vicinity of US 45. Typically, morning and afternoon peak hour volumes range from 8 to 12 percent of the ADT, assuming that each peak represents 10 percent of the ADT (Table 4.13-5). Peak hour truck percentages are typically slightly lower than the daily truck percentage because trucks travel in off-peak hours. However, to be conservative, the existing daily truck percentages were maintained for this analysis.

Table 4.13-5. 2005 Average Daily and Peak Hour Traffic Volumes

Roadway	ADT[1] (vpd)	Truck ADT[1] (vpd)	Weekday Peak Hour Volume[2] (vph)	Weekday Peak Hour Truck Volume[2] (vph)	LOS[3]
SR 121 near the site	4,450	350	445	35	C
CH 13 between SR 121 and CH 18	350	0[4]	35	0*	A
CH 18 near US 45	1,700	170[5]	170	17[5]	A
CH 18 near CH 13	1,200	120[5]	120	12[5]	A
US 45 near CH 18	4,350	475	435	48	A
US 45 near SR 16	11,900	675	1,190	48	A
SR 16 near US 45	6,200	425	620	43	A
I-57 south of SR 16	16,600	5,750	1,660	625	A
I-57 north of SR 16	18,300	6,250	1,830	575	A

[1] Source: FG Alliance, 2006a.
[2] DOE estimate of peak hour volume and LOS assumed peak hour equals 10 percent of ADT.
[3] DOE used HCS+ to perform capacity analysis.
[4] CH 13 is not currently rated for trucks.
[5] No truck data were available. DOE assumed 10 percent trucks, which is consistent with surrounding roadways.
ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

A new interchange on I-57 at CH 18, currently under construction, would provide the main access route for all traffic from the north and east to the proposed Mattoon Power Plant and Sequestration Site, but vehicles coming from the south could take a shorter route from I-57 through Mattoon via US 45 and SR 121. The US 45/SR 121 route provides four lanes plus a two-way left turn lane. All traffic from the west would use SR 121 to access the site.

During a site visit from October 11 to 12, 2006, DOE noted traffic flows below highway capacities (LOS C or better) on the likely routes to the proposed Mattoon Power Plant and Sequestration Site. Table 4.13-5 summarizes the capacity analysis of the existing roadway network. Based on the existing roadway LOS reported in Table 4.13-5, DOE concluded that the key intersections near the proposed Mattoon Power Plant Site are likely to be operating within their capacity as well.

Truck Traffic

Information provided by IDOT indicates that in 2005 there were approximately 5,750 trucks per day using I-57 south of SR 16, and there were approximately 6,250 trucks per day using I-57 north of SR 16 (FG Alliance, 2006a). These volumes represent 35 percent and 34 percent of the ADT volumes using I-57, respectively. US 45 carried approximately 475 trucks per day in the vicinity of CH 18, which represents 11 percent of the ADT. In the vicinity of SR 16, US 45 carried 675 trucks in 2005, representing around 6 percent of the total daily traffic. SR 121 carried approximately 350 trucks per day in the vicinity of the proposed power plant site, which represents about 9 percent of the ADT. SR 16 carried 425 trucks per day, or 7 percent of the ADT, in the vicinity of US 45.

There are several truck routes in the vicinity of the proposed Mattoon Power Plant and Sequestration Site that use state and county roads. These truck routes include I-57 (Class I); and SR 16, SR 121, and US 45 (Class II). A new I-57 interchange with CH 18, currently under construction (FG Alliance, 2006a), would create a new route for all truck traffic from the north and east to the proposed Mattoon Power Plant Site.

Rail Traffic

The proposed Mattoon Power Plant and Sequestration Site would be served by the Canadian National Railroad main line and the Peoria spur, which borders the site to the north. The main rail line through the center of Mattoon is depressed beneath town roads, and rail traffic does not create a conflict with the roads. No new at-grade crossings are proposed to access the proposed Mattoon Power Plant and Sequestration Site.

4.13.3 IMPACTS

4.13.3.1 Construction Impacts

Power Plant Site

Based on the necessary permitting and design requirements, DOE expects that the earliest year that construction would begin on the proposed power plant and related infrastructure is 2009 (FG Alliance, 2006a). Table 4.13-6 shows 2009 No-Build traffic volumes, which DOE projected to the construction year by applying a background growth rate of 1 percent per year to 2005 volumes. DOE determined this growth rate by reviewing ***Illinois Department of Commerce and Economic Opportunity (IDCEO) population projections (IDCEO, 2005).***

Table 4.13-6. 2009 Average Daily and Peak Hour No-Build Traffic Volumes

Roadway	ADT[1] (vpd)	Truck ADT[1] (vpd)	Weekday Peak Hour Volume[1] (vph)	Weekday Peak Hour Truck Volume[1] (vph)	LOS[2]
SR 121 near the site	4,631	364	463	36	C
CH 13 between SR 121 and CH 18	364	36[3]	36	4	A
CH 18 near US 45	1,769	177[4]	177	18	A
CH 18 near CH 13	1,249	125[4]	125	13	A
US 45 near CH 18	4,527	498	453	50	A
US 45 near SR 16	12,383	743	1,238	74	A
SR 16 near US 45	6,452	452	645	45	A
I-57 south of SR 16	17,274	6,045	1,727	605	A
I-57 north of SR 16	19,043	6,474	1,904	647	A

[1] DOE estimate based on 1 percent growth per year from 2005.
[2] DOE used HCS+ to perform capacity analysis.
[3] CH 13 is not currently rated for trucks. Assumed 10 percent trucks under future improved conditions.
[4] No truck data were available. DOE assumed 10 percent trucks, which is consistent with surrounding roadways.
ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

Based on the 2009 No-Build volumes, DOE estimated each roadway's capacity (Table 4.13-6). Because there is no predicted change in the roadway LOS between the 2005 existing conditions and 2009 No-Build conditions, DOE concluded that there would be no change in LOS at key intersections near the proposed power plant and sequestration site. All intersections are expected to continue to operate at LOS C or better under the No-Build conditions.

Over a 44-month construction period, the construction work force for the proposed power plant site is estimated to average 350 workers on a single shift, with 700 workers during the construction's peak (FG Alliance, 2006e). DOE assumed that 100 percent of the construction workforce would arrive at the construction site in single-occupant vehicles. For the analysis of construction conditions, DOE used the peak period of construction to estimate the highest level of potential impact during construction.

Trips would be largely from Mattoon and the new I-57/CH 18 interchange north of Mattoon currently under construction. The balance of trips would come to the site via US 45 from the north and south, and from SR 16 and SR 121 from the southeast and northwest, respectively. The trip distribution is summarized in Figure 4.13-2. It is assumed that access to the proposed site would be provided via CR 800N or via CH 13.

DOE assumed that the construction workforce would work a 10-hour work day, 5 days per week. Construction workforce trips would generally occur prior to the morning peak hours (7:00 to 9:00 am) and coincide with the afternoon peak hours (4:00 to 6:00 pm). It is unlikely that many, if any, trips would occur during mid-day, as construction workers typically do not leave a job site during the half-hour lunch period.

Based on these construction workforce estimates, DOE estimated the percent change in ADT and peak-hour traffic volumes from 2009 No-Build conditions for the likely routes to the site during the expected 44-month construction period (2009-2012) (Table 4.13-7).

Table 4.13-7. 2009 Average Daily and Peak Hour Construction Traffic Volumes

Roadway	ADT[1,2] (vpd)	Change in ADT[1,2] (percent)	Peak Hour Volume[1,3] (vph)	Change in Peak Hour Volume[1,3] (percent)	LOS[4]
SR 121 near the site	6,273	36	1,185	156	D
CH 13 between SR 121 and CH 18	1,548	325[5]	628	1,626	C
CH 18 near US 45	2,953	67[6]	769	335	A
CH 18 near CH 13	2,433	95[6]	717	474	A
US 45 near CH 18	4,556	1	467	3	A
US 45 near SR 16	12,528	1	1,311	6	A
SR 16 near US 45	6,611	3	652	1	A
I-57 south of SR 16	17,418	1	1,800	4	A
I-57 north of SR 16	20,198	6	2,482	30	A

[1] DOE estimate based on peak workforce of 700 workers arriving at site in single-occupancy vehicles, plus 40 truck trips per day (20 entering and 20 exiting the site).
[2] Trip distribution on area roadways is shown in Figure 4.13-2.
[3] DOE derived peak hour volumes assuming half of all passenger car trips occur in peak hour and truck trips are evenly distributed over a 10-hour construction work day.
[4] DOE used HCS+ to perform capacity analysis.
[5] CH 13 is not currently rated for trucks. Assumed 10 percent trucks under future improved conditions.
[6] No truck data were available. DOE assumed 10 percent trucks, which is consistent with surrounding roadways.
ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

The largest construction traffic impact would occur on CH 13, scheduled to be improved by IDOT should the proposed Mattoon Power Plant Site be selected. CH 13 would see a 325 percent increase in daily traffic during construction of the proposed power plant, including both workforce and construction-related truck traffic.

A new I-57 interchange with CH 18, currently under construction, would provide the main access route for all construction traffic from the north via I-57 and US 45 to the proposed Mattoon Power Plant Site, while construction traffic from the west would use SR 121 directly to the site entrance. Traffic from the east would use SR 16. This would not cause a large traffic impact on these roads due to the available capacity, as shown in Table 4.13-7. It appears that construction-related traffic could take a shorter route from the south, via I-57 to US 45 and SR 121. Unless a designated truck route was indicated for the project, this route would create more truck traffic and congestion in the downtown area. This could have a direct impact on intersection LOS in Mattoon.

As shown in Table 4.13-7, the number of passenger vehicle trips by construction workers would be relatively small in terms of available roadway capacity, and direct traffic impacts due to construction would be minor. The roadway that would experience the most direct impact during construction would be SR 121 because all construction-related trips would use this roadway en route to and from the proposed Mattoon Power Plant Site. SR 121 would operate at LOS D during construction compared to LOS C under 2009 No-Build conditions. This would result in a change to the roadway's conditions from one of stable flow (LOS C) to one approaching unstable flow (LOS D), which would be inconvenient for travelers on the highway, particularly during peak traffic hours, but is acceptable for a temporary condition during construction (Bureau of Local Roads and Streets, 2006). The analysis of CH 13 includes the planned upgrade of the roadway, which is described in Section 4.13.3. CH 13 would operate at LOS C (stable flow) during construction, compared to LOS A (free flow) under 2009 No-Build conditions. All other roadways would operate at LOS A, just as they would under 2009 No-Build conditions. Given that the roadways would be operating at LOS D or better, there is no reason to conclude there would be any notable increase in traffic accidents. The capacity analysis summary for the 2009 construction conditions of the proposed project area roadways is shown in Table 4.13-7.

Based on the volumes and LOS on these roadways during construction, the key intersections around the proposed site should be able to accommodate these daily and peak hour traffic volumes. The ramp termini intersections at I-57 and CH 18, as well as the intersections of CH 13 with CH 18 and with SH 121, could see a temporary change in LOS due to the volumes generated during construction. Changes to traffic signal timings may be required at the CH 18/I-57 ramp intersections to accommodate changes in the turning volumes. The planned improvements at CH 13 and SH 121 should adequately accommodate the construction traffic.

In addition to worker traffic, materials and heavy equipment would be transported to the proposed site on trucks from I-57 and via the adjacent rail line. Heavy equipment would remain at the proposed site for the duration of its use. Material deliveries and return trips by empty trucks would likely occur throughout the workday. Mattoon is served by several large construction material supply firms, offering both concrete and asphalt, within 20 miles (32.2 kilometers) of the proposed Mattoon Power Plant Site (Figure 4.13-4). In its estimates of construction-related traffic, DOE did not estimate a specific number of trips by truck from any supply location. However, DOE included 40 truck trips per day (20 entering and 20 exiting the proposed site) in the analysis. Based on the available roadway capacities and the fact that estimated 2009 No-Build LOS are C or better, DOE concluded that 40 truck trips per day would not have a significant direct impact on traffic operations on roadways surrounding the proposed site. Moreover, DOE also concluded that even if the number of trips did occasionally exceed 40 per day, it is highly unlikely that it would result in a significant direct impact on roadways surrounding the proposed site.

Sequestration Site

Because the proposed Mattoon Sequestration Site is the same as the proposed Mattoon Power Plant Site, there would be no additional direct or indirect impacts of construction beyond those described for the proposed power plant site.

Utility Corridors

All underground utilities (potable water, process water, wastewater, natural gas, and CO_2) are proposed to be constructed using boring and directional drilling under roads and railroads (FG Alliance, 2006a); therefore, no open trenches across roadways or railroads are expected. Although there would be a need for staging areas for this construction, DOE assumes that typical construction techniques would be employed and all roadways would be maintained during construction. Construction of several of the proposed utility lines (potable water, wastewater, natural gas) is expected to last for approximately 1 month. Construction of the process water pipeline is expected to last 4 to 6 months (FG Alliance, 2006a).

Construction of the utility lines would require approximately 35 persons for all construction to occur concurrently (FG Alliance, 2006a). In the most conservative case, all construction workers would travel in single-occupant vehicles. Therefore, there would be approximately 70 additional daily trips on the roadway network during construction of the utilities. Assuming that construction operations typically start earlier than the morning peak period of traffic, 35 trips would take place before the morning peak hour. The 35 afternoon trips made by construction workers leaving job sites would likely coincide with the afternoon peak period. Given the proposed locations of the utility corridors, these trips would be spread out on various roadways in the ROI and are not expected to have any appreciable direct impact on traffic operations.

Transportation Corridors

IDOT has committed to upgrade CH 13 to a Class II roadway if the proposed Mattoon Power Plant Site is chosen (FG Alliance, 2006a). This new construction would consist of 1.25 miles (2.0 kilometers) of roadway widening and resurfacing with new shoulders and ditches. The intersection of SR 121 and CH 13 would be rebuilt so that CH 13 would approach SR 121 at right angles. A turn lane would be built on SR 121. This would provide Class II truck route access from I-57 to the plant entrance. The roadway improvement project would require approximately 3 months and 15 workers to construct. The workers would add 30 trips per day to the roadway network (15 trips before the morning peak period and 15 trips coinciding with the afternoon peak period). The small number of trips would not have an appreciable direct impact on the LOS on CH 13, SR 121, or other adjacent roadways.

IDOT would require a Traffic Management Plan during roadway construction. The Traffic Management Plan could include detours while construction occurs on CH 13. However, more typically, at least one lane of travel would be maintained as part of the Traffic Management Plan during construction. While there could be some congestion in the local area surrounding the construction site, it should not have a significant direct impact on the traveling public, given the low existing daily traffic volumes on CH 13, which currently operates at LOS A (see Table 4.13-5). Reconstruction of CH 13 is assumed to occur before the construction of the proposed Mattoon Power Plant and Sequestration Site and associated utility corridors, to ensure that the necessary transportation infrastructure is in place to support the construction traffic volumes.

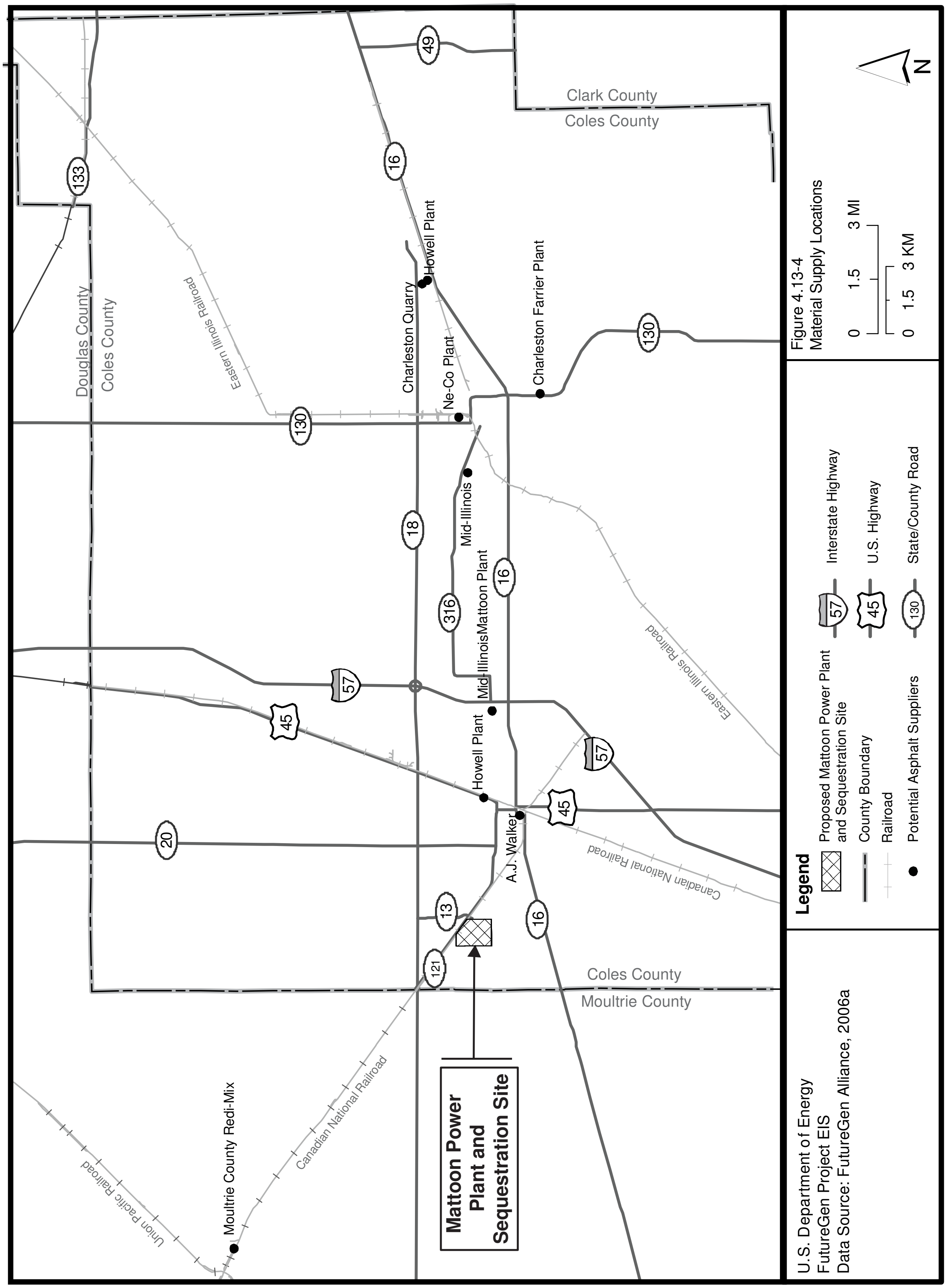


Figure 4.13-4
Material Supply Locations
0 1.5 3 MI
0 1.5 3 KM
N
Legend
Proposed Mattoon Power Plant and Sequestration Site
County Boundary
Railroad
Potential Asphalt Suppliers
Interstate Highway
U.S. Highway
State/County Road
U.S. Department of Energy
FutureGen Project EIS
Data Source: FutureGen Alliance, 2006a
Mattoon Power Plant and Sequestration Site
Clark County
Coles County
Douglas County
Moultrie County
Eastern Illinois Railroad
Canadian National Railroad
Union Pacific Railroad
Howell Plant
Charleston Quarry
Ne-Co Plant
Charleston Farrier Plant
Mid-Illinois
Mid-Illinois Mattoon Plant
A.J. Walker
Moultrie County Redi-Mix
133
49
16
130
18
316
57
45
20
13
121

A private sidetrack from the Canadian National–Peoria spur would be constructed on the proposed Mattoon Power Plant and Sequestration Site and would require approximately 9 to 11 months to complete that could be spread over more than one construction season. It is estimated that up to 18 construction workers would be traveling to and from the proposed site, resulting in an additional 36 trips per day on the roadway network. Eighteen of those trips would take place before the morning peak period, assuming that construction activities typically begin earlier than the regular work day. The other 18 trips would occur during the afternoon peak period, assuming a 10-hour work day. Given that all roadways would be operating at LOS D or better during construction (see Table 4.13-7), these trips would not be expected to appreciably change traffic operations on the roadway network.

During connection of the new rail loop to the existing Canadian National–Peoria spur, railroad safety flaggers would be required. The construction could have some temporary impacts on Canadian National railroad operations while the connection between the private sidetrack and the Peoria spur is completed. This temporary impact could be avoided by completing the connection during hours when the Peoria spur has the least traffic.

4.13.3.2 Operational Impacts

The proposed FutureGen Project is expected to begin operating in 2012 (FG Alliance, 2006a). Table 4.13-8 shows 2012 No-Build traffic volumes, which DOE projected by applying a background growth rate of 1 percent per year to 2005 volumes. This growth rate was determined through review of ***IDCEO population projections (IDCEO, 2005).*** Based on the 2012 No-Build volumes, DOE estimated the capacity of each roadway. The analysis of CH 13 includes the planned upgrade of the roadway (Table 4.13-8).

Table 4.13-8. 2012 Average Daily and Peak Hour No-Build Traffic Volumes

Roadway	2012 No-Build ADT[1] (vpd)	2012 No-Build Truck ADT[1] (vpd)	2012 No-Build Peak Hour Volume[1] (vph)	2012 No-Build Peak Hour Truck Volume[1] (vph)	LOS[2]
SR 121 near the site	4,771	375	477	38	C
CH 13 between SR 121 and CH 18	375	38[3]	38	4	A
CH 18 near US 45	1,823	182[4]	182	18	A
CH 18 near CH 13	1,287	129[4]	129	13	A
US 45 near CH 18	4,664	509	466	51	A
US 45 near SR 16	12,758	724	1,276	72	A
SR 16 near US 45	6,647	456	665	46	A
I-57 south of SR 16	17,797	6,701	1,780	670	A
I-57 north of SR 16	19,620	6,165	1,962	616	A

[1] DOE estimate based on 1 percent growth per year from 2005.
[2] DOE used HCS+ to perform capacity analysis.
[3] CH 13 is not currently rated for trucks. Assumed 10 percent trucks under future improved conditions.
[4] No truck data were available. DOE assumed 10 percent trucks, which is consistent with surrounding roadways.
ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

Power Plant Site

The operating workforce for the proposed plant would be approximately 200 employees, of which 80 administrative personnel would work a regular office day (9:00 am to 5:30 pm), and 40 shift workers would work a daytime shift (7:00 am to 3:30 pm) and each of the two nighttime shifts (FG Alliance, 2006e). The workforce would result in 160 new peak hour trips in both the morning and afternoon. For this analysis, DOE assumed that these employees would arrive at the plant in single-occupant vehicles and that the trip distribution would be the same as for the construction worker trips, with the majority coming from Mattoon or from I-57 and reaching the plant site via SR 121. A portion of the workforce would come from Decatur and other communities to the northwest via SR 121. Depending on how the proposed plant is oriented, a single access gate could be located on either CR 800N or CH 13 (FG Alliance, 2006a).

There would be a small number of delivery truck trips to the proposed plant to support personnel and administrative functions, and deliver spare parts. Coal would be delivered primarily by rail. Other bulk materials used by the plant and byproducts are expected to be delivered or removed from the proposed Mattoon Power Plant Site by truck. DOE estimates that 13 trucks per week would be required for delivery of materials, while 98 trucks per week would be required for removal of byproducts, including slag, sulfur, and ash. The estimate of trucks required is based on the estimated annual amount of materials/byproducts (FG Alliance, 2006e). Based on these estimates and assuming an even distribution of trucks over each day of the week, materials delivery would result in 4 truck trips per day, 2 entering and 2 exiting, and byproduct removal would result in an additional 28 trips per day, 14 entering and 14 exiting. These trips are included in the 2012 Build ADT and peak hour traffic volumes shown in Table 4.13-9. The change in ADT and peak hour volumes between 2012 No-Build and 2012 Build conditions is also shown in Table 4.13-9.

Table 4.13-9. 2012 Average Daily and Peak Hour Build Traffic Volumes

Roadway	2012 Build ADT[1] (vpd)	Change in ADT[1] (percent)	2012 Build Peak Hour Volume[2] (vph)	Change in Peak Hour Volume[2] (percent)	LOS[3]
SR 121 near the site	5,203	9	641	34	C
CH 13 between SR 121 and CH 18	729	94	172	358	B
CH 18 near US 45	2,177	19	317	74	A
CH 18 near CH 13	1,641	27	263	105	A
US 45 near CH 18	4,672	<1	470	1	A
US 45 near SR 16	12,802	<1	1,292	1	A
SR 16 near US 45	6,695	1	666	<1	A
I-57 south of SR 16	17,841	<1	1,796	1	A
I-57 north of SR 16	19,966	2	2,093	7	A

[1] DOE derived ADT using the maximum operating workforce (200 people; 400 vpd) passenger car trips (FG Alliance, 2006a) and assuming 32 operations-related truck trips daily (16 arriving and 16 exiting the site).
[2] DOE derived peak hour volumes assuming that administration and one-third of shift workers arrive in peak hour, and that four truck trips occur in each peak hour.
[3] DOE used HCS+ to perform capacity analysis.
ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

Based on the predicted 2012 Build conditions capacity analysis summary given in Table 4.13-9, the peak hour traffic would result in no major direct impact on the roadways surrounding the proposed Mattoon Power Plant Site. CH 13 would operate at LOS B (reasonably free flow) under the 2012 Build conditions compared to LOS A (free flow) under 2012 No-Build conditions. All other roadways would experience no change in LOS as a result of operating the proposed Mattoon Power Plant. Given that the roadways would be operating at LOS B or better, there is no reason to conclude that there would be any notable increase in traffic accidents.

Based on the volumes and LOS on these roadways during construction, DOE concluded that the key intersections around the proposed site should be able to accommodate these daily and peak hour traffic volumes. Changes to traffic signal timings may be required at the CH 18/I-57 ramp intersections to accommodate changes in the turning volumes. The planned improvements at CH 13 and SR 121 should adequately accommodate the traffic at this location.

The primary component of materials transport would be the delivery of coal to the plant by rail, using a spur track constructed for the purpose. It is anticipated that coal deliveries would require five 100-unit trains per week, or 10 entering or exiting train trips per week (FG Alliance, 2006e). This would represent a 10 percent increase in the number of trains on the main line through Mattoon, which currently accommodates 100 trains per week (12 freight trains 6 days per week and four passenger trains 7 days per week). Ten train trips per week would represent a 71 percent increase in the number of trains on the Peoria spur, which currently accommodates approximately 14 trains per week (an average of two per day).

The Peoria spur joins the north-south Canadian National main line in Mattoon, and some of the trains would use this line to and from the south. The north-south main line runs parallel to South 21st Street and has no grade crossings in the city street grid, so additional rail traffic would not affect street traffic in the city. There are two grade crossings between Mattoon and the proposed Mattoon Power Plant and Sequestration Site. The crossings are currently protected by actuated signals and gates, so additional crossing protection would not be required. The additional 10 train trips per week would create additional delays for some road users, would slightly increase the risk of a vehicle-train accident, and could have an impact on emergency vehicle response time at these crossings. A unit train car ranges from 48 to 53 feet (14.6 to 16.2 meters) long; therefore, a 100-unit train is approximately 1 mile (1.6 kilometers) long. Train speed through at-grade crossings varies from 10 to 40 mph (16 to 64 kmph) (FRA, 2006). DOE assumed that trains would pass through the at-grade crossings at approximately 10 mph (16 kmph). A 100-unit train traveling at 10 mph (16 kmph) would take approximately 6 to 7 minutes to clear each at-grade crossing. DOE did not estimate the number of other trains trips needed to deliver or remove other materials, such as ammonia or sulfur; however, these occasional trains would not appreciably alter the results of this analysis.

Sequestration Site

There would be no additional direct or indirect impacts beyond those indicated for the proposed power plant operations because the proposed sequestration site would be located on the Mattoon Power Plant Site.

Utility Corridors

The proposed utility corridors would have little or no impact on traffic operations and roadway LOS once the proposed FutureGen Project is operational. There would be no direct impact to traffic unless there is a problem with a utility line that requires open trenching to repair. It is expected that this would be an infrequent occurrence, thus having very little long-term potential to affect traffic.

Transportation Corridors

IDOT has committed to roadway improvements on CH 13 to allow trucks to use this route to/from the proposed Mattoon Power Plant Site via I-57. These improvements would have a positive direct impact on the existing roadway traffic. The improvements at SR 121 and CH 13 would also have a positive direct impact on traffic operations around the proposed site. As noted earlier, DOE assumes that these improvements would be completed before beginning construction on the proposed Mattoon Power Plant and Sequestration Site, so the improvements would be in place during the construction period. Operations using the proposed rail spur on the proposed Mattoon Power Plant Site would have little to no direct or indirect impact on the rail operations on the Peoria spur or Canadian National main lines.

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4.14 NOISE AND VIBRATION

4.14.1 INTRODUCTION

Noise is defined as any sound that is undesired or interferes with a person's ability to hear something. The basic measure of sound is the sound pressure level (SPL), commonly expressed as a logarithm in units called decibels (dB). Vibration, on the other hand, consists of rapidly fluctuating motions having a net average motion of zero that can be described in terms of displacement, velocity, or acceleration. This section provides the results of the analysis completed for both noise and vibration. Specific details of the noise and vibration analyses are provided in sequence under each subsection, with results of the noise analysis presented first, followed by those of the ground-borne vibration analysis.

4.14.1.1 Region of Influence

The ROI for noise and vibration includes the area within 1 mile (1.6 kilometers) of the proposed Mattoon Power Plant and Sequestration Site boundary and within 1 mile (1.6 kilometers) of the boundaries of all related areas of new construction, including the utility and transportation corridors.

4.14.1.2 Method of Analysis

This section provides the methods DOE used to assess the potential noise and vibration impacts of construction and operational activities related to the proposed Mattoon Power Plant and Sequestration Site and related corridors. In preparing the noise and vibration analyses, DOE evaluated information presented in the Mattoon EIV (FG Alliance, 2006a), estimated increases in ambient noise and ground-borne vibration levels, and evaluated potential impacts on sensitive receptors.

DOE assessed the potential for impacts based on the following criteria:

- Conflicts with a jurisdictional noise ordinance;
- Permanent increases in ambient noise levels at sensitive receptors during operations;
- Temporary increases in ambient noise levels at sensitive receptors during construction;
- Airblast noise levels in excess of 133 dB;
- Blasting peak particle velocity (PPV) greater than 0.5 inches per second (in/sec) (12.7 millimeters per second [mm/sec]) at off-site structures; and
- Exceeding the Federal Transit Administration's (FTA) distance screening and human annoyance thresholds for ground-borne vibrations of 200 feet (61 meters) and 80 velocity decibels (VdB).[1]

Noise Methods

> The **A-weighted** scale is the most common weighting method used to conduct environmental noise assessments and is expressed as a dBA.

Generally, ambient conditions encountered in the environment consist of an assortment of sounds at varying frequencies (FTA, 2006). To account for human hearing sensitivities that are most perceptible at frequencies ranging from 200 to 10,000 Hertz (Hz) or cycles per second, sound level measurements are often adjusted or weighted and the resulting value is called an "A-weighted" sound level.

A-weighted sound measurements (dBA) are standardized at a reference value of zero decibels (0 dBA), which corresponds to the threshold of hearing, or SPL, at which people with healthy hearing

[1] FTA threshold standards are not applicable to this project, but were used as a basis for comparing effects.

mechanisms can just begin to hear a sound. Because the scale is logarithmic, a relative increase of 10 decibels represents an SPL that is nearly 10 times greater. However, humans do not perceive a 10-dBA increase as 10 times louder; rather, they perceive it as twice as loud (FTA, 2006). Figure 4.14-1 lists measured SPL values of common noise sources to provide some context.

The following generally accepted relationships (***MTA, 2004***) are useful in evaluating human response to relative changes in noise level:

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

The SPL that humans experience typically varies from moment to moment. Therefore, a variety of descriptors are used to evaluate noise levels over time. Some typical noise descriptors are defined below:

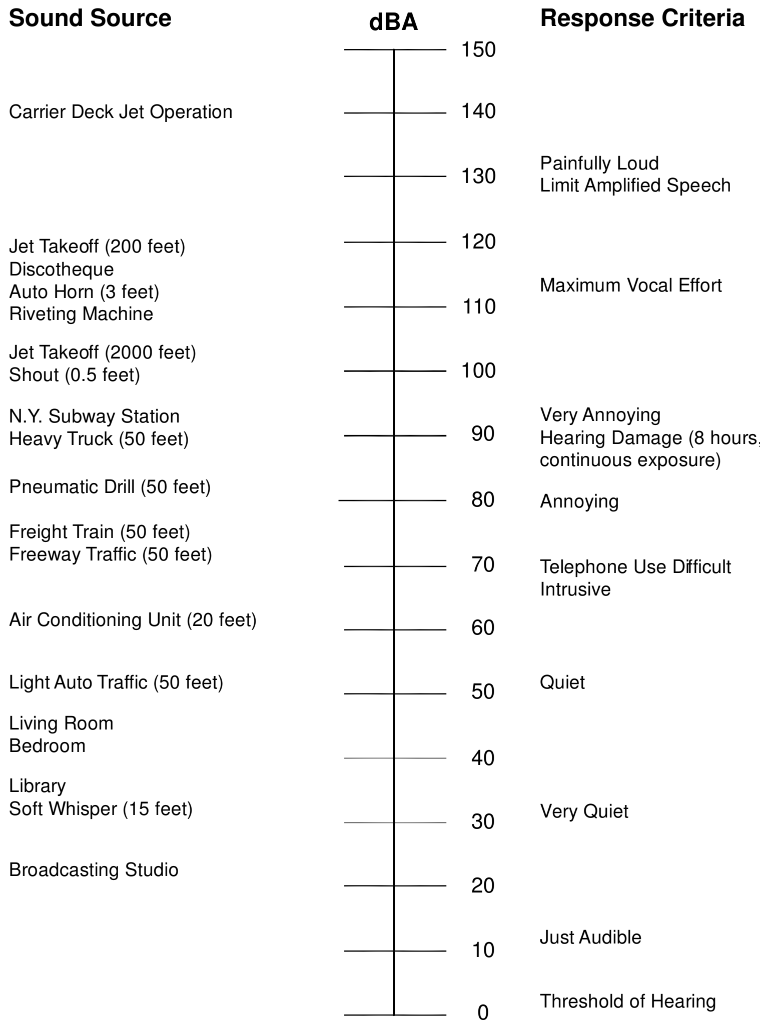
- L_{eq} is the continuous equivalent sound level. The sound energy from fluctuating SPLs is averaged over time to create a single number to describe the mean energy or intensity level. Because L_{eq} values are logarithmic expressions, they cannot be added, subtracted, or compared as a ratio unless that value is converted to its root arithmetic form.
- L_{max} is the highest, while L_{min} is the lowest SPL measured during a given period of time. These values are useful in evaluating L_{eq} for periods that have an especially wide range of noise levels.

For this analysis, DOE evaluated noise levels generated by stationary (e.g., fixed location) sources such as construction-related and power plant operating equipment, and mobile (e.g., moving) sources such as construction-related vehicle trips and operational deliveries by rail, car, and truck. DOE predicted stationary source noise levels during construction and normal plant operations at sensitive receptor locations in direct line-of-sight of proposed project facilities by summing anticipated equipment noise contributions and applying fundamental noise attenuation principles. DOE used the following logarithmic equation (Cowan, 1994) to predict noise levels at the sensitive receptor locations selected for the stationary source analysis:

$SPL_1 = SPL_2 - 20 \text{ Log } (D_1/D_2) - A_e$, where:

- SPL_1 is the noise level at a sensitive receptor due to a single piece of equipment operating throughout the day;
- SPL_2 is the equipment noise level at a reference distance D_2;
- D_1 is the relative distance between the equipment noise source and a sensitive receptor;
- D_2 is the reference distance at which the equipment level is known; and
- A_e is a noise level reduction factor applied due to other attenuation effects.

DOE compared the calculated results to the existing ambient noise levels and the City of Mattoon noise ordinance. Because the FutureGen Project is in the early pre-design stage, noise specification data for the power plant operating equipment are not available. In lieu of project-specific data, DOE used comparable noise data predicted for the proposed Orlando IGCC power plant facility (DOE, 2006) to estimate the increase in the noise level at sensitive receptors in the vicinity of the proposed Mattoon Power Plant Site. Residences and any schools, hospitals, nursing homes, houses of worship, and parks within the 1-mile (1.6-kilometer) ROI were considered sensitive receptors in this analysis.



Source: ***NYSDEC, 2000***

Figure 4.14-1. SPL Values of Common Noise Sources

For mobile sources, DOE estimated noise levels using traffic noise screening ***and analysis*** techniques to compare the vehicle traffic mix data for the future Build and No-Build traffic conditions on each roadway studied. DOE calculated the ratio of the future Build and future No-Build traffic volumes using the following equation (FHWA, 1992):

Predicted Change in Noise Level (dBA) = 10 Log (Future Build PCE/Future No-Build PCE), where
one heavy truck = 28 passenger car equivalents (PCEs)

In applying this equation, a doubling of traffic means future Build conditions are predicted to be twice future No-Build condition. A doubling in the vehicle traffic volume would result in a 3-dBA increase in noise level (10 Log [2/1] = 3 dBA). A ten-fold increase in traffic would result in a +10 dBA change (10 Log [10/1] = 10 dBA).

For this analysis, DOE used a predicted 3-dBA increase in the ambient noise level at sensitive receptors located adjacent to the project-related transportation routes as a threshold indicating that further detailed noise analysis (e.g., modeling) would be needed***. DOE then used FHWA's Traffic Noise Model, Version 2.5 (TNM), which considers roadway geometry, vehicle speed, and traffic direction,*** to ***predict the increase in noise generated by project-related traffic and*** determine if the impacts would be potentially significant. Otherwise, DOE concluded that the anticipated increase in noise levels resulting from project-related activities would not be noticeable and would require no further analysis.

Vibration Methods

> **Vibration** is an oscillatory motion that can be described in terms of displacement, velocity, or acceleration.

The concept of vibration can be understood in terms of displacement as it relates to the distance a fixed object (e.g., floor) moves from its static position. Common measurements of velocity are not well understood by the average person. For example, the preferred vibration descriptors used to assess human annoyance/interference and building damage impacts are the root-mean-square (RMS) vibration velocity level and the PPV, respectively. The RMS vibration level is expressed in units of VdB. The PPV, expressed in in/sec or mm/sec, represents the maximum instantaneous speed at which a point on the floor moved from its static position (FTA, 2006).

Generally, the background vibration velocity level encountered in residential areas is 50 VdB or lower (FTA, 2006). The threshold of perception for humans to experience vibrations is 65 VdB. Typical sources of vibration include the operation of mechanical equipment indoors, slamming of doors, movement of trains on rails, and ground-breaking construction activities such as blasting and pile driving. The effects on vibration-sensitive receptors from these activities can range from feeling the window and the building floor shake, to rumbling sounds, to causing minor building damage (e.g., cracks in plaster walls) in rare cases. The criterion for minor structural damage is 100 VdB, or 0.12 in/sec (3.05 mm/sec) in terms of PPV for fragile buildings (FTA, 2006).

DOE performed the vibration analysis using progressive levels of review. Initially, DOE prepared a vibration screening analysis to evaluate the potential effects that ground-borne vibrations generated by project-related construction and operational activity would have on adjacent sensitive receptors, including humans, buildings, and vibration-sensitive equipment. If the results of this preliminary analysis showed that screening thresholds would be exceeded, DOE applied further vibration study methods to determine if the impacts would be potentially significant.

4.14.2 AFFECTED ENVIRONMENT

4.14.2.1 Power Plant Site

The proposed Mattoon Power Plant Site and the majority of the land area within 1 mile (1.6 kilometers) of the site boundary are currently in agricultural use. There are about two dozen farmsteads (e.g., farm houses, outbuildings, silos, and pastures) and single-family residences within the 1-mile (1.6-kilometer) region surrounding the site, including about a dozen residences along Western Avenue, situated along the eastern edge of the 1-mile (1.6-kilometer) region. Riddle Elementary School is located just outside the 1-mile (1.6-kilometer) boundary along the southeastern edge.

Several existing noise sources contribute to the ambient noise levels in the vicinity of the proposed Mattoon Power Plant Site. These sources include a Canadian National rail line; traffic on SR 121, CR 800N, CR 900N, and CR 130E; and farmsteads. The Mattoon EIV describes ambient noise levels based on daytime and nighttime measurements collected on August 29, 2006, at various locations along and within 1 mile (1.6 kilometers) of the proposed site boundary, as shown in Figure 4.14-2 (FG Alliance, 2006a). Table 4.14-1 describes geographic information and identifiers used for each noise measurement location.[2]

Table 4.14-1. Noise Measurement Locations Near Proposed Mattoon Power Plant Site

Site ID	Location	Proximity to Proposed Mattoon Power Plant Site
SL-1	Along CR 900N between CR 130E and SR 121	Along northern boundary of proposed site near existing farmstead
SL-2	Along Dole Road, approximately 0.25 mile (0.40 kilometer) south of SR 121	Along eastern boundary of proposed site
SL-3	Intersection of Dole Road and CR 800N	Southeast corner of proposed site boundary near existing farmstead
SL-4	Intersection of CR 800N and CR 130E	Southwest corner of proposed site boundary
SL-5	Near intersection of CR 800N, 43rd Street and SR 121	Approximately 1 mile (1.6 kilometers) east of proposed site boundary near existing residence
SL-6	Along CH 13, north of CR 900N	Approximately 0.4 mile (0.6 kilometer) north of proposed site boundary near existing farmstead
SL-7	Intersection of Western Avenue and 43rd Street	More than 1 mile (1.6 kilometers) southeast of proposed site boundary near existing residences and Riddle Elementary School

Source: FG Alliance, 2006a.

Daytime noise measurements were collected at all locations shown on Figure 4.14-2, and nighttime measurements were collected at only three locations: SL-3, SL-5, and SL-7. These locations were chosen because they represent ambient noise levels along the property boundary and at sensitive receptors (residences and one school) that are closest to the proposed Mattoon Power Plant Site. Under Title 35 of the Illinois Administrative Code, Part 900 - "*General Provisions*," daytime hours are the hours between 7:00 AM and 10:00 PM, and nighttime hours are defined between 10:00 PM and 7:00 AM. As reported in the Mattoon EIV (FG Alliance, 2006a), existing noise levels were collected using a Reed Model 322 digital sound level meter with a data logging function in accordance with noise measurements procedures outlined in Title 35 of the Illinois Administrative Code, Part 910. Broadband noise levels were collected and recorded in dBA at each receptor location over 10-minute sampling periods. No octave band measurements were taken (FG Alliance, 2006a). The ambient noise environment in this area ranged from 48 to 59 dBA, which is generally typical of a quiet, rural setting (see Figure 4.14-1). Intermittent increases in the ambient noise due to road and rail traffic fluctuations were observed, which is indicated by the recorded peak maximum levels of 84.7 dBA (at SL-2) and 67.1 dBA (at SL-3) during the day and nighttime measurement periods, respectively. Table 4.14-2 lists the recorded L_{eq} noise levels as well as the maximum and minimum SPL values.

4.14.2.2 Sequestration Site

The proposed sequestration site is the same as the proposed Mattoon Power Plant Site. Therefore, information presented for the proposed power plant site is also applicable to this sequestration site.

[2] SL-2 is inside the proposed Mattoon Power Plant Site boundary and is not discussed further in this EIS. Instead, the EIS focuses on ambient noise levels and potential impacts at residences and other receptors beyond the site boundary.

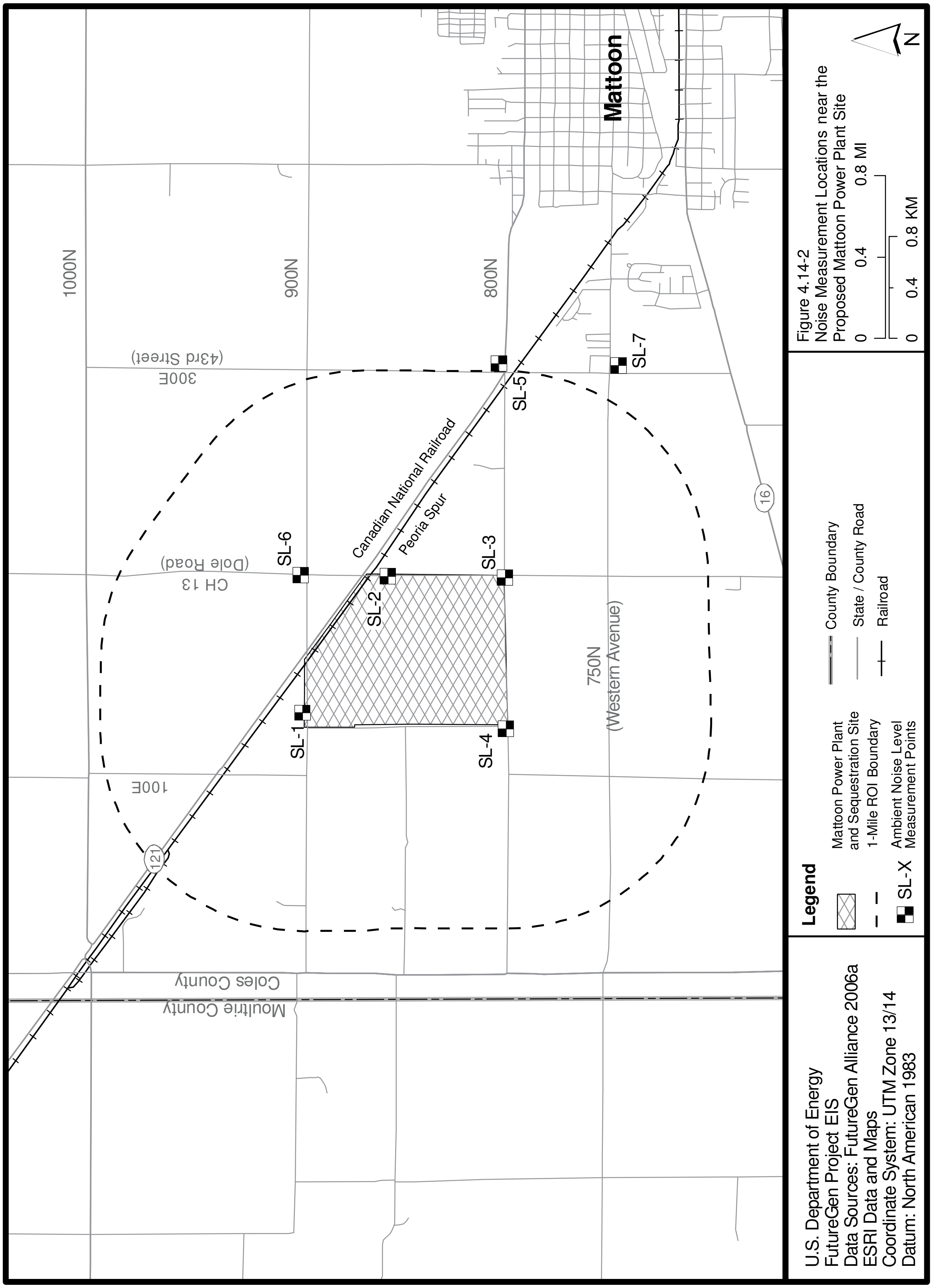


Figure 4.14-2
Noise Measurement Locations near the Proposed Mattoon Power Plant Site

Table 4.14-2. Measured Ambient Noise Levels and Maximum and Minimum Sound Pressure Level Values

Location	Daytime Noise Levels in dBA			Nighttime Noise Levels in dBA			Time Collected	
	L_{max}	L_{min}	L_{eq}	L_{max}	L_{min}	L_{eq}	Day	Night
SL-1	51.7	44.2	47.9	-	-	-	8:50 AM	-
SL-2	84.7	57.0	59.2	-	-	-	7.53 AM	-
SL-3	61.0	49.9	52.2	67.1	55.5	57.5	8:10 AM	6:34 AM
SL-4	54.8	50.9	52.3	-	-	-	8:31 AM	-
SL-5	63.0	49.7	55.2	64.4	54.1	57.1	9:10 AM	5:49 AM
SL-6	70.9	49.1	51.5	-	-	-	7:32 AM	-
SL-7	76.9	48.3	52.5	64.2	50.9	54.3	9:26 AM	6:09 AM

dBA = A-weighted decibels; L_{max} = highest sound pressure level; L_{min} = lowest sound pressure level; L_{eq} = continuous equivalent sound level.
Source: FG Alliance, 2006a.

4.14.2.3 Utility Corridors

Noise was not measured along the transmission line corridor options because any project-related impacts would be limited to a brief construction period. All of the options traverse mostly agricultural farmland. As such, the ambient noise environment along the corridors is likely to be similar to the proposed Mattoon Power Plant Site.

The project-related pipeline corridors (e.g., potable water, sanitary wastewater, process water, and natural gas pipelines) would traverse a variety of land uses. No noise measurements were taken along the proposed pipeline corridors because any project-related impacts would be limited to a brief construction period. Near the proposed Mattoon Power Plant Site, the ambient noise environment of the proposed pipeline corridors is generally similar to that described for the proposed power plant site. The ROIs for the pipeline corridors are predominantly agricultural farmland but also include some residences, woodlands, and water bodies. In particular, the proposed process water pipeline corridor includes some residential streets in Mattoon. Additionally, there are two municipal wastewater treatment plants and seven public schools in the ROIs. As such, the ambient noise levels in these areas are likely to be higher than the ambient noise levels near the proposed power plant site.

4.14.2.4 Transportation Corridors

A few residences are located along the transportation routes (e.g., CH 13 and CH 18) leading to the proposed Mattoon Power Plant Site. The existing ambient noise level measured in this area (SL-6) is 51.5 dBA (FG Alliance, 2006a).

4.14.2.5 Regulatory Setting

There are no federal, state, or local government noise standards applicable to proposed construction activities, although the City of Mattoon requires that noise control measures be applied to minimize objectionable noise from equipment. For plant operation, the State of Illinois and City of Mattoon have established maximum noise level threshold standards. Additionally, the FTA establishes guidelines and threshold standards for noise and vibration related to project affecting transit facilities (FTA, 2006). In

Coles, Cumberland, and Shelby ***counties***, there are no noise ordinances or codes that would apply to activities proposed for this project.

State of Illinois Noise Code

Operational activities at the proposed Mattoon Power Plant Site and its related constructed corridors, including the electrical transmission line, CO_2, process water, wastewater, and potable water corridors, would be governed by noise regulations outlined in Title 35 of the Illinois Administrative Code, Part 901 – *Sound Emission Standards and Limitations for Property Line–Noise–Sources.* These regulations define property use by three distinct land classes: Class A properties are considered the most sensitive receptors (i.e., residences), Class B properties are considered businesses and services, and Class C properties are considered utilities, manufacturing, and industrial (i.e., railroads, industrial plants, agricultural). The proposed site is currently a Class C property (agricultural). Properties within the vicinity of the proposed site and its corridors are currently Class A (residences), Class B (businesses), and Class C (roads, industrial, agricultural, railroads).

Part 901 establishes maximum allowable octave band noise levels emitted from any property-line-noise-source located on any Class A, B, or C land to any receiving Class A property. Tables 4.14-3 and 4.14-4 provide threshold values that should not be exceeded to conform to noise spectrum levels at the octave band center frequencies for daytime and nighttime hours, respectively. The noise spectrum limitations do not apply to sound emitted from equipment being used for construction or to impulsive sound produced by blasting activities.

Table 4.14-3. Daytime Maximum Allowable Octave Band Noise Level Emitted to Receiving Class A Property in dB

Octave Band Center Frequency (Hertz)	Class C Property	Class B Property	Class A Property
31.5	75	72	72
63	74	71	71
125	69	65	65
250	64	57	57
500	58	51	51
1,000	52	45	45
2,000	47	39	39
4,000	43	34	34
8,000	40	32	32

dB = decibels.
Source: 35 IAC 901.

City of Mattoon Noise Ordinance

The City of Mattoon Noise Ordinance establishes a maximum noise level of 70 dB at the property line of any industrial site. Furthermore, it stipulates that noise must be muffled so as not to become objectionable due to intermittence, beat frequency, or shrillness. Noise generated by industrial operations may not exceed current noise levels encountered during the daytime from roadway traffic noise. As such, the City of Mattoon noise ordinance is more restrictive than the state standard; therefore, DOE used the city's standard for assessing potential impacts.

Table 4.14-4. Nighttime Maximum Allowable Octave Band Noise Levels Emitted to Receiving Class A Property in dB

Octave Band Center Frequency (Hertz)	Class C Property	Class B Property	Class A Property
31.5	69	63	63
63	67	61	61
125	62	55	55
250	54	47	47
500	47	40	40
1,000	41	35	35
2,000	36	30	30
4,000	32	25	25
8,000	32	25	25

dB = decibels.
Source: 35 IAC 901.

FTA Noise and Vibration Impact Assessment Criteria

FTA established guidelines and methods to perform noise and vibration impact assessments for proposed projects involving transit facilities (FTA, 2006). To assess noise impacts, FTA recommends applying the same methods described in Section 4.14.1.2 to identify receptors that the project could potentially affect and to estimate noise contributions from project-related mobile and stationary sources. To determine if a proposed transit project would significantly increase ambient conditions at a particular sensitive receptor, FTA established incremental change and absolute daytime/nighttime limits. For vibration, FTA recommends progressive levels of analysis depending on the type and scale of the project, the stage of project development, and the environmental setting. Such analysis typically begins with a screening process that evaluates relative distance information between the source of ground-borne vibrations and the vibration-sensitive receptors that have been identified. If the relative distance from the source of ground-borne vibrations to a residential receptor is greater than 200 feet (61 meters), FTA guidelines indicate that it is reasonable to conclude that no further evaluation of potential vibration impacts is needed (FTA, 2006). Otherwise, FTA provides criteria to assess the impacts of human annoyance, as well as building and vibration-sensitive equipment damage, using detailed quantitative analyses to predict VdB and PPV values generated by the proposed project.

4.14.3 IMPACTS

4.14.3.1 Construction Impacts

Construction of the proposed Mattoon Power Plant is expected to be typical of other power plants in terms of schedule, equipment used, and other related activities. Noise and vibration would be generated by a mix of mobile and stationary equipment noise sources, including bulldozers, dump trucks, backhoe excavators, graders, jackhammers, cranes, pumps, air compressors, and pneumatic tools during construction of the proposed power plant and the related utilities. For the purposes of this analysis, DOE evaluated the proposed project site an area-wide stationary source with construction equipment operating within its boundary. The results of DOE's noise and vibration analyses show that, in the absence of mitigation, the proposed project would increase ambient noise levels for the sensitive receptors located within the 1-mile (1.6-kilometer) ROI, and possibly beyond. However, impacts from ground-borne vibrations would not be expected.

Power Plant Site

Noise levels generated during construction at the proposed Mattoon Power Plant Site would vary, depending upon the phase of construction. Typical power plant construction activity entails the following phases:

- Site preparation and excavation;
- Foundation and concrete pouring;
- Erection of building components; and
- Finishing and cleanup.

DOE anticipates that construction noise contributions would be greatest at the site during the initial site preparation and excavation phase due to the almost constant loud engine and earth breaking noises generated by the use of heavy equipment such as a backhoe excavator, earth grader, compressor, and dump truck. In addition, noise level increases are anticipated along the off-site routes leading to the site because of entry/exit truck movements, especially during the foundation and concrete pouring construction phase. The other phases would generate less audible noise because the equipment used for these activities (e.g., cranes) generally would be transient in nature or would not generate much noise. Table 4.14-5 provides standard noise levels for construction equipment measured at a reference distance of 50 feet (15.2 meters).

Due to the proximity of the receptors located directly opposite the perimeter of the proposed site (SL-1 and SL-3), mitigation would be necessary to reduce impacts resulting from construction of the power plant. To evaluate the potential maximum effects of the anticipated noise level increases on the sensitive receptors located to north, east, and south/southeast of the site boundary, DOE predicted equipment source noise levels using the logarithmic equation described in Section 4.14.1.2. First, the combined noise level expected from the three noisiest pieces of equipment (e.g., excavators, graders, and dump trucks) used during the initial phase of construction was attenuated over relative distances from the site boundary to the following five directional noise-sensitive receptors:

- SL-1: Along northern boundary of proposed site near existing farmstead
- SL-3: Southeast corner of proposed site boundary near existing farmstead
- SL-5: East of proposed site boundary near existing residence
- SL-6: North of proposed site boundary near existing farmstead
- SL-7: Southeast of proposed site boundary near existing residences and Riddle Elementary School

Table 4.14-5. Common Equipment Sources and Measured Noise Levels at a 50-foot (15-meter) Reference Distance

Equipment	Noise Level in dBA
Backhoe Excavator	85
Bulldozer	80
Grader	85
Dump Truck	91

Table 4.14-5. Common Equipment Sources and Measured Noise Levels at a 50-foot (15-meter) Reference Distance

Equipment	Noise Level in dBA
Concrete Mixer	85
Crane	83
Pump	76
Compressor	81
Jackhammer	88
Pile Driver	101

dBA = A-weighted decibels.
Source: Bolt***, Beranek, and Newman***, 1971.

The existing and distance-attenuated noise levels were then logarithmically summed to predict an estimated noise level at each receptor location identified above, as shown in Table 4.14-6. This represents a maximum noise prediction estimate because sound waves generated by the noisiest pieces of equipment are assumed to start at the site boundary and continuously propagate in open air. In addition, the result does not account for any decibel-reducing factors due to atmospheric and ground attenuation effects.

Table 4.14-6. Estimated Noise Levels at Selected Residential Receptor Locations

Sensitive Receptor	Relative Distance in feet (meters)	Existing Ambient Noise Level (dBA)	Combined Equipment Noise Level (dBA)[1]	Equipment Noise Level Attenuated by Distance (dBA)	Estimated Noise Level (dBA)	Change in dBA
SL-1	30 (9.1)	47.9	93	89.1	89.1	+41.2
SL-3	30 (9.1)	52.2	93	89.1	89.1	+36.9
SL-5	5,280 (1,609)	55.2	93	52.5	57.1	+1.9
SL-6	2,000 (610)	51.5	93	61.0	61.5	+10.0
SL-7	5,500 (1,676)	52.5	93	52.2	55.4	+2.9

[1] Combined equipment noise level at 50 feet (15.2 meters) from source.
dBA = A-weighted decibels.

A comparison of the predicted noise levels with the measured daytime ambient noise levels at SL-1, SL-3, and SL-6 shows that, during the hours when construction equipment would be operating as described above (that is, with the noisiest equipment operating), construction of the proposed Mattoon Power Plant would be very noticeable to these receptors because the incremental change from the existing condition would be much greater than 3 dBA. Specifically, the increases would be 41.2, 36.9, and 10 dBA, respectively. Noise level changes of 41.2 and 36.9 would be very significant, as expected with heavy equipment operating right across the street from these two residences. The noise level change of 10 dBA at SL-6 would be perceived as an approximate doubling of the noise level. At SL-5 and SL-7, about 1 mile (1.6 kilometers) from the site, construction of the proposed plant, even with the noisiest equipment operating, would not be noticeable because the incremental change in the noise levels would be less than 3 dBA, the threshold of change detectable by the human ear, at both sensitive receptor locations. Noise mitigation measures, including the use of mufflers to control noise as mandated by the City of Mattoon, would reduce the predicted change in the noise environment.

To evaluate the potential maximum impacts ***for the nighttime period when the existing background noise levels would probably be the quietest,*** DOE ***performed supplemental noise studies on June 26 and 27, 2007 during the early morning hours. The results of the supplemental noise study show that*** the ***ambient environment within an approximate 2-mile radius*** of the power plant ***would be quietest during the night between 12 AM and 4 AM, with an averaged*** noise level of 4***5*** dBA. Based on ***the averaged*** 4***5*** dBA background level, Figure 4.14-3 depicts the change in noise level at various distances from the power plant site. Under this assumption, the threshold 3 dBA increase detectable to the human ear would occur about ***2.4*** miles (3.***9*** kilometers) from the boundary of the power plant site, an area that would encompass several dozen residences and Riddle Elementary School. However, at any point where the background noise level was actually higher than 4***5*** dBA, such as along roadways (for example, SR 121, CH 13, Western Avenue, or 43rd Street) or the Canadian National Railroad, Figure 4.14-3 overstates the increase in noise level at those locations.

During power plant startup, steam blowdown would be required toward the end of the construction phase. The blowdown activity would consist of several blows to test the IGCC system, including the gasifier steam lines, HRSG, and steam turbine. DOE anticipates that very loud noises as high as 102 dBA would be generated during all steam blows. The blowdown noise is assumed to originate at the center of the property and would attenuate to approximately 70 dBA at the property boundary, which would affect the two closest residential receptors (SL-1 and SL-3). Noise levels at these two receptors would increase by as much as 21 dBA, compared to the measured background levels shown in Table 4.14-2. At residential receptors located beyond the perimeter of the site (SL-5, SL-6, and SL-7), the ambient noise generated by the steam blows could range from 59 to 64 dBA, which is up to 13 dBA higher than the existing ambient conditions in the vicinity of the proposed power plant, resulting in short-term adverse impacts. Precautionary measures that could be taken to mitigate this impact include limiting steam blows to the daytime hours, providing advance notice to citizens residing near the power plant, and establishing a community outreach program to inform the community at large before beginning plant blowdown activity. Blowdown activities generally would last no more than 2 weeks.

DOE anticipates little or no vibration impact to sensitive receptors during construction because the closest vibration-sensitive receptors, including humans, buildings, and sensitive equipment, are not located within the 200-foot (61-meter) distance screening and human annoyance threshold for ground-borne vibrations defined by FTA guidance (FTA, 2006).

Sequestration Site

The sequestration site is within the same footprint as the power plant site. Therefore, the impacts on sensitive receptors are included in those as described for the proposed power plant site.

Utility Corridors

Transmission Corridors

Construction of the proposed transmission line in any of the corridor options would occur mostly across agricultural farmland. No major noise and vibration impacts are anticipated; however, a temporary increase in noise due to construction could occur. No major noise and vibration impacts are anticipated at the few residences identified along the transmission line routes because of the nature of transmission line construction techniques and the fact that the duration of construction would be limited to less than 6 months for the 16-mile (25.7-kilometer) line. Temporary construction activities would include activities

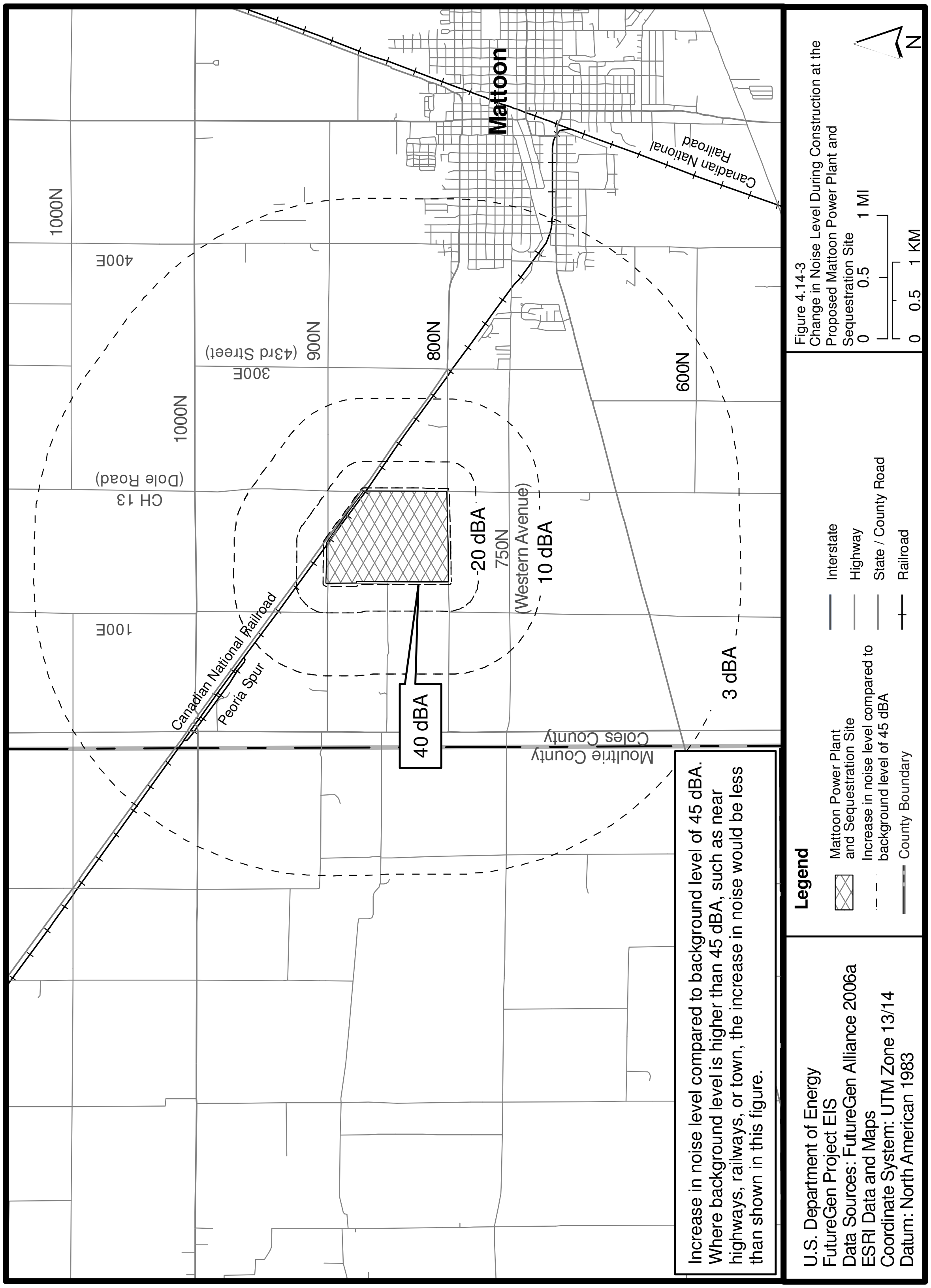


Figure 4.14-3
Change in Noise Level During Construction at the Proposed Mattoon Power Plant and Sequestration Site

such as installing concrete footings and erecting towers or poles using an excavator, crane, and handheld tools at discrete intervals along the proposed transmission line corridor.

Pipeline Corridors

Trench excavations or horizontal directional drilling techniques used to install utility pipelines would take less than 6 months to complete and would result in a temporary increase in noise during construction. Elevated noise levels would be experienced by sensitive receptors located in the vicinity of the proposed construction activity. However, due to the temporary and linear nature of the pipeline construction, DOE expects minimal impacts at adjacent noise- and vibration-sensitive receptors. The primary equipment used for these types of short-term linear and limited ground disturbance construction activities includes excavator and dump trucks. At roadway and rail crossings, boring machines would be used to complete excavation under the roadway or rail line.

Transportation Corridors

The truck routes connecting I-57 to the proposed Mattoon Power Plant Site are CH 18, CH 13, and SR 121. The existing vehicle traffic count data along the primary transportation routes leading into the proposed site are provided in Table 4.14-7.

Additional construction-related truck trips entering or leaving the proposed site would cause the ambient noise levels to increase. To determine the extent of the anticipated traffic-caused noise level increases ***for the DEIS***, DOE evaluated the existing and projected Build and No-Build traffic data for each roadway and applied a factor to account for the greater noise energy contribution from the movement of trucks compared to passenger cars when traveling along roadways near sensitive receptors. Traffic noise screening results listed in Table 4.14-7 show that, in the absence of mitigation, construction-related vehicles (e.g., passenger cars and trucks) traveling on CH 13 and CH 18 to and from the proposed power plant would appreciably increase the noise level (that is, the change would be greater than 3 dBA) at nearby noise-sensitive receptors. Conversely, the impacts on receptors adjacent to SR 121 would not be noticeable.

To obtain more specific information on the potential impacts that construction traffic may have on receptors adjacent to CH 13 and CH 18, DOE took an AM peak hour ambient noise measurement and conducted a detailed TNM analysis along both roadways following issuance of the DEIS. Measurements were taken at a representative location along the CH 13 and CH 18 noise study segments on June 26, 2007, using the same methods described in Section 4.14.1.2. The sound level meter was placed in the middle of the sidewalk for a 20-minute noise measurement period and three-way vehicle classification (i.e., passenger car, medium or heavy trucks) traffic counts were taken simultaneously. Next, DOE multiplied by three the vehicle classification data collected during the noise measurement to compute the hourly traffic flow. The resulting vehicle mix data and traffic speed were then input into TNM along with the configuration of the roadway segment and distance between the noise meter and the roadway's centerline using a three-dimensional coordinate system. DOE then compared the measured L_{eq} values of 55.4 dBA and 65.7 dBA with the TNM predicted L_{eq} values of 50.9 dBA and 54.0 dBA to calibrate the modeling program for the CH 13 and CH 18 roadway segments; respectively. The results of this comparative analysis showed that ambient noise in both noise study areas is influenced by other noise sources in addition to those generated by roadway traffic. A greater difference between the measured and TNM predicted L_{eq} was observed on CH 18 due to the additional tire noise generated by the horizontally grooved roadway.

Finally, DOE used TNM to compute the incremental change in the ambient sound level that would occur due to the additional vehicular noise generated by construction traffic for the proposed power plant. For these model runs, DOE input the proposed 2009 Build and No-Build traffic volume data using the same roadway configuration and including the receptors adjacent to CH 13 and CH 18. The TNM output file predicted an incremental change of 7.9 dBA and 4.9 dBA along CH 13 and CH 18; respectively, which is slightly more than the preliminary results shown in Table 4.14-7. Consistent with the results presented in the DEIS, the detailed TNM analysis also predicted that the residences located adjacent to both roadway segments would be expected to experience an appreciable increase in the ambient noise levels.

Mitigation measures that would reduce noise impacts on CH 13 and CH 18 could include adjusting construction worker shifts to lower the total vehicle trips during the morning and evening peak hours.

Table 4.14-7. Projected Noise Level Increase During Construction

Roadway Segment	Existing Peak Hour Volume	Future No-Build Peak Hour Volume	Project New Total/Truck Trips	Future Build Peak Hour Volume	Projected Noise Level Increase
CH 13, south of CH 18	35/0[1]	36/4	592/4	628/8	+7.7 dBA
CH 18, east of CH 13	120/12	125/13	592/4	717/17	+3.9 dBA
SR 121, near site	445/35	463/36	722/5	1,185/41	+2.0 dBA

[1] CH 13 is not currently rated for trucks. Future conditions assume 10 percent trucks based on surrounding roadways.
Peak hour traffic data are provided as total/truck volumes.
Build/No-Build Year: 2009.
Percentage of trucks traveling along CH 18 is assumed to be 10 percent.
Hour volumes are the same.
Project New Total/Truck Trips were obtained from Table 4.13-9.

During construction of the rail spur loop, the noise and vibration impacts would be the same as described for the proposed power plant site.

4.14.3.2 Operational Impacts

Projected noise levels calculated using the noise screening and analysis methods described in Section 4.14.1.2 show that there would be significant permanent ambient noise level increases resulting from operation of the proposed power plant facility at receptors located directly opposite the perimeter of the proposed power plant site. Mitigation would be necessary to reduce impacts resulting from plant operations. Results from the mobile source analysis show that project-induced traffic noise would not be noticeable to noise-sensitive receptors identified near assigned transportation routes, except for those on CH 13. DOE expects no operational impacts at the constructed pipeline corridors because the pipelines would be buried underground. The transmission line may generate some additional noise; however, the results of the impacts analysis show that any noise impacts would be minimal.

Power Plant Site

The principal equipment noise sources during plant operation include the gas combustion turbine/generator, steam turbine/generator, heat recovery systems, turbine air inlets, exhaust stack, six-cell mechanical-draft cooling tower, coal crusher, coal mill, pumps (e.g., feed, circulating), fans, and compressors, as well as noise from piping flow and flared gas. For the most part, these noise sources would be enclosed inside of a building. In addition, noise sources within the building would be fitted with acoustical enclosures or other noise dampening devices to attenuate sound. Conversely, noise generated by equipment installed without full enclosures and exposed to the outside environment (e.g., flare) could potentially increase the ambient noise levels in the surrounding community.

To determine the impacts of normal plant operations, DOE used a noise prediction algorithm to estimate projected equipment noise contributions at the closest sensitive receptor location. Because the FutureGen Project is in the early pre-design stage, noise specification data for the power plant operating equipment are not available. DOE used comparable noise data estimated for the proposed Orlando IGCC power plant facility (DOE, 2006) to determine the potential effects of operational noise on sensitive receptors in the vicinity of the proposed Mattoon Power Plant Site. Using the predicted noise level of 53 dBA at 0.6 mile (1 kilometer) obtained in the model run completed for the Orlando gasification project (DOE, 2006), DOE used the logarithmic distance attenuation formula to derive an estimated source noise level of 89 dBA for the proposed Mattoon Power Plant.

DOE applied the source noise level to the proposed 444-acre (180-hectare) site to compute the attenuated noise level at the property boundary, assuming the noise sources would be at the center of the property. Based on a relative distance of 0.4 mile (0.6 kilometer) from the center of the property to the site's perimeter, DOE predicted a noise level of 57 dBA at the property boundary. A comparison of this predicted noise level value with the City of Mattoon maximum noise limits of 70 dBA shows that the proposed facility would be in conformance with local government regulations. The incremental change in the ambient noise level for SL-1 and SL-3 would be 9.1 and 5.6 dBAs, respectively, where a 10 dBA increase is perceived as a doubling in the noise level. The predicted noise level at SL-6 (approximately 4,100 feet [1,250 meters] from center of the proposed site) would be 51 dBA. Based on this analysis, DOE anticipates no noticeable impact at this sensitive receptor because noise contributions from the proposed power plant added to the existing ambient noise level at SL-6 (e.g., 51.5 dBA) would result in an incremental change of less than 3 dBA. Similarly, SL-5 and SL-7 located greater than 4,100 feet (1,250 meters) from the center of the proposed site would not be affected because noise contributions from operations of the proposed power plant would result in an incremental change of less than 3 dBA.

To evaluate the potential maximum impacts ***for the nighttime period when the existing background noise levels would probably be the quietest,*** DOE estimated the change in noise level that would occur if the entire area had a background noise level of 4***5*** dBA ***as described in Section 4.14.3.1***. Based on ***the averaged*** 4***5*** dBA background level, Figure 4.14-4 depicts the change in noise level at various distances from the power plant and sequestration site. Under this assumption, the threshold 3 dBA increase detectable to the human ear would occur about 1.***5*** miles (***2.4*** kilometers) from the center of the power plant site (not the boundary, which was used for the assessment of construction-related noise impacts), an area that would encompass about a dozen residences. However, as noted previously, at any point where the background noise level was actually higher than 4***5*** dBA, such as along roadways (for example, SR 121, CH 13, Western Avenue, or 43rd Street) or the Canadian National Railroad, the figure overstates the increase in noise level that would actually occur at those sites.

During coal deliveries, noise would be generated by unloading/loading activities such as the movement of containers, placement of coal feedstock on conveyor systems, and surficial contact of rail containers with other metallic equipment. Based on the estimated number of coal deliveries anticipated for the proposed power plant site, DOE estimated an hourly L_{eq} of 69 dBA from unloading/loading activities at the rail yard using the noise prediction equations listed in Table 5-6 of FTA's guidance document (FTA, 2006). To determine the maximum effects on nearby receptors, DOE assumed that the rail yard noise would occur along the site boundary closest to the receptor. Adding the predicted values for plant operational noise at the boundary (59 dBA) to that of rail yard noise, a combined noise level of 69 dBA was estimated to be generated at the boundary of the plant site during unloading/loading activity.

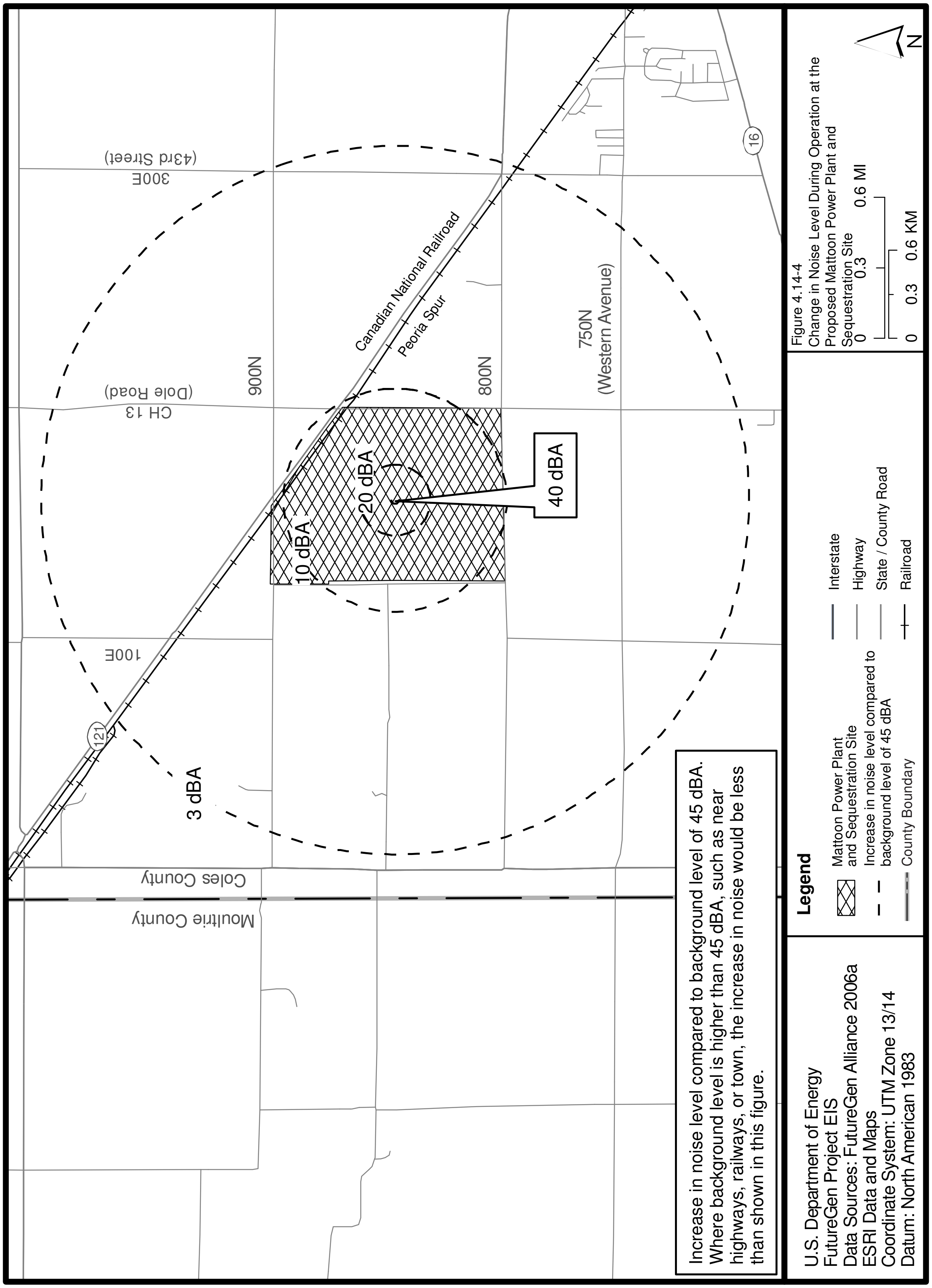


Figure 4.14-4
Change in Noise Level During Operation at the Proposed Mattoon Power Plant and Sequestration Site

This would increase noise levels at the closest residence (SL-1) by as much as 17 dBA. DOE anticipates little or no increase in the noise level at SL-3 because the coal delivery area would likely be located near the northeastern boundary of the site near the existing railroad, which is more than 1,500 feet (457.2 meters) from SL-3. The foregoing analysis does not include additional intermittent noise and vibrations that may be generated by rail car shakers if they are used to loosen coal material from the walls of the rail cars during unloading. Typically, the shakers are mounted on a hoist assembly and are used intermittently for a 10-second period to induce material movement in the rail car (Bolt, Beranek, and Newman, 1984). Pneumatic or electric rail car shakers could generate noise levels up to 118 dBA (VIBCO, Undated-a; VIBCO, Undated-b; Western Safety Products, 2007). If the shaker is used on every rail car, it is estimated that the shaker would be used 253 to 428 times per week. Final design of the coal handling equipment should consider the noise and vibration contributions from the rail car shakers. Limiting unloading/loading activities to an enclosed or screened area or siting these types of activities farthest away from noise-sensitive receptors would help reduce the potential impact.

During unplanned or unscheduled restarts of the power plant, combustible gases would be diverted to the flare for open burning, which would increase the noise level at sensitive receptor locations. Potential noise sources from flare operation that could affect nearby receptors include steam-turbulent induced noise in piping flow and noise generated by pulsating or fluttering flames from the incomplete combustion of the gases. These noise sources could temporarily increase the ambient noise levels in the vicinity of the flare to a range of 96 to 105 dBAs. Positioning the flare unit at a location farthest from a receptor and implementing measures to control the flow of flare gas or steam through piping connected to the flare unit and the incomplete combustion of gases would reduce the impacts. Measures to minimize these short-term impacts would be addressed during the final conceptual design of the IGCC power plant.

Upon completion of final design plans for the proposed Mattoon Power Plant, octave band field measurements would be taken and compared to the State of Illinois noise spectrum limitations. Mitigation measures would be implemented if measured octave band noise levels exceeded the State of Illinois noise spectrum limitations.

Sequestration Site

Because the proposed CO_2 injection site is within the confines of the proposed Mattoon Power Plant Site, the potential effects of noise associated with that facility are included in the effects discussed for the proposed power plant. During borehole micro-seismic testing and surface seismic surveys performed at the sequestration injection site, ground-borne vibrations may be experienced by nearby receptors.

Utility Corridors

Transmission Corridors

No notable impacts would be anticipated from operation of the electrical transmission lines. However, under wet weather conditions, the transmission lines may generate audible or low frequency noises, commonly referred to as a “humming noise.” The audible noise emitted from transmission lines is caused by the discharge of energy (corona discharge) that occurs when the electrical field strength on the conductor surface is greater than the “breakdown strength” (the field intensity necessary to start a flow of electric current) of the air surrounding the conductor. The intensity of the corona discharge and the resulting audible noise are influenced by atmospheric conditions. Aging or weathering of the conductor surface generally reduces the significance of these factors.

Corona noise would not be noticeable because humans are generally insensitive to low frequency noise. However, in some cases, corona noise could be annoying to receptors that are located very near the transmission lines. To mitigate this occurrence, transmission lines are now designed, constructed, and maintained to operate below the corona-inception voltage.

Corona noise is caused by partial discharge on insulators and in air surrounding electrical conductors of overhead power lines.

Pipeline Corridors

No noise or vibration impacts would be anticipated at the proposed pipeline corridors during plant operation.

Transportation Corridors

Additional traffic resulting from operational truck trips entering or leaving the proposed site would be expected to increase the ambient noise levels at receptors adjacent to the assigned truck transportation routes. To determine the extent of the anticipated noise level increases, the existing traffic and the proposed Build and No-Build traffic data were evaluated for each roadway as described in Section 4.14.1.2. ***As presented in the DEIS, r***esults show***ed*** that vehicle trips on roadways leading to the proposed Mattoon Power Plant Site would have no adverse effect on noise-sensitive receptors near CH 18 and SR 121 during normal plant operations because the predicted change in the ambient noise level would be 1.6 and 0.7 dBA, respectively, which is below the 3 dBA change detectable to the human ear. However, in the absence of mitigation, sensitive receptors near CH 13 would experience ambient noise level increases of up to 3.9 dBA. Table 4.14-8 details the projected noise level increase during plant operation.

Similar to what has been described for the construction period, DOE performed an additional analysis following issuance of the DEIS to obtain more specific information on the potential impacts that operational traffic could have on receptors adjacent to CH 13 using the 2012 Build and No Build traffic data. The TNM results predicted an incremental change of 4.0 dBA near CH 13, slightly higher than the value shown in Table 4.14-8. That increase in the noise level would be noticeable in the absence of mitigation.

During the early phase of plant operation, short-term traffic noise impacts are anticipated along the transportation routes related to an increased level of trucks entering/leaving the proposed power plant and sequestration site. Adhering to the recommended truck routes and limiting trips to the daytime hours would help reduce noise impacts at residences along transportation routes.

Table 4.14-8. Projected Noise Level Increase During Plant Operation

Roadway Segment	Existing Peak Hour Volume	Future No-Build Peak Hour Volume	Project New Total/Truck Trips	Future Build Peak Hour Volume	Projected Noise Level Increase
CH 13, south of CH 18	35/0[1]	38/4	134/3	172/7	3.9 dBA
CH 18, east of Ch 13	120/12	129/13	134/3	263/16	1.6 dBA
SR 121, near site	445/35	477/38	164/4	641/42	0.7 dBA

[1] CH 13 is not currently rated for trucks. Future conditions assume 10 percent trucks based on surrounding roadways.
Peak hour traffic data are provided as total/truck volumes.
Build/No-Build Year: 2012.
Percentage of trucks traveling along CH 18 is assumed to be 10 percent.
Hour volumes are the same.
Project New Total/Truck Trips were obtained from Table 4.13-***9***.
dBA = A-weighted decibels.

No noise and vibration-sensitive land use impacts would be anticipated along access routes leading to the pipeline corridors.

Five 100-unit trains per week for coal deliveries would use the Canadian National–Peoria spur rail line. Based on the estimated noise levels listed in FTA's guidance document (FTA, 2006), L_{max} values ranging from 76 to 88 dBA are anticipated from the locomotive, rail cars, whistles/horns, and track switches/crossovers as the freight trains pass by. The L_{max} values are based on an operating speed of 30 mph (48.3 kmph), as measured approximately 50 feet (15.2 meters) from the track's centerline. Comparing the number of additional rail trips projected for coal deliveries during plant operations with the existing two daily rail trips on the Canadian National–Peoria spur rail and the 12 freight trains running daily on the Canadian National main line, DOE estimates that trains using the spur would increase about 71 percent (five trains coming and going [10 trips] added to 14 trains per week) on the Peoria spur and 10 percent on the Canadian National main line (five trains coming and going [10 trips] added to 84 trains per week). Given that the change would amount to about one additional train per day coming or going from the site, the incremental change in the noise environment would be minimal.

Findings from the vibration screening analysis showed that there would be one residential receptor within FTA's distance threshold of 200 feet (61 meters) in one of the potential configurations for the rail spur loop track. As such, DOE applied further vibration study methods to determine if the impacts would be potentially significant to one of the receptors located directly opposite the perimeter of the site (e.g., SL-3). Using the FTA impact criteria for general vibration assessments, DOE compared the established 80 VdB-threshold limit for infrequent rail events to vibration levels that have been predicted in the generalized ground surface vibration curves. An "infrequent event" is defined as fewer than 30 vibration causing events (e.g., rail trips) of the same kind per day (FTA, 2006).

Results from the generalized vibration curves (FTA, 2006) show that freight trains traveling on the rail spur loop at speeds greater than 20 miles per hour (32 kilometers per hour) would cause an exceedance of the FTA's 80 VdB impact threshold limit, and thus vibration impacts are considered probable at any residential receptor located within 40 feet (12 meters) of the track's centerline. However, at lower train speeds or distances greater than 40 feet (12 meters) from the residential receptor, appreciable vibration impacts are not anticipated. A detailed analysis would be needed during final design to help determine appropriate vibration control measures, if deemed necessary to reduce anticipated vibration at sensitive receptors closest to the site (SL-1 and SL-3). The FTA's generalized curves represent the upper range of historical measurement data from well-maintained systems. Other factors, including track surface and rail car suspension characteristics, wheel type and condition, and foundation of the potentially affected building, as well as the placement of the rail spur loop on the site, would need to be evaluated to determine whether vibration from the rail spur loop would affect nearby residences (FTA, 2006).

In some cases geologic conditions, such as stiff clayey soils or shallow bedrock occurring at depths less than 30 feet (9.1 meters) below the surface can result in ground-borne vibrations propagating through the subsurface soils at greater than expected distances from the track (FTA, 2006). Based on the nature of the subsurface soils (e.g., silty clay and loam) and a depth to bedrock of 175 feet (53.3 meters) at the proposed Mattoon Power Plant Site, ground-borne vibrations are not expected to propagate over extended distances (FG Alliance, 2006e).

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4.15 UTILITY SYSTEMS

4.15.1 INTRODUCTION

This section identifies utility systems that may be affected by the construction and operation of the proposed FutureGen Project at the proposed Mattoon Power Plant and Sequestration Site and related corridors. It addresses the ability of the existing utility infrastructure to meet the needs of the proposed FutureGen Project while continuing to meet the needs of other users, and also addresses the question of whether construction of the proposed FutureGen Project could physically disrupt existing utility system features (pipelines, cables, etc.) encountered during construction.

4.15.1.1 Region of Influence

The ROI for utility systems includes two components: (1) the existing infrastructure that provides process and potable water, sanitary wastewater treatment, electricity, and natural gas to nearby existing users and that would also provide service to the proposed project; and (2) pipelines, transmission lines, and other utility lines that lie within or cross the proposed power plant and sequestration site or utility corridors.

4.15.1.2 Method of Analysis

Based on data provided in the Mattoon EIV (FG Alliance, 2006a), DOE performed a comparative assessment of the FutureGen Project utility needs versus the existing infrastructure to determine if the proposed project would strain any of the existing systems. Additionally, DOE used data provided in the EIV (FG Alliance, 2006a) to identify the presence of utility infrastructure that could be affected by project construction.

DOE assessed the potential for impacts based on whether the proposed FutureGen Project would:

- Affect the capacity of public water utilities directly or indirectly;
- Require extension of water mains involving off-site construction for connection with a public water source;
- Require water supply for fire suppression that would exceed water supply capacity;
- Affect the capacity of public wastewater utilities;
- Require extension of sewer mains involving off-site construction for connection with a public wastewater system; and
- Affect the capacity and distribution of local and regional energy and fuel suppliers.

4.15.2 AFFECTED ENVIRONMENT

4.15.2.1 Potable Water Supply

The City of Mattoon draws its potable water supply from Lake Paradise and Lake Mattoon in the Little Wabash River Basin. Currently, Mattoon's daily average potable water use of 2.0 MGD (7.6 MLD) is taken from the Little Wabash River Basin and deposited in the Embarras River Basin as effluent from the wastewater treatment plant (WWTP).

Potable water would be supplied to the Mattoon Power Plant from the city's public potable water system. A 1-mile (1.6-kilometer) extension would be constructed from the proposed Mattoon Power

Plant Site to a 10-inch (25.4-centimeter) potable water pipeline on 43rd Street (CR 300E) south of SR 121. On August 22, 2006, a hydrant flow test was conducted on the fire hydrant nearest the connection point south of the intersection of 43rd Street and SR 121. The hydrant had a flow of 3,438 gallons (13,014 liters) with a residual head of 20 psi (0.14 megapascals) (FG Alliance, 2006a).

Mattoon's potable water treatment plant was built near Lake Paradise in 1999. It is located 5.5 miles (8.9 kilometers) south of the proposed Mattoon Power Plant Site. Lake Paradise is Mattoon's primary potable water source, with the larger Lake Mattoon serving as a secondary source. The plant has a capacity to treat 7.1 MGD (26.9 MLD). From 2001 through 2005, the plant treated an average of 2.26 MGD (8.6 MLD).

4.15.2.2 Process Water Supply

The combined effluent from the municipal WWTPs of Mattoon and possibly Charleston, Illinois, would provide process water for the proposed power plant. Process water would be supplied through a new 6.2-mile (10.0-kilometer) pipeline from the Mattoon WWTP to the power plant site, with the addition of a new 8.1-mile (13-kilometer) pipeline from the Charleston WWTP if necessary. Analysis of daily effluent data from 2004 and 2005 from these two plants indicates that, during these 2 years, there were 179 non-consecutive days where the combined daily effluent amount was below 4.3 MGD (16.3 MLD) (FG Alliance, 2006a). The daily average of the combined effluent over that 2-year period was 7.1 MGD (26.9 MLD). The process water source would also be used for fire suppression. An on-site reservoir could be constructed to store up to 25 million gallons (94.6 million liters) of process water to satisfy water requirements. A small reservoir (7 acres [2.8 hectares]) would be adequate. If a larger reservoir were constructed (approximately 40 acres [16.2 hectares] in size) with a capacity of 200 million gallons (757 million liters), the Mattoon WWTP effluent would be sufficient by itself to supply the proposed plant's process water.

4.15.2.3 Sanitary Wastewater System

The City of Mattoon proposes to supply sanitary sewer service through a 1.25-mile (2-kilometer) extension of the city's existing public wastewater system (FG Alliance, 2006a). In 2004, Mattoon completed a $10 million upgrade to its WWTP. The plant now has the capacity to process 14.0 MGD (53.0 MLD) as a daily maximum and has a design average flow of 5.3 MGD (20 MLD). The current annual average daily flow for this sewer system is 4.4 MGD (16.7 MLD). The force main that would serve the power plant would empty into a lift station that has a maximum capacity of 158,000 gallons (598,095 liters) per day. Currently, during wet flows, it reaches 33,500 gallons (126,811 liters) per day, so the lift station is operating at less than 25 percent of its maximum capacity.

4.15.2.4 Electricity Grid, Voltage, and Demand

The proposed Mattoon Power Plant and Sequestration Site is located in the Southeastern Electric Reliability Corporation (SERC) region. The SERC region includes portions of 16 states in the southeastern and central U.S., and covers an area of approximately 560,000 square miles (1,450,400 square kilometers). SERC is the regional reliability organization for this part of the country, charged with operating and ensuring reliability of the electrical transmission grid.

> Annual average sales of electrical energy in the U.S. are expected to grow from 3,567,000 GWh in 2004 to 5,341,000 GWh by 2030—an increase of about 50 percent (EIA, 2006). The FutureGen Project is scheduled to go on line in 2012 and may contribute toward meeting this need; however, its primary purpose is to serve as a research and development project.

Peak demand in the SERC region occurs during the summer months. As of 2006, the total demand was

188,763 megawatts (MW), and this is forecast to increase to 226,921 MW by 2015 (North American Electric Reliability Council [NERC], 2006), representing a growth rate of 2.1 percent per year. Annual electric energy usage in the region was 962,054 gigawatt-hours (GWh) in 2005 and was forecast to be 973,215 GWh in 2006. Energy usage is forecast to grow at 1.7 percent per year over 10 years, which would result in a potential energy demand of 1,132,654 GWh by 2015 (NERC, 2006).

Current resources in the SERC region equal nearly 250,000 MW (NERC, 2006). This supply, combined with new energy resources of 36,759 MW projected to come on line between 2006 and 2015 (NERC, 2006), would lead to regional supplies exceeding demand by about 60,000 MW in 2015. Thus, the SERC region will likely have significantly more generation capability than needed to meet reliability and adequacy concerns in 2015.

As described in Chapter 2, there are several options for delivering power from the proposed Mattoon Power Plant Site to the regional transmission grid. The nearest high-voltage power line is the 138-kV transmission line running north-south and located less than 0.5 mile (0.8 kilometer) east of the site. A new substation would be required for this connection. The Mattoon West 138-kV substation is located 1.5 miles (2.4 kilometers) southeast and could also be a connection point for the 138-kVsystem. Another option is to connect to the 345-kV system at the Neoga South Substation with a new 16-mile (25.7-kilometer) line south. A preliminary interconnection study (FG Alliance, 2006a) estimates the capacities of the existing transmission network to deliver power from the proposed facility (Table 4.15-1).

Table 4.15-1. Capacities of Existing Transmission Network

Scenario	ATC (Thermal Capacity)		*PV (Voltage Capacity)*	
	Summer	Winter	Summer	*Winter*
138-kV	327 MW	531 MW	475 MW	*500 MW*
345-kV	529 MW	1,025 MW	1,150 MW	*1,213 MW*

kV = kilovolts; MW = megawatts.
Source: PowerWorld Corporation, 2006.

4.15.2.5 Natural Gas

Illinois produces minimal quantities of natural gas and consumes roughly five times what it produces. The state receives substantial natural gas supplies from traditional U.S. source regions along the Gulf Coast and in the mid-continent, as well as from Canada. Illinois ranks first in the nation in per capita annual residential natural gas demand, second in total residential consumption, and third in total commercial consumption of natural gas among the states. Illinois is an important natural gas distribution and storage state, ranking fifth in the nation in natural gas storage capacity, primarily through underground storage of gas used to meet peak winter heating demand in the Midwest and Northeast.

The proposed Mattoon Power Plant and Sequestration Site would have access to a natural gas pipeline owned by Trunkline Gas Company located within approximately 0.25 mile (0.4 kilometer), as shown in Figure 4.15-1. The gas pipeline is a looped high-pressure system. A new tap and delivery station would be required to serve the FutureGen Project.

4.15.2.6 CO_2 Pipeline

No CO_2 pipelines exist in the vicinity of the proposed power plant site.

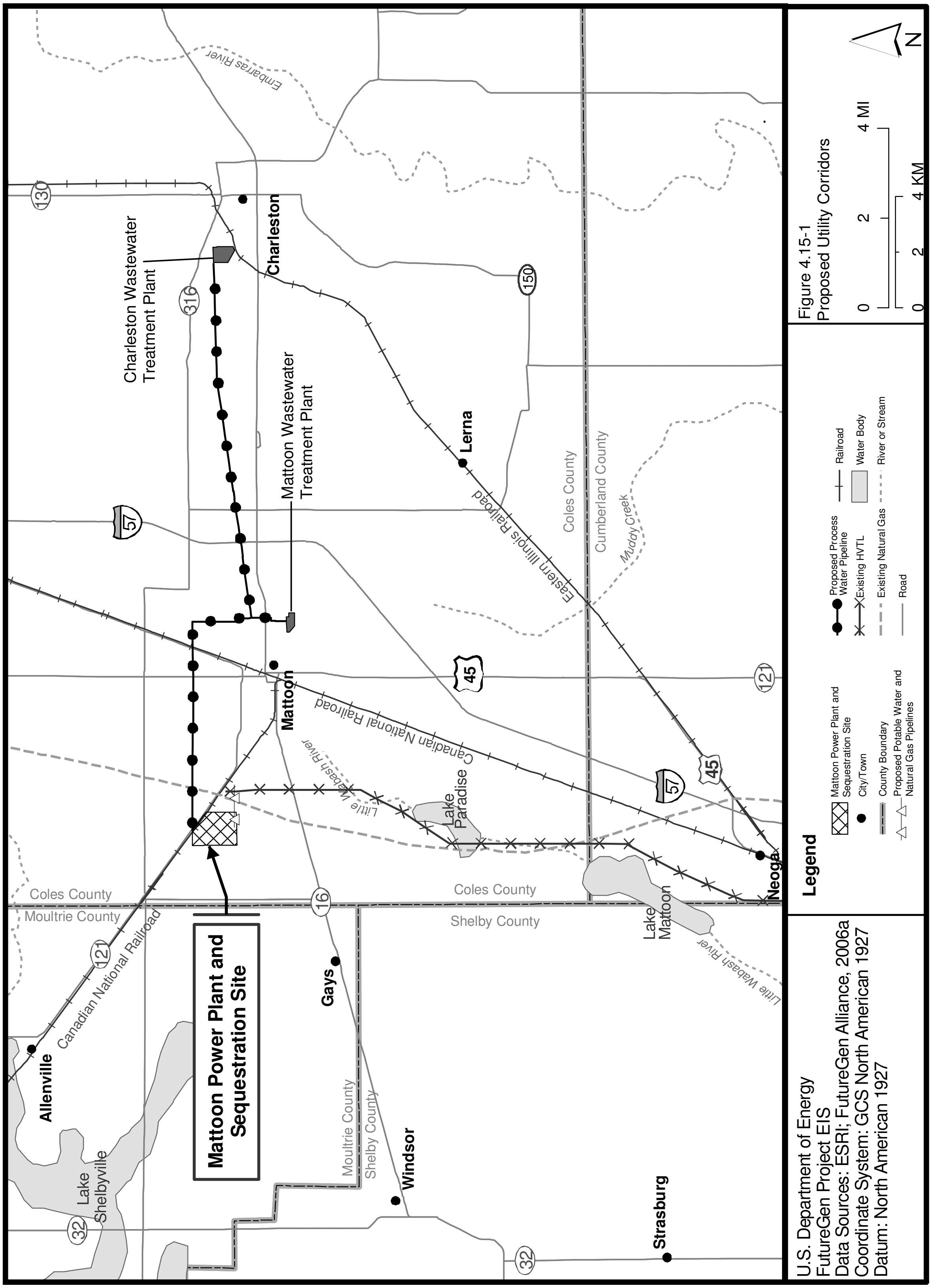

Figure 4.15-1
Proposed Utility Corridors

4.15.3 IMPACTS

4.15.3.1 Construction Impacts

During construction, construction equipment, particularly trenching equipment, could accidentally sever or damage existing underground lines. Additionally, construction equipment could damage power or telephone poles and lines if the equipment were to come into contact with them. However, all of the proposed ROWs have sufficient width to allow for the safe addition of project-related lines without interfering with the existing utilities if standard construction practices are followed. Construction requirements for new utility infrastructure are presented in Table 4.15-2.

Table 4.15-2. Utility System Construction Requirements

Infrastructure Element	Equipment	Duration	Manpower
Potable water pipeline 1 mile (1.6 kilometers) to access nearest pipeline	Backhoe and other small equipment, boring machine for road and rail crossings	1 month	5 workers
Process water pipeline From Mattoon WWTP (6.2 miles [10 kilometers]) and possibly Charleston WWTP (8.1 miles [13.0 kilometers]), wet well, and pumping station	Track hoe, backhoe, other small equipment, boring machine for road and rail crossings	4-6 months each for Mattoon and Charleston portions (could be concurrent)	5-10 workers each for Mattoon and Charleston portions
Sanitary wastewater pipeline 1.25 miles (2.0 kilometers)	Backhoe and other small equipment, boring machine for road and rail crossings	1 month	5 workers
Electric transmission line Option 1: 138-kV line, 2.5 miles (4 kilometers) Option 2: 345-kV line, 16 miles (25.7 kilometers)	Crane for setting poles, bulldozer for earth moving and path leveling, and several bucket trucks	Not estimated	Not estimated
Natural gas pipeline 0.25 mile (0.4 kilometer) to access nearest pipe	Gas pipeline equipment, horizontal directional drilling equipment, other small equipment	1 month	5 workers
CO_2 pipeline	Sequestration site is same as plant site, so connecting pipeline is on plant site	Not estimated	Not estimated

WWTP = wastewater treatment plant.
Source: FG Alliance, 2006a.

Power Plant Site

The proposed Mattoon Power Plant Site does not have any utility lines crossing the site and thus construction at the site would not cause any utility disturbances.

Sequestration Site

The proposed Mattoon Sequestration Site is the same as the proposed power plant site and does not contain utility lines. Consequently, construction activities at the site would not cause any utility disturbances. Utility needs at the sequestration site would be limited to the provision of an electric service line to operate pumps and other equipment.

Utility Corridors

The proposed utility corridors are shown in Figure 4.15-1.

Potable Water Supply

The City of Mattoon proposes to supply potable water for the FutureGen Project from its public potable water system via a 1-mile (1.6-kilometer) extension of the potable water system in the ROW of CR 800N from the proposed Mattoon Power Plant Site to a 10-inch (25.4-centimeter) potable water pipeline on 43rd Street (CR 300E) south of SR 121. Mattoon Township has control of the proposed potable water pipeline ROW and has committed to allow the potable water pipeline to be placed on the ROW.

There are other utilities in the CR 800N ROW. There is a buried telephone cable running the entire length on the north ROW line. Moultrie County Rural Public Water District has a potable water line running between the telephone cable and the roadway on the north side. This line runs 0.5 mile (0.8 kilometer) east of the site to its terminus. An electric transmission line runs in the ROW on the south side of the road beginning 0.5 mile (0.8 kilometer) east of the site and continuing to 43rd Street. A 138-kV transmission line and a set of three high-capacity gas lines cross the proposed ROW perpendicularly 0.5 mile (0.8 kilometer) east of the proposed site.

Process Water Supply

The effluent from the municipal WWTPs of Mattoon and possibly Charleston, Illinois, would provide process water for the proposed power plant. The Mattoon WWTP is located 6.2 miles (10 kilometers) from the proposed Mattoon Power Plant Site. The process water pipeline would be on existing public ROW for all but 2 miles (3.2 kilometers). The existing public ROW varies in width.

North of the Mattoon WWTP, the process water supply corridor is an existing utility easement that is at least 30 feet (9.1 meters) wide. This portion of the corridor contains an existing gravity-flow sanitary sewer. The corridor then follows the Mattoon street ROW through town to the northern edge of Mattoon. The street ROW is a minimum of 70 feet (21.3 meters) wide. At different points, the street ROW contains water lines, sewer lines, underground telephone lines, and overhead electric lines. ***North and west of the Mattoon city limits, the corridor lies on private property for 5.5 (8.9 kilometers) miles. Three property owners own the first 2 miles (3.2 kilometers) of ROW, which would require new easements in an area that appears to be primarily farm land. For the last 3.5 miles (5.6 kilometers) of the corridor, the pipeline would be placed on the ROW of CR 900N. The ROW is proscribed rather than dedicated, and therefore new easements will be required from the current land owner. Option contracts have been secured to purchase two of the three necessary easements from the property owners in the first two miles. Negotiations continue for the remaining easements.*** There is an existing underground telephone line and overhead electric lines in this ROW.

An on-site reservoir could be constructed to store up to 25 million gallons (94.6 million liters) of cooling water. The reservoir could be as small as 7 acres (2.8 hectares) or up to 40 acres (16.2 hectares) with a capacity of 200 gallons (757 million liters). If the larger on-site reservoir were developed, the corridor to the Mattoon WWTP would be sufficient to supply process water to the proposed FutureGen Project. If the larger reservoir were not developed, 8.1 miles (13.0 kilometers) of new pipeline would be required to connect the Charleston WWTP to the proposed Mattoon Power Plant Site piping system. The plant's effluent would be captured in a wet well to be built at the existing outflow structure. From there, a water line would run on City of Charleston property from the WWTP to the ROW of the Lincoln Prairie Grass Bike Trail. The water line would continue on the bike trail into Mattoon. The bike trail is owned by the cities of Charleston and Mattoon. The bike trail ROW is 100 feet (30.5 meters) wide, while the bike trail surface is 10 feet (3.0 meters) wide. The bike trail ROW has existing 138-kV overhead electric lines running its entire length, and also contains buried fiber optic cable.

Fire protection water for the proposed Mattoon Power Plant Site would be supplied by the on-site reservoir.

Sanitary Wastewater System

The City of Mattoon proposes to supply sanitary sewer service through an extension of the city's existing public wastewater system. A sanitary sewer lift station would be constructed at the site. A 1.25-mile (2.0-kilometer) wastewater force main would be constructed in the ROW of SR 121 from the proposed Mattoon Power Plant Site to an existing sanitary lift station in the northeast quadrant of SR 121 and 43rd Street (CR 300E). For the proposed sanitary wastewater pipeline along SR 121, the IDOT maintains the ROW and has committed to allow the wastewater force main to be placed on the ROW (FG Alliance, 2006a).

There are other utilities in the SR 121 ROW. A buried telephone cable runs the entire length of the north ROW line. An electric transmission line on the north side of the ROW runs 0.3 mile (0.5 kilometer) to the east from the eastern edge of the site.

Transmission Line System

Two options for connecting the power plant site to existing transmission lines are being considered. Option 1 would connect with an existing 138-kV transmission line by one of three scenarios. One scenario would construct a transmission line from the proposed Mattoon Power Plant Site and tie into the Ameren 138-kV system 0.5 mile (0.8 kilometer) east of the site with transfer switching. The second scenario would tie directly into the existing 138-kV line with a new substation. The third scenario would run a new transmission line south next to the existing 138-kV line and connect with the existing 138-kV Mattoon West substation 2.5 miles (4.0 kilometers) southeast of the site adjacent to SR 16. The existing substation would need to be upgraded. Option 2 would connect to the 345-kV system at the Neoga South Substation with a new 16-mile (25.7-kilometer) line running south.

Ameren Corporation indicates that the standard width of a new easement for a transmission line is 150 feet (45.7 meters) (FG Alliance, 2006a). This width can be reduced, although narrower ROWs require closer tower spacing to avoid excess line sag. If a new power line is constructed next to an existing line, then an additional 100-foot (30.5-meter) easement would be necessary. It would be possible to add additional conductors on the existing 138-kV utility poles near the site and change the existing single-circuit line to a double circuit. The City of Mattoon has purchased a corridor easement to connect the site to the existing 138-kV electric transmission line.

Natural Gas Pipeline

The Trunkline Gas high-pressure mainline is located approximately 0.25 mile (0.4 kilometer) east of the proposed Mattoon Power Plant Site. The most direct route from the site to the existing gas line is along the CR 800N ROW. Figure 4.15-1 illustrates the location of the gas main relative to the site and the closest point of approach from the gas main to the site, which would be along CR 800N. However, the pipeline ROW could be located on other property adjacent to the proposed Mattoon Power Plant Site, as shown in Figure 4.15-1. This would allow for optimization of the final corridor from the gas main onto the site, depending on plant design and configuration.

CO_2 Pipeline

The proposed CO_2 injection well would be located within the power plant site. Therefore, no CO_2 corridor would be necessary.

4.15.3.2 Operational Impacts

As described below, all of the proposed operational requirements for potable and process water needs, sanitary wastewater needs, and natural gas are well within the capacities of currently existing systems. A report from MISO, scheduled for completion in 2007, is expected to provide a feasibility analysis of operational impacts on the existing transmission system.

Power Plant Requirements

Potable Water Supply

The daily potable water demand from the proposed Mattoon Power Plant Site would be limited to the sanitary needs of a workforce of 200 employees (FG Alliance, 2006a). For 200 employees using 30 gallons (114 liters) of potable water per day, the potable water consumption rate would average 4.2 gallons (15.9 liters) per minute, which would be negligible compared to the water supply capacity of the pipeline that would be connected to the plant (i.e., 3,438 gallons per minute [13,014 liters per minute]). Therefore, the operational needs of the FutureGen Project would have no adverse effect on the ability of the potable water supply system to meet any foreseeable demands.

Process Water Supply

As previously mentioned, an analysis of daily effluent data from 2004 and 2005 from the Mattoon and Charleston WWTPs indicates that during these 2 years, there were 179 non-consecutive days where the combined daily effluent amount was below 4.3 MGD (16.3 MLD) (Patrick Engineering, 2006a). The daily average of the combined effluent over that 2-year period was 7.1 MGD (26.7 MLD). Compared to the 4.3 MGD (16.3 MLD) average process water requirement for the FutureGen Project, the maximum combined cumulative shortfall for the two effluent streams would be 13.8 million gallons (52.3 million liters). The 13.8 million gallons (52.3 million liters) represents the deficit calculated to occur during the longest uninterrupted deficit period observed during two consecutive dry years. To provide sufficient process water at the Mattoon Power Plant Site, this shortfall would be made up by constructing a reservoir on the site. The WWTP effluent would be pumped into the reservoir when flows were above the required 4.3 MGD (16.3 MLD), and would then be available to the plant during shortfall periods. To supplement the WWTP effluent, the site's stormwater runoff could be stored in the reservoir as well.

A large percentage of the Mattoon sewer system that feeds the WWTP is combined sewer (i.e., contains both sanitary flow and storm flow). On an annual average, the stormwater flow accounts for 2.4 MGD (9.1 MLD) of the WWTP's 4.4 MGD (16.7 MLD) total. Because a large portion of the WWTP effluent that would provide process water to the proposed Mattoon Power Plant comes from storm runoff, the supply could be affected by drought. In 2005, Mattoon received 22.97 inches (58.34 centimeters) of rainfall. This was the lowest annual total of the last 5 years by 5.88 inches (14.9 centimeters), or 25 percent. The 2005 annual rainfall was 42 percent below the area's average annual rainfall of 39.00 inches (99.1 centimeters) (Table 4.15-3).

Table 4.15-3. Annual Rainfall Totals for Mattoon Memorial Airport

Year	Total Annual Rainfall (inches [centimeters])
2001	35.77 (90.9)
2002	42.55 (108.1)
2003	28.85 (73.3)
2004	38.88 (98.8)
2005	22.97 (58.3)
Historic Average	**39.00 (99.1)**

Source: FG Alliance, 2006a.

An on-site reservoir is being considered for use for the combined flow from the Charleston and Mattoon reservoirs to ensure water is available to the power plant during drought. Conditions show that a 25-million-gallon (94.6-million-liter) reservoir would be more than adequate to store water during the lowest 2005 low precipitation period (FG Alliance, 2006a). This reservoir could be as small as 7 acres (2.8 hectares). Alternatively, a larger reservoir could be built that could hold 200 million gallons (757 million liters), which would eliminate the need for the Charleston WWTP to supplement the effluent from the Mattoon WWTP. The size of this reservoir could be up to 40 acres (16.2 hectares).

In summary, in 2005, a year that was well below average for rainfall, the Mattoon and Charleston WWTP effluent supply was sufficient to supply current needs plus expected future needs, including the needs of the FutureGen Project with the on-site reservoir available to cover for shortfall periods. Therefore, the project would have no adverse effect on the capacity of the process water supply system, including the availability of water for fire protection.

Sanitary Wastewater System

Because the FutureGen Project would use a ZLD system, there would be no process-related wastewater disposal associated with the project. The daily sanitary wastewater effluent from the power plant would be limited to the sanitary needs of a workforce of 200 employees. Assuming 30 gallons (114 liters) of sanitary wastewater per employee per day (FG Alliance, 2006e), the wastewater needs would equal 6,000 gallons (22,712 liters) per day. As noted above, the sanitary wastewater force main would empty into a lift station that is operating at less than 25 percent of its maximum capacity, and would therefore be capable of handling project-related sanitary wastewater. The water treatment plant has a capacity to treat 14 million gallons (53.0 million liters) of water each day, but averaged just 4.4 million gallons (16.7 million liters) per day, 31 percent of capacity, from 2001 through 2005. Therefore, the operational requirements of the project would have no adverse effect on the wastewater treatment plant's ability to meet current and future sanitary wastewater treatment needs.

Transmission Line System

The proposed power plant would provide a nominal 275 MW of capacity. The project is proposed to operate at an 85 percent plant factor over the long term after reaching steady-state conditions, which would result in an average output of 2,047,650 megawatt-hours (MWh) of energy per year.

The electrical system interconnection was evaluated with both 138-kV and 345-kV connection options (PowerWorld Corporation, 2006). Based on the conclusions of PowerWorld's report, both the 138-kV and 345-kV interconnections are generally capable of supporting the rated output of the proposed FutureGen facility. The simulations reveal that the system could support each of the proposed interconnections at the rated output of the proposed facility, under the specific summer and winter conditions tested. Thus, it appears at this time that the existing electrical transmission system would be adequate to handle the electrical output of the proposed FutureGen Project, and the project would have minimal effects on the system.

PowerWorld's modeling indicates that the 345-kV interconnection is generally more robust than the 138-kV interconnection with respect to both thermal and voltage constraints. It is likely that the 138-kV interconnection may require more reactive power capability or supplemental voltage support than the 345-kV interconnection to satisfy operating criteria and stability margins. It is possible that either of the proposed interconnections could be subject to curtailment under specific loading conditions and contingencies not modeled in PowerWorld's study. Curtailment occurs when the system controller from the Independent System Operator (in this case, MISO) observes a thermal or voltage limit overload for an operating situation or, upon performing a contingency analysis, predicts a thermal or voltage limit overload for a planned project. If this occurs, MISO would notify the participant or power source that new transmission facilities must be completed to avoid this problem. If the facility is predicted to cause an overload, it would have to operate in a curtailed mode. If the power source is already operating and an overload is apparent, MISO would issue a directive to curtail the production of energy from a particular facility or more than one facility on a pro-rata basis if several facilities are involved in causing the overload. A MISO study has been requested, which would clarify the ultimate line requirements to transmit power from the FutureGen Project.

Natural Gas Pipeline

The capacity of a high pressure transmission pipeline consisting of a 26-inch (66.0-centimeter) diameter mainline and 30-inch (76.2-centimeter) diameter and 36-inch (91.4-centimeter) diameter loop lines would typically be significantly more than 1 billion cubic feet (28.3 million cubic meters) per day, or 42 million cubic feet (1.3 million cubic meters) per hour. This is more than sufficient to supply the demands of the proposed FutureGen Project, which could be up to 1.8 million cubic feet (50,970 cubic meters) per hour. Therefore, the operational needs of the project would not have an adverse effect on the ability of the system to supply existing and other future demands for natural gas.

CO_2 Pipeline

The CO_2 pipeline would be constructed on the same site as the power plant and would have sufficient capacity to accommodate the CO_2 expected from the proposed Mattoon Power Plant.

Utility Corridors

Once construction was completed, the operation of project-related utilities would have no impact on the operation of other utilities sharing the corridors.

4.16 MATERIALS AND WASTE MANAGEMENT

4.16.1 INTRODUCTION

Construction and operation of the FutureGen Project would require a source of coal, access to markets for sulfur products, a means to reuse by-products such as slag, and the ability to capture and sequester CO_2, and dispose of any waste that is generated. This section discusses the capabilities of the proposed Mattoon Site to meet each of these requirements. It describes the potential impact of the demands posed by the FutureGen Project on the supply of construction and operational materials in the region. It also discusses the impacts to regional waste management resources.

4.16.1.1 Region of Influence

The ROI includes waste management facilities; industries that could use the FutureGen byproducts; and the suppliers of construction materials, coal, and process chemicals used in the construction and operation of the proposed FutureGen Project (power plant and sequestration site, CO_2 distribution system, and associated utilities and transportation infrastructure). The extent of the ROI varies by material and waste type. For example, the ROI for construction material suppliers and solid waste disposal facilities is small (within about 50 miles [80 kilometers]) of the proposed Mattoon Site) because these types of resources are widely available and the large volumes of materials that would be needed or waste that would be generated are costly to transport over large distances. Treatment and disposal facilities for hazardous waste are less common and the associated ROI includes a multi-state (Illinois, Indiana, Ohio, Michigan) area extending 100 to 400 miles (160 to 644 kilometers) from the site. The ROI for coal and process chemicals, as well as the sulfur product, includes the State of Illinois and could extend farther if the cost or value of the commodity makes it economical to transport over a greater distance.

4.16.1.2 Method of Analysis

DOE evaluated impacts by comparing the demands posed by construction and operation of the FutureGen power plant, sequestration site, utility corridors, and transportation infrastructure to the capacities of materials suppliers and waste management facilities within the ROI. The analysis also evaluated regional demand and access to markets for sulfur products. DOE assessed the potential for impacts based on whether the proposed FutureGen Project would:

- Cause new sources of construction materials and operational supplies to be built, such as new mining areas, processing plants, or fabrication plants;
- Affect the capacity of existing material suppliers and industries in the region;
- Create waste for which there are no commercially available disposal or treatment technologies;
- Create hazardous waste in quantities that would require a treatment, storage, or disposal (TSD) permit;
- Affect the capacity of hazardous waste collection services and landfills;
- Create reasonably foreseeable conditions that would increase the risk of a hazardous waste release; and
- Create reasonably foreseeable conditions that would increase the risk of a hazardous material release.

DOE reviewed information provided in the Mattoon Site EIV (FG Alliance, 2006a) and proposal (FG Site Proposal [Mattoon, Illinois], 2006). Letters of interest, bid prices, and other prospective material supplier information were identified for use in the EIS. DOE then consulted waste management and material supplier information compiled by state agencies and trade organizations to confirm availability of these resources in the ROI. Uncertainty regarding the specific technologies that would be employed in the FutureGen facility and variability in the potential coal feeds made it difficult to quantify operational materials requirements and waste generation. The maximum value for each item was used in the analysis to bound the potential impacts of the technologies that could be selected. Limited information is available regarding materials requirements or waste generation for construction. DOE used NEPA documentation and design information for facilities of similar scope and size to augment the FutureGen-specific information.

4.16.2 AFFECTED ENVIRONMENT

The Mattoon Power Plant and Sequestration Site is 444 acres (180 hectares) and is primarily (93 percent) farm crops with public ROW (3 percent) and rural residential development and woodlands (4 percent). The proposed Mattoon Power Plant and Sequestration Site is typical of farmland throughout the area, which is used for row crop production (primarily corn and soybeans).

A review of various IEPA databases indicates that the proposed site is not associated with voluntary cleanup, leaking underground storage tanks, Resource Conservation and Recovery Act (RCRA) permitted activities, or solid waste landfills. There are no known existing site hazards (FG Alliance, 2006a).

4.16.2.1 Construction Materials

Concrete, asphalt, and aggregate producers within a 50-mile (80-kilometer) radius of the Mattoon Site were asked to identify their capacity to provide materials to support construction of the FutureGen facility. Inquiries were also made regarding the availability and amount of fill material.

Concrete

There are five concrete batch plants within 20 miles (32 kilometers) of the Mattoon Site with a total hourly plant capacity of 500 cubic yards (382 cubic meters) per hour (FG Alliance, 2006a). These plants are:

- Mid-Illinois Concrete, Inc., with a plant in Mattoon capable of batching 140 cubic yards (107 cubic meters) per hour, and a plant in Charleston capable of 120 cubic yards (90 cubic meters) per hour.
- A.J. Walker Construction Company, with a plant in Mattoon rated to produce 90 cubic yards (69 cubic meters) per hour.
- Charleston Stone Company, with the Charleston Farrier concrete plant rated to produce 100 cubic yards (76 cubic meters) of concrete per hour.
- Moultrie County Redi-Mix of Sullivan, with a plant able to produce 50 cubic yards (38 cubic meters) per hour.

Asphalt

There are two companies with three stationary asphalt plants within 20 miles (32.2 kilometers) of the Mattoon Site with a total hourly capacity of over 750 tons (680 metric tons) per hour (FG Alliance, 2006a).

- Howell Companies, headquartered in Mattoon, is a large construction company that specializes in asphalt construction. The company's plant in Mattoon has the capacity to produce 260 tons (236 metric tons) of asphalt per hour. Its Charleston plant is rated at 360 tons (327 metric tons) per hour. Additionally, Howell owns a portable plant capable of producing 300 tons (272 metric tons) per hour.

- Ne-Co Asphalt of Charleston has a plant rated at 130 tons (118 metric tons) per hour.

Aggregate and Fill Material

Charleston Stone Company owns two quarries with an annual production totaling 900,000 tons (816,466 metric tons) per year of aggregate. In addition, the proposed Mattoon Site would require some excavation; therefore, some fill would be available at the site.

4.16.2.2 Process-Related Materials

Coal Supply Environment

Illinois coal-fueled electric generating facilities use mainly sub-bituminous PRB coal from Wyoming or bituminous Illinois Basin coal from Illinois, Indiana or Kentucky. Small amounts of coal from Colorado and Utah also are used in Illinois (FG Alliance, 2006a). Because Pittsburgh coal is not generally utilized by Illinois power plants, delivered pricing is not available.

The best-price quotes shown in Tables 4.16-1 and 4.16-2 indicate coal and transportation bids for the Mattoon Site. Illinois Basin coal could be transported via truck or rail. There would be no truck-delivered option for PRB coal to the Mattoon Site due to distance. The quotes reflect 2006 costs.

Table 4.16-1. Illinois Basin Bituminous Coal

	Rail Dollars per ton (Dollars per metric ton)	Truck Dollars per ton (Dollars per metric ton)
Coal price	30 (33)	28 (30.80)
Transportation cost	5 (5.50)	17 (18.70)
Delivered price	35 (38.50)	45 (49.50)

Source: FG Site Proposal (Mattoon, Illinois), 2006.

Table 4.16-2. Western-PRB Sub-Bituminous Coal

	Rail Dollars per ton (Dollars per metric ton)
Coal price	14.15 (15.56)
Transportation cost	16 (17.60)
Delivered price	30.15 (33.16)

Source: FG Site Proposal (Mattoon, Illinois), 2006.

Figure 4.16-1 shows the locations of coal mines and probable locations of coal deposits in relation to the proposed Mattoon Site. Although coal is present throughout the Illinois Basin, relatively small areas of Springfield and Herrin coal are available for mining in the local area. "Available" coal means coal that is not known to have geological, technological, or land-use restrictions that would negatively affect the economics or safety of mining. The resources are not necessarily economically mineable at the present time, but they are expected to have mining conditions comparable with those currently being mined in the

Illinois state. The Springfield, Herrin, and Danville coals, where available for mining, average approximately 3.5 to 5.5 feet (1.1 to 1.7 meters) thick in this area.

Overall, the thickness of the coals is quite variable in this area, and the coals are thin (less than 2.5 feet [0.8 meters] thick) or are eroded outside the areas classified as available for mining. The Herrin and Springfield coals average 1,000 to 1,100 feet (305 to 335 meters) deep near the Mattoon Site, and the Danville coal averages 900 to 1,000 feet (274 to 305 meters) deep (FG Alliance, 2006a).

The nearest active coal mining area is approximately 50 miles (80 kilometers) to the northeast, in Vermilion County, Illinois, where the Black Beauty Coal Company operates the Riola and Vermilion Grove Mines. These mines are in the Herrin coal, at an average depth of 250 feet (76 meters) and seam thickness of 5 to 6 feet (1.5 to 1.8 meters). Production for each mine was approximately 1 million tons (907,185 metric tons) in 2004 (FG Alliance, 2006a).

Process Chemical Supply Markets

The process chemicals required by the proposed project are common water treatment and conditioning chemicals that are widely used in industry with broad regional and national availability. Large suppliers in the area of water and waste treatment chemicals include Ciba, Kemira, Nalco, Stockhausen, and the SNF Group.

4.16.2.3 Sulfur Markets

The technologies that would be available for sulfur removal at the proposed power plant are similar to the technologies employed in the petroleum refining industry. These treatment technologies result in the production of elemental sulfur, which is marketable. Sulfur is used in the manufacturing of numerous chemical, pharmaceutical, and fertilizer products. U.S. production of sulfur was 13.6 million tons (12.3 MMT) in 2002 (TIG, 2002).

The worldwide supply of sulfur is expected to exceed demand by 5.4 and 5.9 million tons (4.9 and 5.4 MMT) in 2006 and 2011, respectively. The surplus could increase up to 12.1 million tons (11 MMT) in 2011 if clean fuel regulations continue to be implemented worldwide. However, the Sulphur Institute, an international non-profit organization founded by the world's sulfur producers to promote and develop uses for sulfur, sees market potential in developing plant nutrient sulfur products and sulfur construction materials, especially sulfur asphalt. The estimate for the plant nutrient sulfur market is 10.5 million tons (9.5 MMT) annually by 2011. The Sulphur Institute estimates that the potential consumption of sulfur in the asphalt industry in North America could reach 0.45 million tons (0.41 MMT) by 2011 (assuming sulfur captures 5 percent of the 30-million-ton [27-million-metric-ton] asphalt market and an average of 30 percent by weight of asphalt replaced by sulfur). Tests on asphalt made with sulfur show it to have a greater resistance to wheel rutting and cracking than conventional asphalt (Morris, 2003).

4.16.2.4 Recycling Facilities

The bottom slag and ash produced by the gasifier would have local and regional markets for reuse. The American Coal Ash Association (ACAA), a non-profit organization that promotes the beneficial use of coal combustion products, reported that 96.6 percent of the bottom slag and up to 42.9 percent of the ash generated by power plants in 2005 was beneficially used rather than disposed of. Primary uses of slag are as blasting grit and as roofing granules, with lesser amounts in structural and asphalt mineral fills. Ash is primarily used in concrete products, structural fills, and road base construction. The ACAA expects the demand for coal combustion products to increase in the next few years. Some of the increase

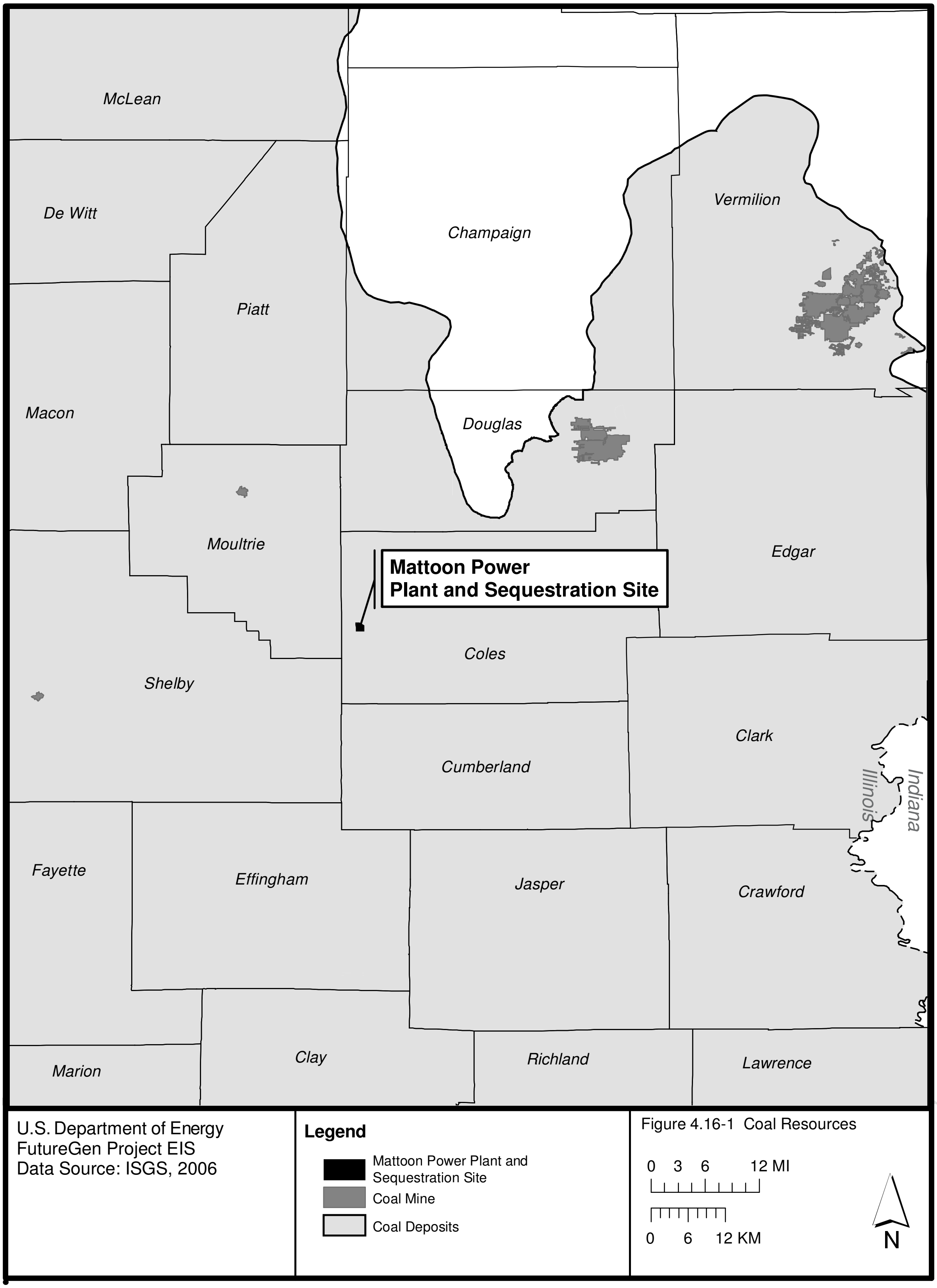

Figure 4.16-1 Coal Resources

would be due to federal and state transportation departments promoting the use of coal combustion products for road construction (ACAA, 2006).

4.16.2.5 Sanitary Waste Landfills

The Illinois Solid Waste Management and Landfill Capacity Report (IEPA, 2005) provides the general location and life expectancies of the landfills in the region. Table 4.16-3 lists the sanitary waste landfills in the region and their remaining disposal capacity. Regional landfill availability in the Mattoon area would be up to 116 years (based on closure of the Illinois Landfill in 2122). Space on the 444-acre (180-hectare) proposed Mattoon Power Plant Site would be available for a landfill if needed. Figure 4.16-2 shows the location of these facilities in relation to the Mattoon Site.

Table 4.16-3. Nearby Sanitary Waste Landfills

Landfill	City	State	Remaining Disposal Capacity in Place[1] (yd^3 [m^3])	Expected Closure Date	Approximate Distance from Site (miles [km])
ERC Coles County Landfill	Charleston	IL	799,000 (610,897)	2008[2]	16 (26)
Landfill 33 Ltd.	Effingham	IL	3,280,000 (2,507,739)	2017	38 (61)
Onyx Valley View Landfill	Decatur	IL	3,831,000 (2,929,000)	2010	45 (72)
Clinton Landfill #2	Clinton	IL	3,518,000 (2,689,704)	2030	57 (92)
Brickyard Disposal and Recycling, Inc.	Danville	IL	18,837,000 (14,401,920)	2022	90 (145)
Illinois Landfill	Hoopeston	IL	21,503,000 (16,440,223)	2122	100 (161)

[1] Capacity as of January 2005.
[2] A transfer station is being developed at the landfill site with an average capacity of 750 tons (680 metric tons) per day. After closure, waste will be transferred to the Onyx Valley View Landfill.
yd^3 = cubic yards; m^3 = cubic meters; km = kilometers.
Source: IEPA, 2005 and FG Alliance, 2006a.

IEPA concluded that the East Central Illinois region (a 19-county region that includes the Mattoon Site) had 15 years of remaining solid waste landfill capacity at the 2004 rate of disposal (IEPA, 2005). New disposal capacity was permitted in 2004, increasing disposal capacity in the region by more than 170 percent (IEPA, 2005). Capacity at hazardous waste landfills is also substantial. The closest hazardous waste landfill alone has remaining capacity of over 14 million cubic yards (11 million cubic meters).

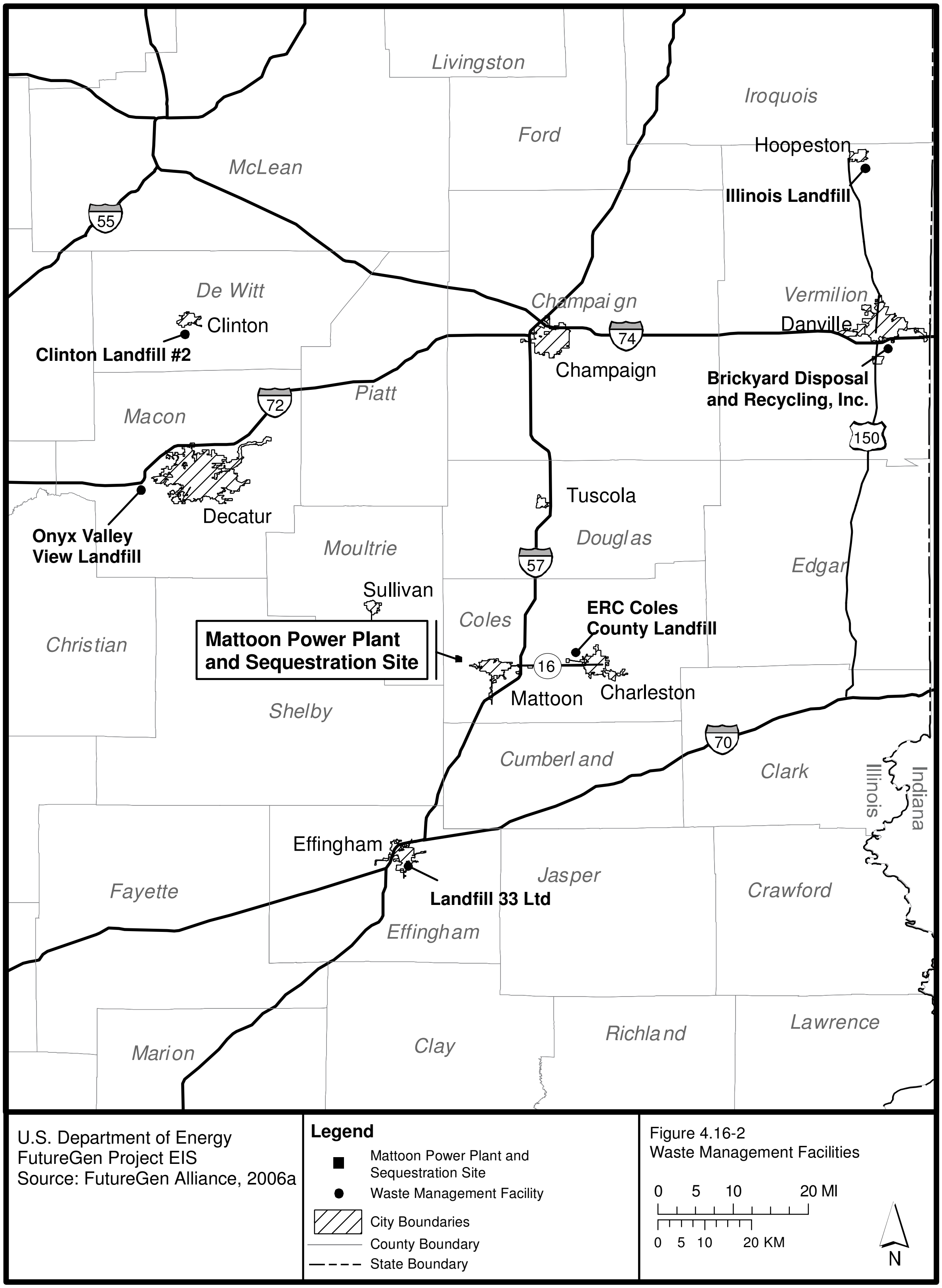

Figure 4.16-2
Waste Management Facilities

4.16.2.6 Hazardous Waste Treatment, Storage, or Disposal Facilities

Table 4.16-4 provides the location of hazardous waste landfills closest to the Mattoon Site that have historically received hazardous waste from Illinois sources.

Special waste includes hazardous waste, potentially infectious medical waste, pollution control waste, and industrial process waste.

In Illinois, pollution control waste is a special waste, which must be managed in accordance with State of Illinois regulations (Title 35 of the Illinois Administrative Code [IAC] Part 808). Numerous Illinois municipal landfills are approved to accept special waste. A special waste can also be certified as non-special, which allows it to be disposed in a municipal landfill. In addition, coal combustion waste is often reclaimed for beneficial uses, depending on their composition. The bottom slag produced from the coal gasification process is expected to be highly marketable.

Table 4.16-4. Hazardous Waste Landfills

Hazardous Waste Landfill	City	State	Remaining Disposal Capacity in Place[1] (yd^3 [m^3])	Approximate Distance from Site (miles [km])
Heritage Environmental	Roachdale	IN	14,665,907 (11,212,890)	112 (180)
PDC	Peoria	IL	660,944 (505,327)	140 (225)
CID Recycling & Disposal Facility #4	Calumet City	IL	88,269 (67,486)	175 (282)
Envirosafe of Ohio, Inc.	Oregon	OH	822,000 (628,464)	400 (644)
Wayne Disposal	Belleville	MI	2,134,101 (1,631,637)	410 (660)

[1]Capacity as of January 2004.
yd^3 = cubic yards; m^3 = cubic meters; km = kilometers.
Source: FG Alliance, 2006a.

A non-hazardous special waste certification is required to make a determination that industrial process or pollution control waste is a "non-special waste." This certification must be made in writing and must be provided when requested by IEPA, the waste transporter, the disposal site, and any other entity involved in managing the waste. If the process that generates the waste changes or the raw materials change, a new certification is required (FG Alliance, 2006a). The information contained in this certification must include (as applicable):

- A description of the process that generated the waste;
- The method for determining that the waste is not hazardous;
- The method for determining that the waste is not a liquid, does not contain polychlorinated biphenyls (PCBs) or asbestos, is not formerly hazardous waste rendered non-hazardous, and is not shredded recyclable metals;
- Any analytical results, or relevant Material Safety Data Sheet; and
- An explanation as to why any analysis was not performed or required.

4.16.3 IMPACTS

4.16.3.1 Construction Impacts

Power Plant Site

Power plant construction materials would consist primarily of structural steel beams and steel piping, tanks, and valves. Locally obtained materials would include crushed stone, sand, and lumber for the proposed facilities and temporary structures (e.g., enclosures, forms, and scaffolding). Components of the facilities would also include concrete, ductwork, insulation, electrical cable, lighting fixtures, and transformers.

Waste from construction of the proposed facilities would include excess materials; metal scraps; and pallets, crates, and other packing materials. Excess supplies of new materials would be returned to vendors or be retained for future use. Surplus paint and other consumables, partial spools of electrical cable, and similar leftover materials would also be retained for possible future use in maintenance, repairs, and modifications. Scrap metal that could not be reused on site would be sold to scrap dealers. Other scrap materials could also be recycled through commercial vendors. Packaging material (e.g., wooden pallets and crates), support cradles used for shipping large vessels and heavy components, and cardboard and plastic packaging would be collected in dumpsters and periodically transported off site for recycling or disposal.

Construction equipment would include cranes, forklifts, air compressors, welding machines, trucks, and trailers. Operation of heavy equipment would require oils, lubricants, and coolants. Should any of these require disposal, they would be special waste or hazardous waste and would be appropriately managed by the construction contractor.

Petroleum products are sometimes spilled at construction sites as a result of equipment failure (split hydraulic lines, broken fittings) or human error (overfilled tanks). To mitigate the impacts of spills, use of petroleum products, solvents, and other hazardous materials would be restricted to designated areas equipped with spill containment measures appropriate to the hazard and volume of material being stored on the construction site. Refueling, lubrication, and degreasing of vehicles and heavy equipment would take place in restricted areas. A Spill Prevention, Control, and Countermeasure (SPCC) Plan would be prepared in accordance with 40 CFR 112.7. Personnel would be trained to respond to petroleum and chemical spills, and the necessary spill control equipment would be available on site in immediately accessible locations.

A reservoir would be constructed at the power plant site to store the water from the Charleston and Mattoon municipal WWTPs that would serve as the process water supply. The reservoir would be sized to ensure adequate water supply during periods of drought. The size of the reservoir would range from 25 to 200 million gallons (95 to 757 million liters), covering an area of 7 to 40 acres (2.8 to 16.2 hectares), depending on whether one or both WWTP effluents were used. Construction of the reservoir would require use of heavy equipment. Depending on the size and design of the reservoir, fill material may be required for the construction of berms, or spoils may be generated as a result of excavation.

The proposed Mattoon Power Plant Site would require up to 200 acres (81 hectares) to allow for the power plant, coal and equipment storage, associated processing facilities, research facilities, the railroad loop surrounding the power plant envelope, and a buffer zone. Debris would be generated as a result of clearing and grading. Only about 60 acres (24 hectares) of the site would be required for the facilities comprising the power plant footprint (see Figure 2-18). Any excavated material could be used as fill on the site when feasible. Debris would be disposed of at an on-site landfill or transported to an off-site landfill for disposal. In Illinois, on-site non-hazardous landfills do not require a permit but are regulated under Illinois Administrative Code Title 35, Subtitle G – Waste Disposal, Part 815, Procedural Requirements for All Landfills Exempt from Permits.

The Mattoon Site would have adequate acreage for placement of an on-site landfill, if one should be required at the site.

The large amount of solid waste disposal capacity in the region is detailed in Table 4.16-3. Because the quantity of waste from construction of the FutureGen facility would be small in comparison with the landfill capacity and waste quantities routinely handled, the impact to waste collection and disposal services would be negligible.

Sequestration Site

The proposed sequestration site is co-located with the power plant site on the same parcel of land. The component dedicated to CO_2 sequestration would be the injection well(s), associated piping from the plant to the well, and the compression units. The materials needed would include piping and concrete for seaming. Sources for these construction materials are well established nationally, and none of the quantities of materials required would create demand or supply impacts.

The materials would be ordered in the correct sizes and quantities, resulting in small amounts of excess material that could be saved for use on a different project and very small amounts of waste to be disposed in a permitted landfill that accepts construction debris. Heavy equipment would be used that requires fuel, oils, lubricants, and coolants. Should any of these hazardous materials require disposal, they would be special waste or hazardous waste and would be appropriately managed by the construction contractor. Precautions would be taken to mitigate the impacts of petroleum and chemical spills, and personnel would be trained and equipped to respond to spills when they occur. Solid and hazardous waste disposal capacity in the region is detailed in Tables 4.16-3 and 4.16-4. There would be no impact to waste collection services or disposal capacity.

Utility Corridors

The following utility corridors and pipelines would be constructed to support the proposed FutureGen facility:

- 0.5-mile (0.8-kilometer) long transmission line in existing ROW and new substation (options to connect to an existing substation less than 2 miles (3.2 kilometers) from the site or to connect a substation about 1.6 miles (2.6 kilometers) from the site are also being evaluated). A second option would be a 16-mile (25.7-kilometer) transmission line that would connect to an existing 345-kV line.
- 6.2-mile (10.0-kilometer) long process water pipeline on existing ROW for all but 2 miles (3.2 kilometers).
- 8.1-mile (13.0-kilometer) long process water pipeline on existing ROW (this second corridor may not be required if the larger process water reservoir option is selected).
- 0.25-mile (0.4-kilometer) long natural gas pipeline connecting to the existing mainline, a new tap, and delivery station using an existing ROW.
- 1-mile (1.6-kilometer) long potable water pipeline in existing ROW.
- 1.25-mile (2.0-kilometer) long sanitary wastewater force main from the sanitary sewer lift station at the power plant site to an existing lift station using existing ROW.

The sequestration site would be located at the power plant site; therefore, no CO_2 pipeline corridor would be needed (FG Alliance, 2006a).

Where utilities would be placed along existing utility corridors minimal clearing of vegetation and grading, creating land clearing debris may require removal and disposal. The 2 miles (3.2 kilometers) of new ROW for the process water pipeline may require more extensive land clearing and grading. However, adequate construction debris disposal capacity is available at area landfills.

The construction of pipelines, transmission lines, transmission substation, and sanitary sewage lift stations would require metal and PVC pipe, as well as joining and welding materials including compressed gasses, steel cable and structures, and insulated wiring for transmission lines. Sources for these construction materials are well established nationally, and the quantities of materials required to construct the pipelines and transmission lines would not create demand or supply impacts.

Construction materials would be ordered in the correct sizes and quantities, resulting in small amounts of excess material that could be saved for use on a different project and very small amounts of waste to be disposed in a permitted landfill accepting construction debris. Heavy equipment would be used that requires fuel, oils, lubricants, and coolants. Should any of these require disposal, they would be special waste or hazardous waste, and would be appropriately managed by the construction contractor. Precautions would be taken to mitigate the impacts of petroleum and chemical spills, and personnel would be trained and equipped to respond to spills when they occur. Solid and hazardous waste disposal capacity in the region is detailed in Tables 4.16-3 and 4.16-4. There would be no impact to waste collection services or disposal capacity.

Transportation Corridors

Roads

The Mattoon Site is served by a well-developed road system. Approximately 1.25 miles (2.0 kilometers) of county road leading to the site boundary would require upgrading (i.e., widening and resurfacing) by the Illinois Department of Transportation (FG Alliance, 2006a). The FutureGen contractor would be responsible for constructing on-site roads.

The materials needed for on-site road construction include concrete, aggregate, and asphalt. Road construction would result in minimal waste due to recycling and reuse of these materials. Excavated soil would be used for fill elsewhere along the route and asphalt would be recycled. Road construction would require heavy equipment that would need fuel, oils, lubricants, and coolants. Should any of these hazardous materials require disposal, they would be special waste or hazardous waste, and would be appropriately managed by the construction contractor. Precautions would be taken to mitigate the impacts of petroleum and chemical spills, and personnel would be trained and equipped to respond to spills when they occur. Solid and hazardous waste disposal capacity in the region is detailed in Tables 4.16-3 and 4.16-4. There would be no impact to waste collection services or disposal capacity.

Rail

The materials needed for construction of an industrial rail siding and loop track (approximately 2.0 miles [3.2 kilometers] of track [FG Alliance, 2006a]) would be steel rails, pre-cast concrete railbed ties, and rock for ballast. The sources for rails and railbed ties are well established nationally, and none of the quantities of materials required for constructing a rail spur would create demand or supply impacts. Furthermore, these materials would be ordered in the correct sizes and number, resulting in small amounts of excess material that could be saved for use on a different project and extremely small amounts of waste to be disposed in a permitted landfill that accepts construction debris.

In addition to the materials to be installed, construction of the rail spur would require fuel, oils, lubricants, and coolants for heavy machinery, and compressed gasses for welding. Should any of these hazardous materials require disposal, they would be special waste or hazardous waste, and would be shipped to a permitted hazardous waste treatment and disposal facility or other disposal facility permitted to accept the waste. Precautions would be taken to mitigate the impacts of petroleum and chemical spills, and personnel would be trained and equipped to respond to spills when they occur. Solid and hazardous waste disposal capacity in the region is detailed in Tables 4.16-3 and 4.16-4. There would be no impact to waste collection services or disposal capacity.

4.16.3.2 Operational Impacts

Power Plant Site

The FutureGen power plant would be capable of using various coals. For purpose of analysis, the following coals are evaluated:

- Northern Appalachian Pittsburgh seam;
- Illinois Basin from the states of Illinois, Indiana, and Kentucky; and
- PRB from Wyoming.

Coal consumption would vary depending on the gasification technology and type of coal. Table 4.16-5 provides the range of values based on the conceptual design for the FutureGen Project. The Case 3B option is a smaller, side-stream power train that would enable more research and development activities than the main train of the power plant. To estimate the operating parameters for analysis of impacts in this EIS, DOE assumed this smaller system could be paired with any of the other designs under consideration. The Illinois Basin and PRB are the main sources of coal used by Illinois electric generating facilities and are the most viable options for the Mattoon Site. For those fuel types, the maximum coal consumption rate would be approximately 254 tons (230 metric tons) per hour (FG Alliance, 2007) or up to 1.89 million tons (1.72 MMT) per year based on 85 percent availability (FG Alliance, 2006e). This represents 3.5 percent of the 53.8 million tons (48.9 MMT) of coal of all types consumed by electric utilities within the State of Illinois in 2005 (EIA, 2006). Coal would be delivered to the power plant site by rail and would be stored in two coal piles, each providing storage capacity for approximately 15 days of operation (FG Alliance, 2006e). If required, runoff from the coal storage areas would be collected and treated in the plant's zero liquid discharge (ZLD) wastewater treatment system.

Table 4.16-5. Coal Consumption

Coal Gasification Technology	Type of Coal (pounds [kilograms] per hour)		
	Pittsburgh	Illinois Basin	Powder River Basin
Case 1	224,745 (101,943)	248,370 (112,659)	281,167 (127,535)
Case 2	213,287 (96,745)	244,153(110,746)	353,809 (160,485)
Case 3A	208,425 (94,540)	238,577 (108,217)	342,790 (155,487)
Case 3B (optional)[1]	97,625 (44,282)	111,791 (50,708)	154,349 (70,012)

[1]Case 3B is an optional add-on to any of the other technology cases (1, 2, 3A), but is considered unlikely to be implemented.
Source: FG Alliance, 2007.

The estimated consumption of process chemicals by the proposed power plant is presented in Table 4.16-6. The table also provides the estimated on-site storage requirements assuming a 30-day chemical supply would be maintained at the power plant site. Potential impacts from storage of the chemicals are discussed in Section 4.17. These chemicals are commonly used in industrial facilities and are widely available from national suppliers. The materials needed in the largest quantities would be sulfuric acid, sodium hypochlorite, and lime. The polymer and antiscalants and stabilizers needed for the cooling tower, makeup water, and wastewater systems are not specified at this time and a variety of products are available from national suppliers including the Illinois-based Nalco and the largest producer of water treatment specialty chemicals, Ciba (Nalco, 2006 and Ciba, 2006).

Table 4.16-6. Process Chemicals Consumption and Storage

Chemical	Annual Consumption (tons [metric tons])	Estimated Storage On Site (gallons [liters])
Selective Catalytic Reduction (NO_x emission control)		
Aqueous Ammonia (19 percent)	1,333 (1,209)	28,700 (108,641)
Cooling Tower		
Sulfuric Acid (98 percent)	8,685 (7,879)	94,200 (356,586)
Antiscalant	0.47 (0.42)	8 (30)
Sodium Hypochlorite	1,684 (1,527)	32,900 (124,540)
Make-up Water and Wastewater Treatment Demineralizers		
Sodium Bisulfite	12 (10.9)	155 (587)
Sulfuric Acid	106 (95.8)	1,150 (4,353)
Liquid Antiscalant and Stabilizer	27 (24.5)	443 (1,677)
Clarifier Water Treatment		
Lime	1,237 (1,122)	7,380 (27,936)
Polymer	295 (268)	5,020 (19,003)
Acid Gas Removal		
Physical Solvent	11,300 gallons (42,775 liters)	940 (3,558)

Source: FG Alliance, 2007.

The coal gasification process would annually consume approximately 8,700 tons (7,893 metric tons) of sulfuric acid, 1,680 tons (1,524 metric tons) of sodium hypochlorite, and 1,240 tons (1,120 metric tons) of lime. As discussed in Section 4.16.2.3, the sulfur market is expected to have a surplus for the next few years as production increases, so additional demand would not adversely impact the sulfur market. Sodium hypochlorite has producers located across the U.S. including Illinois, Indiana, Michigan, and Missouri. The U.S. sodium hypochlorite production capacity is vastly underused. Industrial sodium hypochlorite production capacity is estimated at 1.55 billion gallons (5.87 billion liters) per year (TIG, 2003). The current (2006) demand is projected to be 292 million gallons (1.1 billion liters), less than 20 percent of the production capacity (TIG, 2003). Worldwide production of lime was 141 million tons (128 MMT) in 2005, with the U.S. producing 22 million tons (20 MMT) (USGS, 2006a). Charmeuse, one of the 10 largest lime producers in the U.S., operates plants in South Chicago, Illinois and in Buffington, Indiana (USGS, 2006b). Given that the chemicals required to operate the proposed FutureGen facility are common industrial chemicals that are widely available and produced in large quantities in the U.S., the chemical consumption impact would be minimal.

The byproducts generated by the proposed power plant would be sulfur, bottom slag, and ash. As previously discussed, there are established markets and demand for these materials.

Sulfur production would depend on the gasification technology and the type of coal used. The maximum amount of sulfur generated would be 133 tons (121 metric tons) per day (FG Alliance, 2007) for an annual maximum of 41,232 tons (37,406 metric tons) based on 85 percent availability. The U.S. production of sulfur in 2002 was 13.6 million tons (12.3 MMT). The maximum potential FutureGen sulfur production represents 0.30 percent of the total U.S. production. Supply of sulfur exceeds demand; however, new uses of sulfur are being promoted by sulfur producers that should help balance future supply and demand of sulfur. The worldwide supply is estimated to exceed demand by up to 12.1 million tons (11 MMT) in 2011 without the development of new markets. The FutureGen Project maximum production would increase this surplus by less than 0.34 percent.

As previously noted, operation of the FutureGen Project would require a source of sulfuric acid. Assuming a complete conversion to sulfuric acid, the facility would generate about 126,000 tons (115,000 metric tons) per year of sulfuric acid. This would be sufficient to meet the demand for sulfuric acid at the power plant site.

The FutureGen facility would generate an estimated 96,865 tons (87,875 metric tons) of bottom slag or ash annually based on the three primary technology cases (1, 2, and 3A) (FG Alliance, 2007). If Case 3B were implemented, the amount of slag or ash would increase by approximately 49 percent over the base case. Nearly all of the bottom slag (96.6 percent) produced in the U.S. enters the market and is beneficially used, and the availability of bottom slag is expected to decrease (ACAA, 2006). Based on the 2006 statistics from ACAA for beneficial use of slag, 3.4 percent of the bottom slag that would be generated annually would be disposed as waste (see Table 4.16-7). Further characterization would be necessary to determine whether the quality of the slag produced by the proposed power plant would support this level of reuse. Based on the average of the ACAA (2006) statistics for bottom ash and fly ash, 58.1 percent of the ash that would be generated annually would be disposed as waste (see Table 4.16-7). The recycled bottom slag and ash produced by the proposed power plant would not be expected to have an adverse impact on the market, as future supply is expected to be equal to or less than the demand.

Table 4.16-7. Waste Generation

Waste	Annual Quantity (tons [metric tons])	Classification
Unrecycled bottom slag (Cases 1, 2, 3B)	3,290 (2,985)[1]	Special waste (Coal combustion byproduct)
Unrecycled ash (if non-slagging gasifiers are used)	56,280, (51,056)[2]	Special waste (Coal combustion byproduct)
ZLD (wastewater system) clarifier sludge	1,545 (1,402)	Special waste
ZLD filter cake	5,558 (5,042)	Special waste
Sanitary solid waste (office and break room waste)[3]	336 (305)	Municipal solid waste

[1] Based on ACAA (2006) statistics, DOE assumed that all but 3.4 percent of total slag production would be recycled rather than disposed of. If Case 3B were implemented, quantities would increase by 49 percent.
[2] Based on ACAA (2006) statistics, DOE assumed that 41.9 percent of total ash production would be recycled rather than disposed of. If Case 3B were implemented, quantities would increase by 49 percent.
[3] Quantity estimated for 200 employees using an industrial waste generation rate of 9.2 pounds (4.2 kilograms) per day per employee (CIWMB, 2006).
Source: FG Alliance, 2007, except as noted.

The estimated waste generated for the Mattoon Power Plant is presented in Table 4.16-7. In addition to the waste listed in the table, the facility may generate small amounts of hazardous waste such as solvents and paints from maintenance activities. Hazardous waste would be managed in accordance with federal and state hazardous waste regulations, including providing secondary containment where necessary. The special waste category would require disposal in a hazardous waste facility if the waste is hazardous, or in a sanitary waste landfill that is also permitted to dispose of special waste that is non-hazardous. As discussed in Section 4.16.2.6, special waste meeting certain criteria can also be certified as non-hazardous and can be disposed of as sanitary waste.

Chemical waste would be generated by periodic cleaning of the heat recovery steam generator and turbines. This waste would consist of alkaline and acidic cleaning solutions and wash water, which are likely to contain high concentrations of heavy metals. Chemical cleaning would be performed by outside contractors who would be responsible for the removal of associated waste products from the site. Precautions would be taken to prevent releases by providing spill containment for tankers used to store cleaning solutions and waste.

Other waste would include solids generated by water and wastewater treatment systems, such as activated carbon used in sour water treatment. Sulfur-impregnated activated carbon would be used to remove mercury from the synthesis gas. This mercury sorbent would be replaced periodically and the spent carbon would likely be hazardous waste. The spent carbon would be regenerated and reused at the site. It could also be returned to the manufacturer for treatment and recycling, or be transferred to an off-site hazardous waste treatment facility. Used oils and used oil filters would be collected and transported off site by a contractor for recycling or disposal.

Effluents from the Charleston and Mattoon municipal WWTPs would serve as the process water supply for the FutureGen facility. The as-received quality of these wastewater treatment plant effluents may not meet the FutureGen process water requirements. The water would be treated to decrease the concentrations of dissolved solids and constituents such as sodium and potassium to levels consistent with the process water design parameters. Waste generated by the water treatment facility would include sludge and spent filter media that would be transported off site for disposal in a municipal landfill approved for disposal of special waste.

The FutureGen facility would have the option of disposing of some of its waste in an on-site landfill, if one was developed. In addition, the operator could apply to certify its special waste as non-hazardous and dispose of those waste streams in a municipal landfill permitted to dispose of non-hazardous special waste. Given the sanitary and hazardous waste disposal capacities available in the region, the impact of disposal of FutureGen-generated waste would be minimal. Given the small amount of hazardous waste (e.g., paints and solvents) that would be generated and the availability of commercial treatment and disposal facilities, the on-site waste management activities are not expected to require a RCRA permit.

Sequestration Site

During normal operations, the sequestration site components would generate minimal waste due to routine maintenance and presence of workers. The waste could be special/hazardous (e.g., lubricants and oils) and sanitary waste (e.g., packaging and food waste). The expected minimal waste quantities would not impact disposal capacities of area landfills and waste collection services.

Several pre-injection hydrologic tests would be performed during site characterization to establish the hydrologic storage characteristics and identify the general permeability characteristics at the sequestration site. The following water-soluble tracers may be used:

- Potassium bromide (as much as 220 lb [100 kg])
- Fluorescein (as much as 132 lb [60 kg])
- 2,2-dimethyl-3-pentanol (as much as 4.4 lb [2.0 kg])
- Pentafluorobenzoic acid (as much as 8.8 lb [4.0 kg])

A suite of gas-phase tracers would be co-injected with the CO_2 to improve detection limits for monitoring. The tracers expected to be used include:

- Perfluoromethylcyclopentane (as much as 330 lb [150 kg])
- Perfluoromethylcyclohexane (as much as 2,646 lb [1,200 kg])
- Perfluorodimethylcyclohexane (as much as 330 lb [150 kg])
- Perfluorotrimethylcyclohexane (as much as 2,646 lb [1,200 kg])
- Sulfur hexafluoride (SF_6) (as much as 66 lb [30 kg])
- Helium-3(^{3}He) (as much as 0.033 lb [15 g])
- Krypton-78 (^{78}Kr) (as much as 0.44 lb [200 g])
- Xenon- 124 (^{124}Xe) (as much as 0.088 lb [40 g])

The last three are stable, non-radioactive, isotope noble gas tracers. Tracers are a key aspect of the planned monitoring activities for the FutureGen sequestration site. The tracers would 1) contact the CO_2, water and minerals, 2) limit the problem of interference from naturally occurring CO_2 background concentrations, and 3) provide a statistically superior monitoring and characterization method because of the redundancy built in by using multiple tracers. Tracers would be purchased in the required amounts and would be consumed (injected into the subsurface) as a result of the site characterization and monitoring activities.

Utility Corridors

During normal operations, the utility corridors and pipelines would not require additional materials and would not generate waste other than cleared vegetation, if necessary, that could be disposed of at a non-hazardous waste landfill.

Transportation Corridors

Roads

On-site roads would require periodic re-surfacing at a frequency dependent on the level of use and weathering. Asphalt removed from the road surface would be recycled. Road re-surfacing would involve heavy equipment that would require oils, lubricants, and coolants. Should any of these materials require disposal, they would be special waste or hazardous waste and would be appropriately managed by the construction contractor.

Rail

Maintenance of the rail spur would consist of replacing the rails and equipment at a frequency dependent on the level of use and weathering. Replacement materials would be obtained in the correct sizes and quantities from established suppliers, and the small amount of waste remaining after materials are reused or recycled would be disposed of in a permitted facility. Any special or hazardous waste (e.g., oils and coolants) generated during rail replacement would be properly managed by the contractor.

4.17 HUMAN HEALTH, SAFETY, AND ACCIDENTS

4.17.1 INTRODUCTION

This section describes the potential human health and safety impacts associated with the construction and operation of the proposed project. The health and safety impacts are evaluated in terms of the potential risk to both workers and the general public. The level of risk is estimated based on the current conceptual design of the proposed project, applicable health and safety and spill prevention regulations, and expected operating procedures.

Federal, state, and local health and safety regulations would govern work activities during construction and operation of the proposed project. Additionally, industrial codes and standards also apply to the health and safety of workers and the general public.

4.17.1.1 Region of Influence

The ROI for human health, safety, and accidents is the area within 10 miles (16.1 kilometers) of the boundaries of the proposed power plant and sequestration site, and CO_2 pipeline. At the proposed Mattoon Power Plant and Sequestration Site, modeling of the deep saline formation with an injection rate of 1.1 million tons (1 MMT) per year for 50 years produced a CO_2 plume radius of 1.2 miles (1.9 kilometers) (FG Alliance, 2006a). Because this is a first of its kind research project, 10 miles (16.1 kilometers) was chosen as a conservative distance in terms of the ROI for the proposed sequestration site.

4.17.1.2 Method of Analysis

DOE performed analyses to evaluate the potential effects of the proposed power plant and sequestration activities on human health, safety, and accidents. The potential for occupational or public health impacts was based on the following criteria:

- Occupational health risk due to accidents, injuries, or illnesses during construction and normal operating conditions;
- Health risks (hazard quotient or cancer risk) due to air emissions from the proposed power plant under normal operating conditions;
- Health risks due to unintentional releases associated with carbon sequestration activities; and
- Health risks due to terrorist attack or sabotage at the power plant or carbon sequestration site.

Potential occupational safety impacts were estimated based on national workplace injury, illness, and fatality rates. These rates were obtained from the U.S. Bureau of Labor Statistics (USBLS) and are based on similar industry sectors. The rates were applied to the anticipated numbers of employees for each phase of the proposed project. From these data, the projected numbers of Total Recordable Cases (TRCs), Lost Work Day Cases (LWDs), and fatalities were calculated. These analyses are presented in Section 4.17.2.

The calculated cancer risks and hazard quotients for air emissions under normal operating conditions are summarized in Section 4.17.3.1. Potential hazards from the accidental release of toxic/flammable gas for different plant components were evaluated by Quest (2006). This study addressed failure modes within the proposed plant boundary and was performed to identify any systems or individual process unit components that would produce a significantly larger potential for on-site or off-site impact based on different plant configurations. The results are summarized in Section 4.17.3.2.

Potential health effects were evaluated for workers and the general public who may be exposed to releases of captured gases (CO_2 and H_2S) during pre- and post-sequestration conditions. Gas releases were evaluated at the proposed plant, during transport via pipeline, at the sequestration site, and during subsurface storage (Tetra Tech, 2007). The results of these risk analyses are summarized in Section 4.17.4.

The potential impacts from a terrorism or sabotage event were determined by examining the results of the accident analysis of major and minor system failures or accidents at the proposed plant site and gas releases along the CO_2 pipeline(s) and at injection wells. The results of this analysis are provided in Section 4.17.5.

4.17.2 OCCUPATIONAL HEALTH AND SAFETY

4.17.2.1 Typical Power Plant Health and Safety Factors and Statistics

Power Plant Construction

Table 4.17-1 shows the injury/illness and fatality rates for utility related construction. These rates are expressed in terms of injury/illness per 100 worker-years (or 200,000 hours) for TRCs, LWDs, and fatalities.

Power Plant Operation

Because of the gasification and chemical conversion aspects of the proposed power plant, it would operate more like a petrochemical facility rather than a conventional power plant. As a result, occupational injury/illness rates for the petrochemical manufacturing sector were used in the analysis of the proposed power plant operation (Table 4.17-1). These rates are presented for TRCs, LWDs, and fatality rates.

Table 4.17-1. Occupational Injury/Illness and Fatality Data for Project Related Industries in 2005

Industry	2005 Average Annual Employment (thousands)[1]	Total Recordable Case Rate (per 100 workers)[1]	Lost Work Day Case Rate (per 100 workers)[1]	Fatality Rate (per 100 workers)[2]
Utility system construction	388.2	5.6	3.2	0.028
Petrochemical Manufacturing	29.2	0.9	0.4	0.001
Electric power transmission, control, and distribution	160.5	5.1	2.4	0.0062
Natural Gas Distribution	107.0	5.9	3.2	0.0025

[1] Source: USBLS, 2006a.
[2] Source: USBLS, 2006b.

Transmission Lines and Electro-Magnetic Fields

Magnetic fields are induced by the movement of electrons in a wire (current); and electric fields are created by voltage, the force that drives the electrical current. All electrical wiring, devices, and equipment, including transformers, switchyards, and transmission lines, produce electromagnetic fields (EMF). The strength of these fields diminishes rapidly with distance from the source. Building material, insulation, trees, and other obstructions can reduce electric fields, but do not significantly reduce magnetic fields. Electrical field strength is measured in kilovolts per meter, or kV/m. Magnetic field strength is expressed as a unit of magnetic induction (Gauss) and is normally expressed as a milligauss (mG), which is one thousandth of a Gauss. The average residential electric appliance typically has an electrical field of less than 0.003 kV/ft (0.01 kV/m). In most residences, when in a room away from electrical appliances, the magnetic field is typically less than 2 mG. However, very close to an appliance carrying a high current, the magnetic field can be thousands of milligauss.

Electric fields from power lines are relatively stable because line voltage does not vary much. However, magnetic fields on most lines fluctuate greatly as current changes in response to changing loads (consumption or demand).

Transmission lines contribute a relatively small portion of the electric and magnetic fields to which people are exposed. Nonetheless, over the past two decades, some members of the scientific community and the public have expressed concern regarding human health effects from EMFs during the transmission of electrical current from power plants. The scientific evidence suggesting that EMF exposures pose a health risk is weak. The strongest evidence for health effects comes from observations of human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults (NIEHS, 1999). The National Institute of Environmental Health Sciences report concluded that, "extremely low-frequency and magnetic field exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard" (NIEHS, 1999). While a fair amount of uncertainty still exists about the EMF health effects issue, the following determinations have been established from the information:

- Any exposure-related health risk to an individual would likely be small;
- The types of exposures that are most biologically significant have not been established;
- Most health concerns relate to magnetic fields; and
- Measures employed for EMF reduction can affect line safety, reliability, efficiency, and maintainability, depending on the type and extent of such measures.

CO_2 and Natural Gas Pipeline Safety

More than 1,500 miles (2,414 kilometers) of high-pressure long distance CO_2 pipelines exist in the U.S (Gale and Davison, 2004). In addition, numerous parallels exist between CO_2 and natural gas transport. Most rules and regulations written for natural gas transport by pipeline include CO_2. These regulations are administered and enforced by DOT's Office of Pipeline Safety. States also may regulate pipelines under partnership agreements with Office of Pipeline Safety. The rules are designed to protect the public and the environment by ensuring safety in pipeline design, construction, testing, operation, and maintenance. Risks associated with pipeline activities are determined to be low (IOGCC, 2005). However, in pipelines that carry captured CO_2 for sequestration, other gases may be captured and transported as well, and could affect risks posed to human health and the environment. For the proposed FutureGen Project, the captured gases might contain up to 100 parts per million volume (ppmv) of H_2S in the pipeline on a routine basis, and should any of the captured gases escape to the environment, risks from exposure to H_2S would have to be estimated, as well as risks from CO_2 exposure.

Table 4.17-1 shows the occupational injury and fatality rates for 2005 for operation of natural gas distribution systems. These rates are expressed in terms of injury/illness rate per 100 workers (or 200,000 hours) for TRCs, LWDs, and fatality rates. These rates are used to indicate occupational injuries associated with pipelines, although the properties and types of hazards of natural gas are different from those of CO_2. Because natural gas is highly flammable, these rates are determined to be conservative in relation to CO_2 pipelines.

4.17.2.2 Impacts

This subsection describes potential occupational health and safety risks associated with construction and operation of the proposed project. Features inherent in the design of project facilities as well as compliance with mandatory regulations, plans, and policies to reduce these potential risks are summarized within each risk category.

Construction

Power Plant Site

Potential occupational health and safety risks during construction of the proposed power plant and facilities are expected to be typical of the risks for major industrial/commercial construction sites. Health and safety concerns include: the movement of heavy objects, including construction equipment; slips, trips, and falls; the risk of fire or explosion from general construction activities (e.g., welding); and spills and exposures related to the storage and handling of chemicals and disposal of hazardous waste.

Risk of Fire or Explosion from General Construction Activities

Contractors experienced with the construction of coal and gas-fired electricity generating plants and refineries would be used on the proposed project. Construction specifications would require that contractors prepare and implement construction health and safety programs that are intended to control worker activities as well as establish procedures to prevent and respond to possible fires or explosions. The probability of a significant fire or explosion during construction of the proposed project has been determined to be low. With implementation of BMPs and procedures described in the following paragraphs, health and safety risks to construction workers and the public would also be low.

During construction, small quantities of flammable liquids and compressed gases would be used and stored on site. Liquids would include construction equipment fuels, paints, and cleaning solvents. Compressed gases would include argon, acetylene, helium, nitrogen, and O_2 for welding. Potential risk hazards associated with the use of flammable liquids and compressed gases would be reduced by compliance with a construction health and safety program and proper storage of these materials when not in use, in accordance with all applicable federal, state, and local regulations. The construction health and safety program would include the following major elements:

- An injury and illness prevention program;
- A written safety program (including hazard communication);
- A personnel protection devices program; and
- On-site fire suppression and prevention plans.

Storage and Handling of Hazardous Materials, Fuels, and Oils

Hazardous materials used during construction would be limited to gasoline, diesel fuel, motor oil, hydraulic fluid, solvents, cleaners, sealants, welding flux and gases, various lubricants, paint, and paint thinner. Small quantities of materials would be stored in a flammable storage locker, and drums and tanks would be stored in a secondary containment. Storage of the various types of chemicals would conform to Occupational Safety and Health Administration (OSHA) and applicable state guidelines. Construction personnel would be trained in handling chemicals, and would be alerted to the dangers associated with the storage of chemicals. An on-site Environmental Health and Safety Representative would be designated to implement the construction health and safety program and to contact emergency response personnel and the local hospital, if necessary. MSDSs for each chemical would be kept on site, and construction employees would be made aware of their location and content.

To limit exposure to uncontrolled releases of hazardous materials and ensure their safe handling, specific procedures would be implemented during construction, including:

- Lubrication oil used in construction equipment would be contained in labeled containers. The containers would be stored in a secondary containment area to collect any spillage.
- Vehicle refueling would occur at a designated area and would be closely supervised to avoid leaks or releases. To further reduce the possibility of spills, no topping-off of fuel tanks would be allowed.
- If fuel tanks are used during construction, the fuel tank(s) would be located within a secondary containment with an oil-proof liner sized to contain the single largest tank volume plus an adequate space allowance for rainwater. Other petroleum products would be stored in clearly labeled and sealed containers or tanks.
- Construction equipment would be monitored for leaks and undergo regular maintenance to ensure proper operation and reduce the chance of leaks. Maintenance of on-site vehicles would occur in a designated location.
- All paint containers would be sealed and properly stored to prevent leaks or spills. Unused paints would be disposed of in accordance with applicable state and local regulations.

Overall, BMPs would be employed that would include good housekeeping measures, inspections, containment maintenance, and worker education.

Spill Response and Release Reporting

Small quantities of fuel, oil, and grease may leak from construction equipment. Such leakage should not be a risk to health and safety or the environment because of low relative toxicity and low concentrations. If a large spill from a service or refueling truck were to occur, a licensed, qualified waste contractor would place contaminated soil in barrels or trucks for off-site disposal.

The general contractor's responsibility would include implementation of spill control measures and training of all construction personnel and subcontractors in spill avoidance. Training would also include appropriate response when spills occur, and containment, cleanup, and reporting procedures consistent with applicable regulations. The primary plan to be developed would describe spill response and cleanup procedures. In general, the construction contractor would be the generator of waste oil and miscellaneous hazardous waste generated during construction and would be responsible for compliance with applicable federal, state, and local laws, ordinances, regulations, and standards. This would include licensing, personnel training, accumulation limits, reporting requirements, and record keeping.

During construction, the potential exists for a major leak during the chemical cleaning of equipment or piping before it is placed into service. This method of cleaning could consist of an alkaline degreasing step (in which a surfactant, caustic, or NH_3 solution is used), an acid cleaning step, and a passivation step. Most of the solution would be contained in permanent facility piping and equipment. The components of the process that would be most likely to leak are the temporary chemical cleaning hoses, pipes, pump skids, and transport trailers. The cleaning would be within curbed areas, and spills would be manually cleaned up and contaminated materials disposed of in accordance with the applicable regulations.

Due to the limited quantities and types of hazardous materials used during construction, the likelihood of a spill reaching or affecting off-site residents would be low.

Medical Emergencies during Construction

Selected construction personnel would receive first aid and CPR training. On-site treatment would be provided in medical situations that require only first aid or stabilization of the victim(s) until professional medical attention could be attained. Any injury or illness that would require treatment beyond first aid would be referred to the local hospital.

Worker Protection Plan

The construction contractor would develop, implement, and maintain a Worker Protection Plan. This plan would implement OSHA requirements (1910 and 1926) and would define policies, procedures, and practices implemented during the construction process to ensure protection of the workforce, environment, and the public. The minimum requirements addressed by the Worker Protection Plan would include:

- Environment, Safety, and Health Compliance
- Working Surfaces
- Scaffolding
- Powered Platforms, Manlifts, and Vehicle-Mounted Platforms
- Fall Protection
- Cranes, Derricks, Hoists, Elevators, and Conveyors
- Hearing Conservation
- Flammable and Combustible Liquids
- Hazardous Waste Operations
- Personal Protective Equipment
- Respiratory Protection
- Confined Space Program
- Hazardous Energy Control
- Medical and First Aid
- Fire Protection
- Compressed Gas Cylinders
- Materials Handling and Storage
- Hand and Portable Powered Tools
- Welding, Cutting and Brazing
- Electrical Safety
- Toxic and Hazardous Substances
- Hazardous Communications
- Heat Stress

Industrial Safety Impacts

Based on data for the construction of similar projects, the construction workforce would average about 350 employees, with a peak of about 700 during the most active period of construction. Since the nature of the activities to be performed across all areas of the proposed project would be similar in scope, industrial safety impacts were calculated for the proposed project and not for each construction sector. Based on the employment numbers during the construction phase, the TRCs, LWDs, and fatalities presented in Table 4.17-2 would be expected. As shown in Table 4.17-2, based on the estimated number of workers during construction, no fatalities would be expected (calculated number of fatalities is less than one).

Table 4.17-2. Calculated Annual Occupational Injury/Illness and Fatality Cases for Power Plant Construction

Construction Phase	Number of Employees	Total Recordable Cases	Lost Work Day Cases	Fatalities
Average	350	20	11	0.098
Peak	700	39	22	0.196

Sequestration Site

Accidents are inherently possible with any field or industrial activities. Well drilling can lead to worker injuries due to: being struck with or pinned by flying or falling parts and equipment; trips and falls; cuts, bruises, and scrapes; exposure to high noise; and muscle strains due to overexertion. Catastrophic accidents could involve well blowouts, derrick collapse, exposure to hydrogen sulfide and other hazardous gases, fire, or explosion. Although catastrophic accidents frequently involve loss of life as well as major destruction of equipment, they represent only a small percentage of the total well drilling occupational injury incidence and severity rates. Most well drilling injuries (60 to 70 percent) were reported by workers with less than six months of experience (NIOSH, 1983). To avoid well drilling accidents, a worker protection plan and safety training (particularly for new workers) should be instituted, covering all facets of drilling safety.

Utility Corridors

Risks and hazards associated with construction of power lines, substations, and pipelines would be addressed through the Worker Protection Plan. Many of these types of construction activities may be undertaken by public utilities or companies specializing in this type of work and would be governed by their worker protection programs.

Transportation Infrastructure Corridors

Risks and hazards associated with construction activities for access roads, public road upgrades, and the rail loop would be addressed through the Worker Protection Plan. Construction activities on public roads may be undertaken by city or county public works departments and would be governed by their worker protection programs.

Operational Impacts

Two categories of accidents could occur that would pose an occupational health and safety risk to individuals at the proposed power plant and sequestration site, on the CO_2 pipeline corridor, or in the project vicinity: risk of fire or explosion either from general facility operations or specifically from a gas release (e.g., syngas, hydrogen, natural gas, H_2S, or CO_2); and risk of a hazardous chemical release or spill. Risk assessments evaluating accidents (e.g., explosions and releases) were performed to evaluate potential impacts for both workers and the public. The results of these assessments are summarized in Sections 4.17.3.2 and 4.17.4.

Power Plant Site

The operation of any industrial facility or power plant holds the potential for workplace hazards and accidents. To promote the safe and healthful operation of the proposed power plant, qualified personnel would be employed and written safety procedures would be implemented. These procedures would provide clear instructions for safely conducting activities involved in the initial startup, normal operations, temporary operations, normal shutdowns, emergency shutdowns, and subsequent restarts. The procedures for emergency shutdowns would include the conditions under which such shutdowns are required and the assignment of emergency responsibilities to qualified operators to ensure that procedures are completed in a safe and timely manner. Also covered in the procedures would be the consequences of operational deviations and the steps required to correct or avoid such deviations. Employees would be given a facility plan, including a health and safety plan, and would receive training regarding the operating procedures and other requirements for safe operation of the proposed power plant. In addition, employees would receive annual refresher training, which would include the testing of their understanding of the procedures. The operator would maintain training and testing records.

The proposed power plant would be designed to provide the safest working environment possible for all site personnel. Design provisions and health and safety policies would comply with OSHA standards and consist of, but not be limited to, the following:

- Safe egress from all confined areas;
- Adequate ventilation of all enclosed work areas;
- Fire protection;
- Pressure relief of all pressurized equipment to a safe location;
- Isolation of all hazardous substances to a confined and restricted location;
- Separation of fuel storage from oxidizer storage;
- Prohibition of smoking in the workplace; and
- Real-time monitoring for hazardous chemicals with local and control room annunciation and alarm.

Industrial Safety Impacts

The operational workforce is expected to average about 200 employees. As shown in Table 4.17-3, the number of calculated fatalities for operation of this facility would be less than one.

Table 4.17-3. Calculated Annual Occupational Injury/Illness and Fatality Cases for Power Plant Operation

Number of Employees	Total Recordable Cases	Lost Work Day Cases	Fatalities
200	2	1	0.002

Risk of Fire or Explosion

Operation of the proposed facility would involve the use of flammable and combustible materials that could pose a risk of fire or explosion. The potential for fire or explosion at the proposed power plant would be minimized through design and engineering controls, including fire protection systems. The risks of fire and explosion could be minimized also through good housekeeping practices and the proper storage of chemicals. Workers would consult MSDS information to ensure that only compatible chemicals are stored together. Impacts of a potential large or catastrophic explosion are discussed in Section 4.17.3.2.

Risk of Hazardous Chemical Release or Spill

Chemicals and hazardous substances would be delivered, used, and stored at the proposed project site during operation. Petroleum products used on site during operation would be stored following the same guidelines described for construction. During operation, the worst-case scenario would be a major leak during chemical cleaning of equipment and associated piping.

The presence of hazardous environments during normal operations is not anticipated. Plant equipment would be installed, maintained, and tested in a manner that reduces the potential for inadvertent releases. Scheduled and forced maintenance would be planned to incorporate engineering and administrative controls to provide worker protection as well as mitigate any possible chemical releases. Facility and spot ventilation would provide for the timely removal and treatment of volatile chemicals. Worker practices and facility maintenance procedures would provide for the containment and cleanup of non-volatile chemicals. Personnel and area monitoring will provide assurance that worker exposures are maintained well below regulatory limits.

Seven chemical compounds are identified that could produce harmful effects in exposed individuals. The severity of these effects is dependent on the level of exposure, the duration of the exposure, and individual sensitivities to the various chemical compounds. Table 4.17-4 describes chemical exposure limits, potential exposure routes, organs targeted by the compounds, and the range of symptoms associated with exposures to these chemicals. The occupational exposure limits are defined in Table 4.17-5. Potential public exposures to accidental releases of these chemicals are described in Section 4.17.3.2.

While some of the chemicals listed in Table 4.17-4 would be generated during proposed power plant operation, others are stored on site and the potential for personnel exposure as the result of minor spills or leaks, while low, exists.

Table 4.17-4. Properties and Hazards Associated with Chemicals of Concern

Chemical	Exposure Limits	Exposure Routes	Target Organs	Symptoms
Ammonia (NH_3)	**NIOSH REL**: TWA 25 ppm, ST 35 ppm **OSHA PEL**: TWA 50 ppm **IDLH**: 300 ppm	Inhalation, ingestion (solution), skin and eye contact (solution/liquid)	Eyes, skin, respiratory system	Irritation in eyes, nose, throat; dyspnea (breathing difficulty), wheezing, chest pain; pulmonary edema; pink frothy sputum; skin burns, vesiculation; liquid: frostbite
Carbon Dioxide (CO_2)	**NIOSH REL**: TWA 5,000 ppm ST 30,000 ppm **OSHA PEL**: TWA 5,000 ppm **IDLH**: 40,000 ppm	Inhalation, skin and eye contact (liquid/solid)	Respiratory and cardiovascular systems	Headache, dizziness, restlessness, paresthesia; dyspnea (breathing difficulty); sweating, malaise (vague feeling of discomfort); increased heart rate, cardiac output, blood pressure; coma; asphyxia; convulsions; liquid: frostbite
Carbon Monoxide (CO)	**NIOSH REL**: TWA 35 ppm; C 200 ppm **OSHA PEL**: TWA 50 ppm **IDLH**: 1200 ppm	Inhalation, skin and eye contact (liquid)	Cardiovascular system, lungs, blood, central nervous system	Headache, tachypnea, nausea, lassitude (weakness, exhaustion), dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope
Chlorine (Cl_2)	**NIOSH REL**: C 0.5 ppm [15-minute] **OSHA PEL**: C 1 ppm **IDLH**: 10 ppm	Inhalation, skin and eye contact	Eyes, skin, respiratory system	Burning of eyes, nose, mouth; lacrimation (discharge of tears), rhinorrhea (discharge of thin mucus); cough, choking, substernal (occurring beneath the sternum) pain; nausea, vomiting; headache, dizziness; syncope; pulmonary edema; pneumonitis; hypoxemia (reduced oxygen in the blood); dermatitis; liquid: frostbite
Hydrogen Chloride (HCl)	**NIOSH REL**: C 5 ppm **OSHA PEL**: C 5 ppm **IDLH**: 50 ppm	Inhalation, ingestion (solution), skin and eye contact	Eyes, skin, respiratory system	Irritation in nose, throat, larynx; cough, choking; dermatitis; solution: eye, skin burns; liquid: frostbite; in animals: laryngeal spasm; pulmonary edema

Table 4.17-4. Properties and Hazards Associated with Chemicals of Concern

Chemical	Exposure Limits	Exposure Routes	Target Organs	Symptoms
Hydrogen Sulfide (H_2S)	**NIOSH REL**: C 10 ppm [10-minute] **OSHA PEL**: C 20 ppm 50 ppm [10-minute maximum peak] **IDLH:** 100 ppm	Inhalation, skin and eye contact	Eyes, respiratory system, central nervous system	Irritation in eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; gastrointestinal disturbance; liquid: frostbite
Sulfur Dioxide (SO_2)	**NIOSH REL**: TWA 2 ppm ST 5 ppm **OSHA PEL**: TWA 5 ppm **IDLH**: 100 ppm	Inhalation, skin and eye contact	Eyes, skin, respiratory system	Irritation in eyes, nose, throat; rhinorrhea (discharge of thin mucus); choking, cough; reflex bronchoconstriction; liquid: frostbite

NIOSH = National Institute of Occupational Safety and Health.
OSHA = Occupational Safety and Health Administration.
IDLH = Immediately Dangerous to Life and Health.
PEL = Permissible Exposure Limit.
REL = Recommended Exposure Limit.
TWA = Time-Weighted Average.
ST = Short-term.
C = Ceiling.
Source: NIOSH, 2007.

Table 4.17-5. Definitions of Occupational Health Criteria

Hazard Endpoint	Description
NIOSH REL C	NIOSH REL. A ceiling value. Unless noted otherwise, the ceiling value should not be exceeded at any time.
NIOSH REL ST	NIOSH REL. Short-term exposure limit (STEL), a 15-minute TWA exposure that should not be exceeded at any time during a workday.
NIOSH REL TWA	NIOSH REL. TWA concentration for up to a 10-hour workday during a 40-hour work week.
OSHA PEL C	Permissible exposure limit (PEL). Ceiling concentration that must not be exceeded during any part of the workday; if instantaneous monitoring is not feasible, the ceiling must be assessed as a 15-minute TWA exposure.
OSHA PEL TWA	PEL. TWA concentration that must not be exceeded during any 8-hour work shift of a 40-hour workweek.
IDLH	Airborne concentration from which a worker could escape without injury or irreversible health effects from an IDLH exposure in the event of the failure of respiratory protection equipment. The IDLH was evaluated at a maximum concentration above which only a highly reliable breathing apparatus providing maximum worker protection should be permitted. In determining IDLH values, NIOSH evaluated the ability of a worker to escape without loss of life or irreversible health effects along with certain transient effects, such as severe eye or respiratory irritation, disorientation, and incoordination, which could prevent escape. As a safety margin, IDLH values are based on effects that might occur as a consequence of a 30-minute exposure.

NIOSH = National Institute of Occupational Safety and Health.
OSHA = Occupational Safety and Health Administration.
IDLH = Immediately Dangerous to Life and Health.
PEL = Permissible Exposure Limit.
REL = Recommended Exposure Limit.
TWA = Time-Weighted Average.
ST = Short-term.
C = Ceiling.

The FutureGen Project would use aqueous NH_3 in a selective catalytic reduction process to remove NO_X and thousands of pounds could be stored on-site. Three scenarios for the accidental release of NH_3 were evaluated using the EPA's ALOHA model: a leak from a tank valve, a tanker truck spill, and a tank rupture. (See Appendix F for summary of how the model was used, a description of input data, and the results of sensitivity analyses.) Health effects from inhalation of NH_3 can range from skin, eye, throat, and lung irritation; coughing; burns; lung damage; and even death. Impacts of NH_3 releases on workers and the public depends on the location of the releases, the meteorological conditions (including atmospheric stability and wind speed and direction) and other factors. The criteria used to examine potential health effects, are defined in Table 4.17-6 and Table 4.17-7.

Table 4.17-6. Hazard Endpoints for Individuals Potentially Exposed to an Ammonia Spill

Exposure Time	Gas	Effect Category	Concentration (ppmv)	Hazard Endpoint[1]
1 hour	NH_3	Adverse effects	30	AEGL 1
		Irreversible adverse effects	160	AEGL 2
		Life Threatening	1,100	AEGL 3

[1]See Table 4.17-7 for descriptions of the AEGL endpoints.
AEGL = Acute Exposure Guideline Level.

Table 4.17-7. Description of Hazard Endpoints for Ammonia Spill Receptors

Hazard Endpoint	Description
AEGL 1	The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGL 2	The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects, or an impaired ability to escape.
AEGL 3	The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

AEGL = Acute Exposure Guideline Level.
Source: EPA, 2007.

Leakage of 400 pounds (180 kilograms) of aqueous NH_3 solution (19 percent NH_3) from a tank, through a faulty valve was selected as a plausible upper-bound accidental spill. It was assumed that this release would create a one-centimeter deep pool, with a surface area of 211 square feet (19.6 square meters). The temperature of the solution was assumed to be 101°F (38.3°C), based on the maximum daily air temperature in Mattoon for the past three years. Downwind atmospheric concentrations of volatilized (vapor-phase) NH_3 were calculated using a wind speed of 1.5 m/sec, Pasquill atmospheric stability class F (most conservative) using EPA's ALOHA model, which assumes a source duration of up to one hour. Concentrations within 2,805 feet (855 meters) of the pool would exceed AEGL Level 1 criteria for temporary health effects (30 ppmv – 1 hour) (see Table 4.17-8). Individuals exposed within a distance of 1,266 ft (386 m) of the pool would be expected to experience NH_3 concentrations above AEGL Level 2 for irreversible adverse effects (160 ppmv – 1 hour), while life threatening exposures (AEGL Level 3, i.e., 1,100 ppmv – 1 hour) could occur only within 531 feet (162 meters) of the spill. Thus, only workers (assumed to be within 250 meters of a release) could potentially be exposed to life-threatening levels of atmospherically dispersed NH_3. The peak concentrations are predicted to last about 5 minutes, and would not exceed the AEGL-3 criteria of 2,700 ppmv for a 10-minute exposure at 250 meters.

Table 4.17-8. Effects of an Ammonia Spill at the Proposed Power Plant

Release Scenario	Gas	Effect[1]	Distance (feet [meters])
NH_3 leaky valve (400 pounds, 19 percent solution)	NH_3	Adverse Effects	2,805 (855)
		Irreversible adverse effects	1,266 (386)
		Life threatening effects	531 (162)
NH_3 tanker truck spill (46,200 pounds, 19 percent solution)	NH_3	Adverse Effects	14,763 (4,500)
		Irreversible adverse effects	5,577 (1,700)
		Life threatening effects	1,880 (573)
NH_3 tank rupture (104,355 pounds, 19 percent solution)	NH_3	Adverse Effects	8,202 (2,500)
		Irreversible adverse effects	2,969 (905)
		Life threatening effects	1,023 (312)

[1] See Table 4.17-6 and 4.17-7 for an explanation of the effects.

For the tanker truck spill scenario, it was assumed that all 46,200 pounds (20,956 kilograms) of the 19 percent NH_3 solution in the truck may be spilled on the ground surface. It was assumed that this release would create a ten-centimeter deep pool, with a surface area of 2,454 square feet (228 square meters). The temperature of the solution was assumed to be 101°F (38.3°C), based on the maximum daily air temperature in Mattoon for the past three years. Downwind atmospheric concentrations of volatilized (vapor-phase) NH_3 were calculated using a wind speed of 1.5 m/sec, Pasquill atmospheric stability class F (most conservative) using EPA's ALOHA model, which assumes a source duration of up to one hour. Concentrations within 14,763 feet (4,500 meters) of the pool would exceed AEGL Level 1 criteria for temporary health effects (30 ppmv – 1 hour) (see Table 4.17-8). Individuals within a distance of 5,577 feet (1,700 meters) of the pool would be expected to experience NH_3 concentrations above AEGL Level 2 for irreversible adverse effects (160 ppmv – 1 hour), while life threatening exposures (AEGL Level 3, i.e., 1,100 ppmv – 1 hour) could occur within 1,880 feet (573 meters) of the spill. Thus, workers and the general public (assumed to be located at least 820 feet [250 meters] from a release) could potentially be exposed to life-threatening levels of atmospherically dispersed NH_3. The peak concentrations are predicted to last about 10 minutes, and would exceed the AEGL-3 criteria of 2,700 ppmv for a 10-minute exposure at 820 feet (250 meters), but not inside a building.

For the tank rupture spill scenario, it was assumed that all 104,355 pounds (13,400 kilograms) of the 19 percent NH_3 solution in one of two on-site storage tanks may be released within the diked area around the tank. The tank discharge was assumed to create a 92-centimeter deep pool with a surface area of 601 square feet (55.8 square meters). Again the temperature of the solution was conservatively assumed to be 101°F (38.3 °C). The same atmospheric conditions as above, and EPA's ALOHA model with a source duration of 1 hour were used to calculate downwind atmospheric NH_3 concentrations. Concentrations within 8,202 feet (2,500 meters) of the pool would exceed AEGL Level 1 criteria for temporary health effects (30 ppmv – 1 hour) (see Table 4.17-8). Individuals within a distance of 2,969 feet (905 meters) of the pool would be expected to experience NH_3 concentrations above AEGL Level 2 for irreversible adverse effects (160 ppmv – 1 hour), while life threatening exposures (AEGL Level 3, i.e., 1,100 ppmv – 1 hour) could occur within 1,023 feet (312 meters) of the spill. Thus, workers and the general public (assumed to be located at least 820 feet [250 meters] from a release) could potentially be exposed to life-threatening levels of atmospherically dispersed NH_3. The peak concentrations are predicted to last about 10 minutes, and would not exceed the AEGL-3 criteria of 2,700 ppmv for a 10-minute exposure at 820 feet (250 meters).

The meteorological conditions specified for these analyses (F stability class) result in conservative estimates of exposure. At Mattoon, this stability class occurs about 8 percent of the time. Simulations of the other six stability classes showed that the predicted distances to a given criteria were no more than 35 percent of the distance for the conservative stability class F. The stability class (D12), which gave the second highest results, occurs about 0.3 percent of the time. Since NH_3 produces a distinct, pungent odor at low concentrations (approximately 17 ppmv (AIHA, 1997), it is expected that most workers and the public in the vicinity of an accident would quickly evacuate under the scenarios discussed above. Depending on the size and location of the accident, the public would be alerted to the appropriate response such as shelter-in-place procedures or evacuation for the public living near the accident.

Sections 4.17.3.2 and 4.17.4 discuss scenarios involving equipment failure or rupture at the proposed power plant site, along utility corridors, and at the injection site.

Medical Emergencies

All permanent employees at the facility would receive first aid and CPR training. On-site treatment would be provided in medical situations that require only first aid treatment or stabilization of the victim(s) until professional medical attention is obtained. Any injury or illness that requires treatment beyond first aid would be referred to the plant's medical clinic or to a local medical facility.

Coal Storage

The National Fire Protection Association (NFPA) identifies hazards associated with storage and handling of coal, and gives recommendations for protection against these hazards. NFPA recommends that any storage structures be made of non-combustible materials, and that they be designed to minimize the surface area on which dust can settle, including the desirable installation of cladding underneath a building's structural elements.

Coal is susceptible to spontaneous combustion due to heating during natural oxidation of new coal surfaces. Also, coal dust is highly combustible and an explosion hazard. If a coal dust cloud is generated inside an enclosed space and an ignition source is present, an explosion can ensue. Dust clouds may be generated wherever loose coal dust accumulates, such as on structural ledges or if there is a nearby impact or vibration due to wind, earthquake, or even maintenance operations. Because of coal's propensity to heat spontaneously, ignition sources are almost impossible to eliminate in coal storage and handling, and any enclosed area where loose dust accumulates is at great risk. Further, even a small conflagration can result in a catastrophic "secondary" explosion if the small event releases a much larger dust cloud.

A Quonset hut-type building for on-site coal storage is being evaluated (FG Alliance, 2006e). This structure would protect the pile from rain and wind, which would otherwise foster spontaneous combustion in open-air piles and cause air and runoff pollution. Internal cladding would prevent dust accumulation on the structure. A breakaway panel may provide for accidental overloading and ventilation at the base, and exhaust fans or ventilation openings ensure against methane or smoke buildup. Dust suppression/control techniques would be employed. Fire detection and prevention systems may also be installed.

The surfaces of stored coal can be unstable, and workers can become entrapped and subsequently suffocate while working on stored coal piles (NIOSH, 1987). NIOSH recommendations for preventing entrapment and suffocation would be followed.

Sequestration Site

Industrial Safety Impacts

The operational workforce for the proposed sequestration site would be up to 20 employees. Since this proposed site would not be a permanently staffed facility, these personnel would be rotated from the permanent site pool. Based on these employment numbers, during operation of the proposed power plant, the TRCs, LWDs, and fatalities presented in Table 4.17-9 would be expected. As shown in Table 4.17-9, the number of calculated fatalities for operation of this facility would be less than one.

Table 4.17-9. Calculated Annual Occupational Injury and Fatality Cases for Sequestration Site Operation

Number of Employees	Total Recordable Cases	Lost Work Day Cases	Fatalities
20	<1	<1	0.0002

Utility Corridors

Risk of Fire or Explosion

The proposed transmission line connector would be located high above ground (typically between 50 to 100 feet [15.2 to 30.5 meters] high). Only qualified personnel would perform maintenance on the proposed transmission lines. Sufficient clearance would be provided for all types of vehicles traveling under the proposed transmission lines. The operator of the line would establish and maintain safe clearance between the tops of trees and the proposed transmission lines to prevent fires. Ground and counterpoise wires would be installed on the proposed transmission system, providing lightning strike protection and thereby reducing the risk of explosion. However, a brush fire could occur in the rare event that a conductor parted and one end of the energized wire fell to the ground, or perhaps in the event of lightning strikes. Under these rare circumstances, the local fire department would be called upon.

Releases or Potential Releases of Hazardous Materials to the Environment

Hazardous materials used during maintenance of the proposed transmission facilities would be limited to gasoline, diesel fuel, motor oil, hydraulic fluid, solvents, cleaners, sealants, welding flux and gases, various lubricants, paint, and paint thinner. Small quantities of fuel, oil, and grease may leak from maintenance equipment. Such leakage should not be a risk to health and safety or the environment because of low relative toxicity and low concentrations.

Industrial Safety Impacts

The operational workforce for the proposed utility corridors would be less than 20 employees. As with the proposed sequestration site, the majority of these workers would not be on permanent assignment and would be drawn from the plant pool. Based on these employment numbers, during operation and maintenance of utility corridors, the TRCs, LWDs, and fatalities presented in Table 4.17-10 would be expected. As shown in Table 4.17-10, the number of calculated fatalities for operation of this facility would be less than one.

Table 4.17-10. Calculated Annual Occupational Injury and Fatality Cases for Utility Corridors Operation

Number of Employees	Total Recordable Cases	Lost Work Day Cases	Fatalities
20	<1	<1	0.0002

Transportation Corridors

Facility personnel would not be involved in activities associated with these infrastructure operations. Rail and road transportation activities would be performed by non-facility employees and vendors. Hazards related to the proposed transportation corridor operation would not be different from those posed by the normal transportation risks associated with product delivery.

4.17.3 AIR EMISSIONS

4.17.3.1 Air Quality – Normal Operations

Air quality impacts on human health were evaluated for HAPs potentially released during normal operation of the proposed Mattoon Power Plant and Sequestration Site. HAP emissions from the FutureGen Project were estimated based on the Orlando Gasification Project. The methods used to analyze impacts are described in Section 4.2.3 with supporting materials in Appendix E. Assessment of the potential toxic air pollutant emissions demonstrated that all ambient air quality impacts for air toxics would be below the relevant EPA recommended exposure criteria. This section of the report provides a summary of the results of potential air quality impacts.

As described in Section 4.2.3 regarding the modeling approach, estimated emissions of HAPs were based on data taken from the Orlando Gasification Project (DOE, 2007). Although the Orlando project is an IGCC power plant, there are differences from the proposed project. Consequently, the Orlando project data were scaled, based on relative emission rates of VOCs and particulate matter, to produce more appropriate estimates of stack emissions from the proposed project.

Airborne HAP concentrations were determined by modeling the impact of 1 g/s emissions rate using AERMOD. Table 4.17-11 shows representative air quality impacts for several metallic and organic toxic air pollutants. Each of these airborne concentrations was evaluated using chronic exposure criteria (expressed as inhalation unit risk factors and reference concentrations) obtained from the EPA Integrated Risk Information System (IRIS) (EPA, 2006a). As appropriate, an inhalation unit risk factor was multiplied by the maximum annual average airborne concentration for each HAP to calculate a cancer risk. Hazard coefficients were calculated by dividing the maximum annual average airborne concentration for each HAP by the appropriate reference concentration taken from the EPA IRIS (EPA, 2006a). The cancer risks and hazard coefficients calculated for each HAP were then summed and compared to the EPA criteria for evaluating HAP exposures. The results of this analysis, as indicated in Table 4.17-11, show that predicted exposures are safely well below the EPA exposure criteria.

Normal Air Quality and Asthma

Asthma is a chronic respiratory disease characterized by attacks of difficulty breathing. It is a common chronic disease of childhood, affecting over 6.5 million children in the U.S. in 2005 and contributing to over 12.8 million missed school days annually (DHHS, 2006). In 2005, the prevalence of asthma among children in the U.S. was 8.9 percent. Asthma prevalence rates among children remain at historically high levels after a large increase from 1980 until the late 1990s.

Asthma-related hospitalizations followed a trend similar to those for asthma prevalence, rising from 1980 through the mid-1990s, remaining at historically high plateau levels. Asthma-related mortality rates in the U.S. have declined recently after a rising trend from 1980 through the mid-1990s (DHHS, 2006).

It remains unknown why some people get asthma and others do not (DHHS, 2006). Asthma symptoms are triggered by a variety of things such as allergens (e.g., pollen, dust mites, and animal dander), infections, exercise, changes in the weather, and exposure to airway irritants (e.g., tobacco smoke and outdoor pollutants). Although extensive evidence shows that ambient air pollution (based on measurements of NO_2, particulate matter, soot, and O_3) exacerbates existing asthma, a link with the development of asthma is less well established (Gilmour et al., 2006).

A 2006 workshop sponsored by the EPA and the National Institute of Environmental Health Sciences (Selgrade et al., 2006) found that there are a number of scientific questions that need to be answered in order to make appropriate regulatory decisions for ambient air, including which air pollutants are of greatest concern and at what concentrations. Nevertheless, IGCC power plants that are currently in operation have achieved the lowest levels of criteria air pollutant (SO_2, CO, O_3, NO_2, Pb, and respirable particulate matter) emissions of any coal-fueled power plant technologies (DOE, 2002). Tables 4.2-1 and 4.2-2 show that the IGCC technology under evaluation for the proposed project would exceed the performance of technologies used at more conventional types of coal-fueled power plants of comparable size. Furthermore, based on evaluations conducted for this proposed site (as described in Section 4.2), the maximum predicted concentrations of the criteria air pollutants would not exceed the National Ambient Air Quality Standards and would not significantly contribute to existing background levels. Based on these determinations, it is unlikely that the proposed project would be a factor in asthma-related health effects.

Table 4.17-11. Summary Analysis Results — Hazardous Air Pollutants

Chemical Compound	CT/HRSG Emissions[1] (lb/hr)	CT/HRSG Emissions[1] (g/s)	Inhalation Unit Risk Factor[2] $(\mu g/m^3)^{-1}$	Reference Concentration[2] $(\mu g/m^3)^{-1}$	Cancer Risk[3]	Hazard Coefficient[4]
2-Methylnaphthalene	1.99E-04	2.51E-05	n/a	n/a	n/a	n/a
Acenaphthyalene	1.44E-05	1.81E-06	n/a	n/a	n/a	n/a
Acetaldehyde	9.99E-04	1.26E-04	2.20E-06	9.00E+00	2.77E-12	1.40E-07
Antimony	**5.59E-03**	**7.04E-04**	n/a	**2.00E-01**	n/a	**3.52E-05**
Arsenic	**2.94E-03**	**3.70E-04**	**4.30E-03**	**3.00E-02**	**1.59E-08**	**1.24E-04**
Benzaldehyde	1.61E-03	2.03E-04	n/a	n/a	n/a	n/a
Benzene	2.69E-03	3.39E-04	7.80E-06	3.00E+01	2.65E-11	1.13E-07
Benzo(a)anthracene	1.28E-06	1.61E-07	1.10E-04	n/a	1.77E-13	n/a
Benzo(e)pyrene	3.05E-06	3.84E-07	8.86E-04	n/a	3.40E-12	n/a
Benzo(g,h,i)perylene	5.26E-06	6.63E-07	n/a	n/a	n/a	n/a
Beryllium	**1.26E-04**	**1.59E-05**	**2.40E-03**	**2.00E-02**	**3.81E-10**	**7.93E-06**
Cadmium	**4.06E-03**	**5.12E-04**	**1.80E-03**	**2.00E-02**	**9.21E-09**	**2.56E-04**
Carbon Disulfide	2.49E-02	3.14E-03	n/a	7.00E+02	n/a	4.49E-08
Chromium[5]	**3.78E-03**	**4.76E-04**	**1.20E-02**	**1.00E-01**	**5.72E-08**	**4.76E-05**
Cobalt	**7.97E-04**	**1.00E-04**	n/a	**1.00E-01**	n/a	n/a
Formaldehyde	1.85E-02	2.33E-03	5.50E-09	9.80E+00	1.28E-13	n/a
Lead	**4.06E-03**	**5.12E-04**	n/a	**1.50E+00**	n/a	**3.41E-06**
Manganese	**4.34E-03**	**5.47E-04**	n/a	**5.00E-02**	n/a	**1.09E-04**
Mercury	**1.27E-03**	**1.60E-04**	n/a	**3.00E-01**	n/a	**5.34E-06**
Naphthalene	2.95E-04	3.72E-05	3.40E-05	3.00E+00	n/a	1.24E-07
Nickel	**5.45E-03**	**6.87E-04**	**2.40E-04**	**9.00E-02**	**1.65E-09**	**7.63E-05**
Selenium	**4.06E-03**	**5.12E-04**	n/a	**2.00E+01**	n/a	**2.56E-07**
Toluene	4.12E-04	5.19E-05	n/a	4.00E+02	n/a	1.30E-09
TOTAL					8.44E-08	6.65E-04
Risk Indicators					1.00E-06	1.00E+00
Percent of Indicator					8.4 percent	0.07 percent

[1] Emission rates scaled by the ratio of VOC or particulate emissions from Orlando EIS to FutureGen.
[2] Provided by EPA Integrated Risk Information System (IRIS).
[3] Unit risk factor multiplied by maximum annual average impact of 0.0100 $\mu g/m^3$ determined by AERMOD at a 1 g/s emission rate.
[4] Maximum AERMOD annual average impact divided by reference concentration.
CT/HRSG = combustion turbine/heat recovery steam generator; lb/hr = pounds per hour; g/s = grams per second; $\mu g/m^3$ = micrograms per cubic meter; n/a = not available.
[5] Conservatively assumed all chromium to be hexavalent.
Compounds that are considered to be particulate matter in **bold** text.

4.17.3.2 Hazard Analysis

The "Consequence-Based Risk Ranking Study for the Proposed FutureGen Project Configurations" (referred hereafter as the Quest Study) was conducted to define creditable upperbound impacts from potential accidental releases of toxic and flammable gas from the proposed systems (Quest, 2006). Risks associated with gas releases include asphyxiation, exposure to toxic gas clouds, flash fires, torch fires, and vapor cloud explosions.

A particular concern associated with the release of gas is exposure to a toxic component within the dispersing gas cloud. Many of the process streams of the proposed power plant could contain one or more toxic components. The Quest Study evaluated the extent of exposure to gas clouds containing NH_3, CO, Cl_2, HCl, H_2S, and SO_2. Additional analyses were performed to define the extent of potential asphyxiation hazard associated with exposure to high concentrations of CO_2.

The hazard of interest for flash fires was direct exposure to flames. Flash fire hazard zones were determined by calculating the maximum size of the flammable gas cloud before ignition. The lower flammable limit (LFL) of the released hydrocarbon mixture was used as a boundary. The hazard of interest for the torch fires (ignition of a high velocity release of a flammable fluid, such as a hydrogen deflagration) was exposure to thermal radiation from the flame (Quest, 2006). For vapor clouds explosions, the hazard of interest was the overpressure created by the blast wave. For toxic components, potential impacts were determined by calculating the maximum distance at which health effects could occur.

Plant System Configurations

For the purposes of the analysis, the facility was assumed to be located in an area of reasonably flat terrain with limited vertical obstructions. This provided the bounding conditions that allow for the most conservative hazard impact analysis (Quest, 2006).

For the base case evaluation, the main process components for each of the proposed plant configurations were laid out in a rectangular area approximately 75 acres (30 hectares) in size. This area was surrounded by the rail line used to deliver the coal. The total area required for the project would consist of a minimum of 200 acres (81 hectares) (Quest, 2006).

Three other cases were also evaluated. Assuming the proposed facility is placed in the middle of a 200-, 400-, or 600-acre (81-, 162-, or 243-hectare) site, it was determined whether any explosion would extend beyond the boundaries of each site configuration.

Summary of Results

A full evaluation of the hazards associated with the preliminary designs of the four proposed gasifier systems for use in the proposed project was performed. This analysis was composed of the following three primary tasks:

- Task 1: Determine the maximum credible potential releases for each process unit within each proposed system configuration for each candidate coal source.
- Task 2: For each release point identified in Task 1, determine the maximum downwind travel for harmful, but not fatal, consequences of the release under worst-case atmospheric conditions.
- Task 3: Using the results of Task 2 and the available general layout information for the proposed system configurations, develop a methodology to rank the potential impacts to the workers on site and the potential off-site public population.

Hazards Identification

In general, all four of the gasifier systems evaluated for the FutureGen Project are composed of similar equipment. All gas processing equipment downstream of the gasifier is in common use in the petroleum industry and does not provide any unique hazards (Quest, 2006).

Upperbound-Case Consequence Analysis

The Quest Study evaluated the largest releases to determine the extent of possible flammable and toxic impacts under maximum (upperbound) release conditions. The analysis included a combination of four gasifiers and three types of coal (12 gasifier/coal combinations). The impacts were defined as those that could cause injury to workers or members of the public.

None of the flammable hazards were found to have impacts that extended beyond the proposed plant property. The largest flash fire impact zones extended less than 200 feet (61 meters) from the point of release. Areas within the process units in each of the four project system designs would have the potential to be impacted by flammable releases. This result is not unexpected for a facility handling similar materials (Quest, 2006).

The upperbound for toxic impacts associated with the 12 gasifier/candidate coal combinations evaluated would have the potential to extend past the proposed project property line. The toxic impacts would be dominated by releases of H_2S and SO_2 from the Claus process unit. The resulting plumes could extend from 0.3 to 1.4 miles (0.5 to 2.3 kilometers) from the point of release. There are 22 family residences or farm home sites within the 1.4-mile (2.3-kilometer) plume release radius. ***The Riddle Elementary School would be outside this plume radius, situated approximately 1.75 miles (2.8 kilometers) from the assumed point of release.***

The longest downwind toxic impact distance associated with any of the four gasifiers is due to the CO in the syngas process stream. These streams can produce toxic CO impacts extending from 0.4 to 0.6 mile (0.6 to 1.0 kilometer) from the point of release (Quest, 2006). There are three family residences or farm homes within the 0.6-mile (1.0-kilometer) release footprint radius, with two farm home sites immediately adjacent to the release area perimeter.

The potential health risks to these receptors are discussed in more detail in Section 4.17.5.

Hazard Ranking

Using the results from Tasks 1 and 2, a framework for ranking the flammable and toxic impacts associated with the upperbound release was designed as a function of the location of a worker or member of the public relative to the facility process units. Four zones were developed: two for the workers inside the property line and two for the public outside of the property lines (Quest, 2006).

Since none of the flammable hazards were found to have impacts that extended past the property line, there would be no off-site or public impacts due to flammable releases within the facility process units (Quest, 2006).

The upperbound for toxic impacts associated with all 12 gasifier/coal candidate combinations would have the potential to extend past the project property line. In 11 of the 12 gasifier/candidate coal combinations, toxic impacts associated with the Claus unit would be greater than the impacts from any other process unit (Quest, 2006).

In general, all 12 gasifier/candidate coal systems would have the potential to produce toxic impacts that could extend into a public area outside of the property line for the 200-acre (81-hectare) base case layout. By this measure, all four gasifier systems, regardless of candidate coal, have the potential to produce similar worst-case impacts and, thus, are ranked equally. This conclusion is also true for a 400-acre (162-hectare) layout and is true for 11 of the 12 gasifier/candidate coal systems assuming a 600-acre (243-hectare) site (Quest, 2006).

Conclusions

The identification and evaluation of the largest potential releases associated with the four gasifier system designs for the proposed project results in the following findings:

- There are no flammable hazard impacts that extend off the project property.
- All four gasifier designs produce similar toxic hazards. No design demonstrates a clear advantage over others in this respect.

- The potential toxic impacts associated with the four gasifier system designs are dominated by releases of H_2S and SO_2 from the Claus unit that is included in each design.
- All three candidate coals, when used as feed to any of the four gasifier designs, have the potential to produce off-site toxic impacts. The Powder River Basin coal, used in any of the gasifiers, produces slightly smaller toxic impact distances strictly due to its lower sulfur content and thus, lower H_2S flow rates to the Claus unit (Quest, 2006).

4.17.4 RISK ASSESSMENT FOR CO_2 SEQUESTRATION

The "Final Risk Assessment Report for the FutureGen Project Environmental Impact Statement" (Tetra Tech, 2007) describes the results of the human health risk assessment conducted to support the proposed project. The risk assessment addresses the potential releases of captured gases at the proposed power plant, during transport via pipeline to the proposed geologic storage site, and during subsurface storage.

The approach to risk analysis for CO_2 sequestration in geologic formations is still evolving. However, a substantial amount of information exists on the risks associated with deep injection of hazardous waste and the injection of either gaseous or supercritical CO_2 in hydrocarbon reservoirs for enhanced oil recovery. There are also numerous projects underway at active CO_2 injection sites that are good analogs to determine the long-term fate of CO_2. The FutureGen Project assessment relies heavily on the findings from these previous and ongoing projects.

4.17.4.1 CO_2 Sequestration Risk Assessment Process

The human health risk assessment is presented in five sections: conceptual site models (CSMs); toxicity data and benchmark concentration effect levels; pre-injection risk assessment; the post-injection risk assessment; and the risk screening and performance assessment. The results of the risk screening of CO_2 sequestration activities are presented in Section 4.17.4.2.

Conceptual Site Models

A central task in the risk assessment was the development of the CSMs. Potential pathways of gas release during capture, transport, and storage were identified for the pre- and post-injection periods. Site-specific elements of the proposed Mattoon Site were described in detail based on information from the EIVs provided by the FutureGen Alliance (FG Alliance, 2006a-d). These data provided the basis for the CSM parameters and the analysis of likely human health exposure routes.

Toxicity Data and Benchmark Concentration Effect Levels

The health effect levels were summarized for the identified exposure pathways. The toxicity assessment provides information on the likelihood of the chemicals of potential concern (COPCs) to cause adverse human-health effects. These data provided the basis for the comparison of estimated exposures and the assessment of potential risks.

Risk Screening and Performance Assessment

Pre-Injection Risk Assessment

This assessment evaluated the potential risks associated with the proposed plant and aboveground facilities for separating, compressing, and transporting CO_2 to the proposed injection site. The risk assessment for the pre-injection components was based on qualitative estimates of fugitive releases of captured gases and quantitative estimates of gas releases from aboveground sources under different failure scenarios. Failure scenarios of the system included pipeline rupture, pipeline leakage through a puncture (3-square-inch [19.4-square-centimeter] hole), and rupture of the wellhead injection equipment. The volumes of gas released for the pipeline scenarios were calculated using site-specific data for the four sites and the equations for gas emission rates from pipelines (Hanna and Drivas, 1987).

In general, the amount of gas released from a pipeline rupture or puncture was the amount contained between safety valves, assumed to be spaced at 5-mile (8.0-kilometer) intervals. The amount of gas released by a wellhead rupture was assumed to be the amount of gas contained within the well casing itself. The atmospheric transport of the released gas was simulated using the SLAB model (Ermak, 1990), with the gas initially in a supercritical[1] state (pressure ~2000 psi, temperature ~90°F [32.2°C]). The evaluation was conducted for the case with CO_2 at 95 percent and H_2S at 100 ppmv. The predicted concentrations in air were used to estimate the potential for exposure and any resulting impacts on workers, off-site residents, and sensitive receptors.

Post-Injection Risk Assessment

The post-injection risk assessment describes the analysis of potential impacts from the release of CO_2 and H_2S after the injection into the subsurface CO_2 storage formation. A key aspect of the analysis was the compilation of an analog database that included the proposed site characteristics and results from studies performed at other CO_2 storage locations and from sites with natural CO_2 accumulations and releases. The analog database was used for characterizing the nature of potential risks associated with surface leakage due to caprock seal failures, faults, fractures, or wells. CO_2 leakage from the proposed project storage formation was estimated using a combination of relevant industry experience, natural analog studies, modeling, and expert judgment.

Qualitative risk screening of the proposed site was based upon a systems analysis of the site features and scenarios portrayed in the CSM. Risks were qualitatively weighted and prioritized using procedures identified in a health, safety, and environmental risk screening and ranking framework developed by Lawrence Berkeley National Laboratory for geologic CO_2 storage site selection (Oldenburg, 2005). In addition, further evaluation was conducted by estimating potential gas emission rates and durations using the analog database for a series of release scenarios. Three scenarios could potentially cause acute effects: upward leakage through the CO_2 injection wells; upward leakage through the deep oil and gas wells; and upward leakage through undocumented, abandoned, or poorly constructed wells.

Six scenarios could potentially cause chronic effects: upward leakage through caprock and seals by gradual failure; release through existing faults due to effects of increased pressure; release through induced faults due to effects of increased pressure (local over-pressure); upward leakage through the CO_2 injection wells; upward leakage through the deep oil and gas wells; and upward leakage through undocumented, abandoned, or poorly constructed wells. For the chronic-effects case for the latter three well scenarios, the gas emission rates were estimated to be at a lower rate for a longer duration. The predicted concentrations in air were then used to estimate the potential for exposure and any resulting impacts on workers, off-site residents, and sensitive receptors. Other scenarios, including catastrophic failure of the caprock and seals above the sequestration reservoir and fugitive emissions, are discussed, but were not evaluated in a quantitative manner.

[1] A supercritical fluid occurs at temperatures and pressures where the liquid and gas phases are no longer distinct. The supercritical fluid has properties of both the gaseous and liquid states; normally its viscosity is considerably less than the liquid state, and its density is considerably greater than the gaseous state.

4.17.4.2 Consequence Analysis

Risk Screening Results for Pre-Sequestration Conditions (CO_2 Pipeline and Injection Wellheads)

As with all industrial operations, accidents can occur as part of the CO_2 transport and sequestration activities. Of particular concern is the release of CO_2 and H_2S. The CO_2 sequestration risk assessment (Tetra Tech, 2007) identified three types of accidents that could potentially release gases into the atmosphere before sequestration. Accidents included ruptures and punctures of the pipeline used to transport CO_2 to the injection sites and rupture of the wellhead equipment at these sites. The frequency of these types of accidents along the pipelines or at the wellheads is expected to be low. The amount of gas released depends on the severity and the location of the accident (i.e., pipeline or wellhead releases).

Accident Categories and Frequency Ranges

Likely: Accidents estimated to occur one or more times in 100 years of facility operations (frequency $\geq 1 \times 10^{-2}$/yr).

Unlikely: Accidents estimated to occur between once in 100 years and once in 10,000 years of facility operations (frequency from 1×10^{-2}/yr to 1×10^{-4}/yr).

Extremely Unlikely: Accidents estimated to occur between once in 10,000 years and once in 1 million years of facility operations (frequency from 1×10^{-4}/yr to 1×10^{-6}/yr).

Incredible: Accidents estimated to occur less than one time in 1 million years of facility operations (frequency $< 1 \times 10^{-6}$/yr).

Health effects from inhalation of high concentrations of CO_2 gas can range from headache, dizziness, sweating, and vague feelings of discomfort, to breathing difficulties, increased heart rate, convulsions, coma, and possibly death. Exposure to H_2S can cause health effects similar to those for CO_2, but at much lower concentrations. In addition H_2S can cause eye irritation, abnormal tolerance to light, weakness or exhaustion, poor attention span, poor memory, and poor motor function.

Impacts of CO_2 and H_2S gas releases on workers and the public depends on the location of the releases, the equipment involved, the meteorological conditions (including atmospheric stability and wind speed and direction), the directionality of any release from a puncture (e.g., upwards and to the side), and other factors. The effects to workers near a ruptured or punctured pipeline or wellhead are likely to be dominated by the physical forces from the accident itself, including the release of gases at high flow rates (3,000 kilograms per second) and at very high speeds (e.g., ~ 500 mph [804.7 kmph]). Thus, workers involved at the location of an accidental release would be impacted, possibly due to a combination of effects, such as physical trauma, asphyxiation (displacement of oxygen), toxic effects, or frostbite from the rapid expansion of CO_2 (2,200 psi to 15 psi). Workers near a release up to a distance of 79 feet (24 meters) could also be exposed to very high concentrations of CO_2 (e.g., 170,000 ppm) for short durations of 1 minute, which would be life-threatening.

For this evaluation, risks to workers were evaluated at two distances: workers at a distance of 66 feet (20 meters) of a release and other workers at a distance of 820 feet (249.9 meters). For all ruptures or punctures, these individuals may experience adverse effects up to and including irreversible effects when concentrations predicted using the SLAB model (Ermak, 1990) exceed health criteria. The criteria used for this determination were the RELs established as occupational criteria for exposures to CO_2 and H_2S, consisting, respectively, of a short-term exposure limit (averaged over 15 minutes) for CO_2 and a ceiling concentration for H_2S that should not be exceeded at any time during a workday (NIOSH, 2007). Each of these criteria was listed in Table 4.17-4. Table 4.17-12 summarizes locations where pipeline and wellhead accidents create gas concentrations exceeding allowable levels for facility workers. Workers would be expected to be affected by CO_2 concentrations equal to or greater than 30,000 ppm from a pipeline puncture out to a distance of 372 feet (113.4 meters), but not for a pipeline rupture or a wellhead rupture. H_2S concentrations would exceed worker criteria at least out to a distance of 66 feet (20 meters) from the failure, but not at the proposed plant boundary 820 feet (249.9 meters) for a pipeline puncture, a pipeline rupture or a wellhead rupture.

Table 4.17-12. Exceedance of Occupational Health Criteria[1] for Workers

Release Scenario	Frequency Category[2]	Exposure Time	Gas	Area of Exceedance
Pipeline Rupture	EU	Minutes	CO_2	None
			H_2S	Within plant boundaries[3]
Pipeline Puncture[4]	EU	Approximately 4 hours	CO_2	Near pipeline only[5]
			H_2S	Near pipeline only[5]
Wellhead Rupture	EU	Minutes	CO_2	None
			H_2S	Near wellhead only[5]

[1] Occupational health criteria used were the NIOSH REL ST and NIOSH REL C for CO_2 and H_2S, respectively. See Table 4.17-4.
[2] EU (extremely unlikely) = frequency of $1x10^{-4}$/yr to $1x\ 10^{-6}$/yr;.
[3] Within 820 feet (250 meters) of release.
[4] 3-inch by 1-inch rectangular opening in pipe wall.
[5] Distances for a pipeline puncture are: 372 feet (113.4 meters) for CO_2 and at least 548 feet (167 meters) for H_2S; for a pipeline rupture is at least 131 feet (40 meters) and a wellhead rupture at least 216.5 feet (66 meters).

There is also interest in whether ruptures or punctures may affect non-involved workers. Non-involved workers are those workers present within the proposed plant boundary distance, but employed in activities distant from the release point.

The effects for non-involved workers were evaluated at a distance of 820 feet (249.9 meters) from the release point. The same occupational health criteria were used to determine the potential effects to the non-involved workers. Potential effects were determined by comparing SLAB model calculated concentrations with health criteria at the distances of concern. As shown in Table 4.17-12, no effects were estimated for non-involved worker exposures to CO_2 from any of the evaluated accidental releases. H_2S would also not affect non-involved workers exposed to releases from a pipeline puncture, or pipeline or wellhead rupture.

Accidental releases from the pipeline or wellhead, although expected to be infrequent, could potentially have greater consequences and affect the general public in the vicinity of a release. To determine potential impacts to the public, the CO_2 sequestration risk assessment

Health Effects from Accidental Chemical Releases

The impacts from accidental chemical releases were estimated by determining the number of people who might experience adverse effects and irreversible adverse effects.

Adverse Effects*:* Any adverse health effects from exposure to a chemical release, ranging from mild and transient effects, such as headache or sweating (associated with lower chemical concentrations) to irreversible (permanent) effects, including death or impaired organ function (associated with higher concentrations).

Irreversible Adverse Effects: A subset of adverse effects, irreversible adverse effects are those that generally occur at higher concentrations and are permanent in nature. Irreversible effects may include death, impaired organ function (such as central nervous system damage), and other effects that impair everyday functions.

Life Threatening Effects: A subset of irreversible adverse effects where exposures to high concentrations may lead to death.

(Tetra Tech, 2007) evaluated potential effects to the public for accidental releases of gases from the pipelines and wellheads. The CO_2 pipeline failure frequency was calculated based on data contained in the on-line library of the Office of Pipeline Safety (OPS, 2007). Accident data from 1994-2006 indicated that 31 accidents occurred during this time period. DOE categorized the two accidents with the largest CO_2 releases (4,000 barrels and 7,408 barrels) as rupture type releases, and the next four highest releases (772 barrels to 3,600 barrels) as puncture type releases. For comparison, 5 miles (8.0 kilometers) of FutureGen pipeline contains about 6,500 barrels, depending on the pipeline diameter. Assuming the total length of pipeline involved was approximately 1,616 miles (2,600 kilometers) based on data in Gale and Davison (2004), the rupture and puncture failure frequencies were calculated to be 5.92 x 10^{-5}/(km-yr) and 1.18 x 10^{-4}/(km-yr), respectively. Puncture failure frequencies are reported in failure events per unit length and time based on data for a particular length of pipeline and period of time.

The pipeline failure frequencies are only one component of the exposure frequency. The total exposure frequency also considered the percent of time the wind was blowing in the direction of the receptor, the percent of time the wind stability was the greatest, and the section of the pipeline that would have to fail to possibly allow the release to reach the exposed population.

The failure frequencies for pipeline ruptures and punctures are calculated as the product of the pipeline length at the site and the failure frequencies presented above (ruptures: 5.92 x 10^{-5}/km-yr; punctures: 1.18 x 10^{-4}/km-yr) (Gale and Davison, 2004). The failure rate of wellhead equipment during operation is estimated as 2.02 x 10^{-5} per well per year based on natural gas injection-well experience from an IEA GHG Study (Papanikolau et al., 2006). These failure frequencies provide the basis for the frequency categories presented in Tables 4.17-12 and Table 4.17-15.

The predicted releases, whether by rupture or puncture, are classified as extremely unlikely: the frequencies for ruptures is 4.7 x 10^{-5}, and the frequency for punctures is 9.4 x 10^{-5}. The frequencies for a wellhead rupture are 1 x 10^{-6} to 2 x 10^{-5}/year. The criteria used to examine potential health effects, including mild and temporary as well as permanent effects, are defined in Tables 4.17-7 and 4.17-13. The CO_2 and H_2S exposure durations that could potentially occur for the three types of release scenarios are presented in Table 4.17-14.

Table 4.17-13. Description of Hazard Endpoints for Public Receptors

Hazard Endpoint	Description
RfC	An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.
TEEL 1	The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
TEEL 2	The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
TEEL 3	The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

RfC = Inhalation Reference Concentration.
TEEL = Temporary Emergency Exposure Limits.
Sources: EPA, 2006a,b; DOE, 2006.

Table 4.17-14. Hazard Endpoints for Public Receptors

Exposure Time	Gas	Effect Category	Concentration (ppmv)	Hazard Endpoint[1]
Minutes (Pipelines)	CO_2	Adverse	30,000	TEEL 1
		Irreversible adverse	30,000	TEEL 2
		Life threatening	40,000	TEEL 3
	H_2S	Adverse	0.51	TEEL 1
		Irreversible adverse	27	TEEL 2
		Life threatening	50	TEEL 3
Minutes (Explosions[2])	H_2S	Irreversible adverse	41	AEGL 2 (10 minute)
		Life threatening	76	AEGL 3 (10 minute)
	SO_2	Irreversible adverse	0.75	AEGL 2 (10 minute)
		Life threatening	42	AEGL 3 (10 minute)[3]
Hours/Days	CO_2	Adverse	20,000	Headache, etc.[4,5]
		Life threatening	70,000	Headache, etc.[4,5,6]
	H_2S	Adverse	0.33	AEGL 1 (8 hour)
		Irreversible adverse	17	AEGL 2 (8 hour)
		Life threatening	31	AEGL 3 (8 hour)
Years	CO_2	Adverse	40,000	Headache, etc.[4,7]
		Life threatening	70,000	Headache, etc.[4,6,7]
	H_2S	Irreversible adverse	0.0014	RfC

[1] See Tables 4.17-7 and 4.17-13 for descriptions of the TEEL and AEGL endpoints.
[2] Used by Quest (2006) to evaluate releases from explosions.
[3] Quest, 2006.
[4] EPA, 2000.
[5] Headache and dyspnea with mild exertion.
[6] Unconsciousness and near unconsciousness.
[7] Headache, dizziness, increased blood pressure, and uncomfortable dyspnea.
TEEL = Temporary Emergency Exposure Limits
AEGL = Acute Exposure Guideline Level
RfC = Inhalation Reference Concentration.

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

The potential effects of CO_2 and H_2S releases from pipeline ruptures and punctures were evaluated using an automated "pipeline-walk" analysis. The methodology (described briefly in Appendix D and in detail in Section 4.4.2 and Appendix C-IV of the risk assessment) estimates the maximum expected number of individuals from the general public potentially affected by pipeline ruptures or punctures at each site. The analysis takes into account the effects of variable meteorological conditions and the location of pipeline ruptures or punctures. For wellhead ruptures the potential impact zones corresponding to health-effects criterion values for H_2S and CO_2 were determined using the SLAB model and assuming meteorological conditions that resulted in the highest potential chemical exposures (i.e., assuming wind speeds of 2 meters per second and stable atmospheric conditions). The number of individuals potentially affected within the impact zone was determined from population data obtained from the 2000 U.S. Census.

This modeling approach to assess potential chemical exposures is based on the assumption that the population size and locations near the proposed project would not change during the time period assessed for this proposed project (i.e., 50 years for releases during the operation phase and 5,000 years for releases of sequestered gases).

Among the three types of accidental releases at this site, none of the postulated accidents would result in adverse health effects (including mild and temporary as well as permanent effects) to off-site residents (see Table 4.17-15). Since the pipeline would be within the boundaries of the proposed power plant site property, workers are more likely to be affected than members of the public.

The postulated accident of a pipeline puncture would not cause irreversible health effects to the general public (e.g., poor memory or poor attention span). No fatalities were projected for the same group.

As shown in Table 4.17-15, no members of the general public would be affected by adverse effects from other types of accidents such as a pipeline rupture or wellhead rupture. No fatalities were projected for a pipeline puncture or wellhead rupture.

Although the potential for releases from pipelines or wellheads may be low, any releases from the pipeline or wellheads could be high consequence events. For this reason, there are well-established measures for preventing or reducing impacts of accidental releases. These include design recommendations (e.g., increasing pipeline wall thickness, armoring pipelines in specific locations such as water body and road crossings and near the plant); use of newer continuous pipeline monitors to detect corrosion and computer models to rapidly interpret changes in fluid densities, pressures, etc.; use of safety check valves that can quickly isolate damaged section of the pipeline, operational procedures (e.g., activating "bleed" valves to control location and direction of releases should a puncture occur); and emergency response procedures (e.g., notifying the public of events requiring evacuation). In some cases, it may be possible to further reduce the concentrations of effect-causing substances being transported (e.g., H_2S). These measures would be implemented, as appropriate.

Risk Screening Results for Post-sequestration Conditions

Under post-sequestration conditions, a slow continuous leak through a deep well was determined to be the only scenario that may cause adverse health effects to the general public (Tetra Tech, 2007). Since the deep wells within the vicinity of the proposed CO_2 injection wells would be properly sealed before initiation of CO_2 sequestration and, since the proposed CO_2 injection well(s) would also be properly sealed after their use, it is extremely unlikely that the proposed project would create a gas release of consequence from the subsurface (Table 4.17-16). However, if this type of release occurred at the proposed sequestration site, it is estimated that approximately one member of the public might experience

Table 4.17-15. Effects to the Public from Pre-Sequestration Releases

Release Scenario	Frequency Category[2]	Gas	Effect[3]	Distance ft (m)	Number Affected
Pipeline Rupture[1] (release duration = minutes)	EU	CO_2	Adverse	<3 (<0.9)	0
			Irreversible adverse	<3 (<0.9)	0
			Life threatening	<3 (<0.9)	0
		H_2S	Adverse	4,170 (1,271)	0
			Irreversible adverse	131 (40)	0
			Life threatening	13 (4)	0
Pipeline Puncture (release duration = approximately 4 hours)	EU	CO_2	Adverse	646 (197)	0
			Life threatening	125 (38)	0
		H_2S	Adverse	5,341 (1,628)	0
			Irreversible adverse effects	548 (167)	0
			Life threatening	377 (115)	0
Wellhead Equipment Rupture (release duration = minutes)	EU	CO_2	Adverse	16 (4.9)	0
			Irreversible adverse	16 (4.9)	0
			Life threatening	13 (4.0)	0
		H_2S	Adverse	2,257 (688)	0
			Irreversible adverse	138 (42.1)	0
			Life threatening	<66 (<20.1)	0

[1] Rupture assumed to occur on the proposed power plant property since the sequestration site is at the approximate center of the plant property.
[2] EU (extremely unlikely) = frequency of $1x10^{-4}$/yr to $1x10^{-6}$/yr.
[3] See 4.17.4.2 for an explanation of the effects categories.

irreversible adverse effects from H_2S exposures (i.e., nasal lesions). This estimate is based on assuming that the future population would be the same as current conditions, with the sequestration plume footprint coinciding with the proposed power plant site and the surrounding area remaining as farmland. Also, this evaluation is based on the EPA RfC criterion for chronic (i.e., long-term and low level) exposures that incorporates a safety factor of 300 to be protective of sensitive individuals. The RfC criterion value for H_2S is an extremely low concentration: 0.0014 ppm.

Since CO_2 sequestration is a relatively new technology, a series of mitigation and monitoring measures have been developed for these activities. In addition to plugging and properly abandoning wells, monitoring plans include use of remote sensing methods, atmospheric monitoring techniques, methods for monitoring gas concentrations in the subsurface and surface environments, and processes for monitoring subsurface phenomena associated with the injection reservoir and the caprock (FG Alliance, 2006a-d). A specific schedule for different types of monitoring has been proposed for the proposed Mattoon Sequestration Site and surrounding areas that would occur before and during sequestration activities (FG Alliance, 2006a). Also, after the cessation of injection monitoring, activities would be used to identify any long-term, post-closure changes in land surface conformation, soil gas, and atmospheric fluxes of CO_2.

Table 4.17-16. Number of Individuals with Adverse Effects from Potential Exposure to Post-Sequestration H_2S Gas Releases

Release Scenario	Frequency Category[1]	Number Affected[2]
Upward slow leakage through CO_2 injection well	EU	1
Upward slow leakage through deep oil and gas wells	n/a	n/a
Upward slow leakage through other existing wells	EU[3]	1

[1] EU (extremely unlikely)=frequency of $1x10^{-4}$/yr to $1x10^{-6}$/yr.
[2] Potentially irreversible adverse effects could occur within 745 feet of the release point; instances presented here are converted from meters, which were used in the risk assessment (see Appendix D). Also, assumed future population density would remain the same as current conditions, with the property surrounding the proposed power plant and sequestration plume footprint remaining as farmland.
[3] Assumes that the other wells potentially within the sequestration plume footprint have been properly sealed before sequestration begins.
n/a = not applicable.

4.17.5 TERRORISM/SABOTAGE IMPACT

As with any U.S. energy infrastructure, the proposed power plant could potentially be the target of terrorist attacks or sabotage. In light of two recent decisions by the U.S. Ninth District Court of Appeals (*San Luis Obispo Mothers v. NRC, Ninth District Court of Appeals, June 2, 2006; Tri Valley Cares v. DOE, No. 04-17232, D.C. No. CV-03-03926-SBA, October 16, 2006),* DOE has examined potential environmental impacts from acts of terrorism or sabotage against the facilities being proposed in this EIS.

Although risks of terrorism or sabotage cannot be quantified because the probability of an attack is not known, the potential environmental effects of an attack can be estimated. Such effects may include localized impacts from releases from the proposed power plant and associated facilities, assuming that such releases would be similar to what would occur under an accident or natural disaster (such as a tornado). To evaluate the potential impacts of terrorism/sabotage, failure scenarios are analyzed without specifically identifying the cause of failure mechanism. For example, a truck running over a wellhead at the proposed sequestration site would result in a wellhead failure, regardless of whether this was done intentionally or through mishap. Therefore, the accident analysis evaluates the outcome of catastrophic events without determining the motivation behind the incident. The accident analyses evaluated potential releases from pipelines, wellheads, and major and minor system failures/accidents at the proposed power plant site. These accidents could also be representative of the impacts from a sabotage or terrorism event.

Various release scenarios were evaluated including: pipeline rupture, pipeline puncture, and wellhead equipment rupture. Gaseous emissions were assumed to be 95 percent CO_2 and 0.01 percent H_2S. Table 4.17-15 provides effects levels for individuals who could potentially be exposed to releases. Of these release scenarios at the proposed Mattoon Site, a pipeline puncture would result in impacts to the public over the largest distance. For a release of the CO_2 gas from a pipeline puncture, no impacts from CO_2 would occur beyond 646 feet (147 meters) of the release, while irreversible adverse impacts from the H_2S in the gas stream could occur within 548 feet (167 meters) of the release, tapering to no impact at a distance of 5,341 feet (1,628 meters). Under upperbound conditions such a release would not cause any fatalities, but there could be adverse health effects to workers at the plant, but not the general public.

For short-term CO_2 and H_2S co-sequestration testing over the two non-consecutive one-week test periods, the concentration of H_2S in the sequestered gas would be 2 percent (20,000 ppmv) or 200 times greater than the base case, which assumed the H_2S concentration would be 100 ppmv. Because these tests would occur for a very short period of time (a total of two weeks), it would be very unlikely that an accidental release would occur during co-sequestration testing. Nevertheless, additional model simulations of pipeline ruptures or punctures to represent releases during the co-sequestration experiment were conducted, as discussed in Section 4.5.5 of the Final Risk Assessment Report. These results show that the distance downwind where the public could be exposed to H_2S at levels that could result in adverse effects are significantly greater than for the base case, and thus more people could be exposed, if a release occurred during an experiment. While the distances where adverse effects occur, as listed in the Risk Assessment, are quite high (tens of miles), they are likely greatly overestimated in the model, as it assumes that the wind would be maintained at the same stability class, wind speed and direction over a substantial amount of time (e.g., 19 hours for Jewett). Although short-term testing of co-sequestration (CO_2 with H_2S) may be considered for two weeks during the DOE-sponsored phase of the proposed project, no decision has been made yet to pursue the co-sequestration testing, and further NEPA review may be required before such tests could be conducted. If co-sequestration would be considered for a longer period of time under DOE funding, further NEPA review would be required. To minimize the potential for releases during the co-sequestration experiments, additional protective measures could be implemented, including inspection of the pipeline before and after the tests and not allowing any excavation along the pipeline route during the tests.

In general, ruptures or punctures of pipelines are rare events. Based on Office of Pipeline Safety nationwide statistics, 31 CO_2 pipeline accidents occurred between 1994 and 2006. None of these reported accidents were fatal or caused injuries (OPS, 2006). Should a CO_2 pipeline rupture occur, it would be immediately detected by the pipeline monitoring system, alerting the pipeline operator. Once the flow of gas has stopped, the gas would dissipate and chemical concentrations at the source of the release would decline to non-hazardous levels in a matter of minutes for a pipeline rupture and several hours for a pipeline puncture. However, the released gas then migrates downwind, as described in the preceding sections.

The potential health effects from "upperbound" explosion and release scenarios at the proposed power plant (Section 4.17.3.2) can be contrasted with those associated with the pipeline. Hazardous events evaluated for the proposed power plant included: gas releases and exposure to toxic gas clouds, flash fires, torch fires, and vapor cloud explosions. Evaluations of these results indicate:

- Toxic releases from the Claus unit that could extend from 0.2 to 1.4 miles (0.3 to 2.3 kilometers) from the point of release (Quest, 2006). Based on aerial photographs of the region, there are 22 family residences or farm home sites within the 1.4-mile (2.3-kilometer) plume release radius where adverse health effects could potentially occur (see Section 4.17.4.2). Examination of population density estimates (see Section 4.17.4.2) suggests that such releases could potentially cause irreversible adverse effects in 19 individuals exposed to H_2S and 143 individuals exposed to SO_2, with 10 exposed to potentially life threatening concentrations of H_2S and 4 exposed to potentially life threatening concentrations of SO_2 (Table 4.17-17). The Riddle Elementary School is nearby; however, it is located outside of the 1.4 miles (2.3 kilometers) point of release boundary; therefore, the school population was not added to the potentially affected individuals.
- Toxic releases from the gasifier could extend from 0.2 to 0.6 mile (0.3 to 1.0 kilometer) from the point of release (Quest, 2006). Based on aerial photographs of the region, there are three family residences or farm homes within the 0.6-mile (1.0-kilometer) release radius, with two farm home sites immediately adjacent to the release area perimeter. However, examination of the population density estimates suggests that such a release could potentially cause irreversible adverse effects in 26 individuals exposed to carbon monoxide, with four exposed to potentially life-threatening effects.

- Fire hazards at the plant site would not extend off site.
- Under all worst case scenarios, plant workers would be the most at-risk of injury or death.

As discussed, if an explosion occurred at the proposed plant site as the result of a terrorist attack, it is likely that hazardous gases would cause injury and death of workers within the proposed plant site and most likely the public located within 1.4 miles (2.3 kilometers) of the proposed plant site.

Table 4.17-17. Effects to the Public from Explosions at the FutureGen Plant

Release Scenario	Gas	Effect[1]	Distance[2] (miles [kilometers])	Number Affected
Claus unit failure (release duration = minutes)	H_2S	Irreversible adverse	0.5 (0.8)	19
		Life threatening	0.4 (0.6)	10
	SO_2	Irreversible adverse	1.4 (2.3)	143
		Life threatening	0.2 (0.3)	4
Gasifier release (release duration = minutes)	CO	Irreversible adverse	0.6 (1.0)	26
		Life threatening	0.2 (0.3)	4

[1]See Table 4.17-6 and Table 4.17-7 for an explanation of the effects.
[2]Distances taken from Quest, 2006.

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4.18 COMMUNITY SERVICES

4.18.1 INTRODUCTION

This section identifies the community services most likely to be affected by the construction and operation of the proposed FutureGen Project at the Mattoon Power Plant and Sequestration Site in Coles County, Illinois. This section addresses law enforcement, fire protection, emergency response, health care services, and the school system. Additionally, the potential effects that construction and operation of the FutureGen Project could have on those services, as well as any proposed mitigation measures that could reduce any adverse effects, are discussed.

4.18.1.1 Region of Influence

The ROI for community services includes the land area within 50 miles (80.5 kilometers) of the boundaries of the proposed power plant and sequestration site. As shown in Figure 4.18-1, the proposed sequestration site is located on the same property as the proposed power plant site. The ROI for the proposed Mattoon Power Plant and Sequestration Site includes all land area within the counties of Coles, Clark, Cumberland, Douglas, Effingham, Moultrie and Shelby in Illinois; and some land area within the counties of Champaign, Christian, Clay, Crawford, DeWitt, Edgar, Fayette, Jasper, Macon, Marion, Montgomery, Piatt, Richland, Sangamon and Vermillion in Illinois, and Vigo in Indiana.

Community services data are reported county-wide because this format is most often used in public information. This includes counties that have only a relatively small portion of land lying within the 50-mile (80.5-kilometer) radius. Therefore, if only a minor portion of a county was touched by the 50-mile (80.5-kilometer) radius and two or fewer small communities fall within that minor portion of the county, then that county was excluded from the analysis as not materially affecting the aggregate community services in the ROI. Those counties with two or fewer small communities that were excluded from the ROI include Logan in Illinois, and Sullivan and Vermillion in Indiana. Excluding these counties from the ROI makes the remaining data more meaningful for determining project effects.

Although the analysis in this section addresses the entire ROI, the affected environment and environmental consequences focus on the proposed power plant site in Coles County.

4.18.1.2 Method of Analysis

DOE evaluated the impacts to community services based on anticipated changes in demand for law enforcement, fire protection, emergency response, health care services, and schools using research provided in the Mattoon EIV (FG Alliance, 2006a). In many cases, the change in demand is directly related to the increased population.

DOE assessed the potential impacts based on the following criteria:

- Affect on law enforcement;
- Conflict with local or regional management plans for law enforcement;
- Affect on fire protection;
- Conflict with local or regional management plans for fire protection;
- Affect on emergency response;
- Conflict with local or regional management plans for emergency response;
- Affect on health care services;

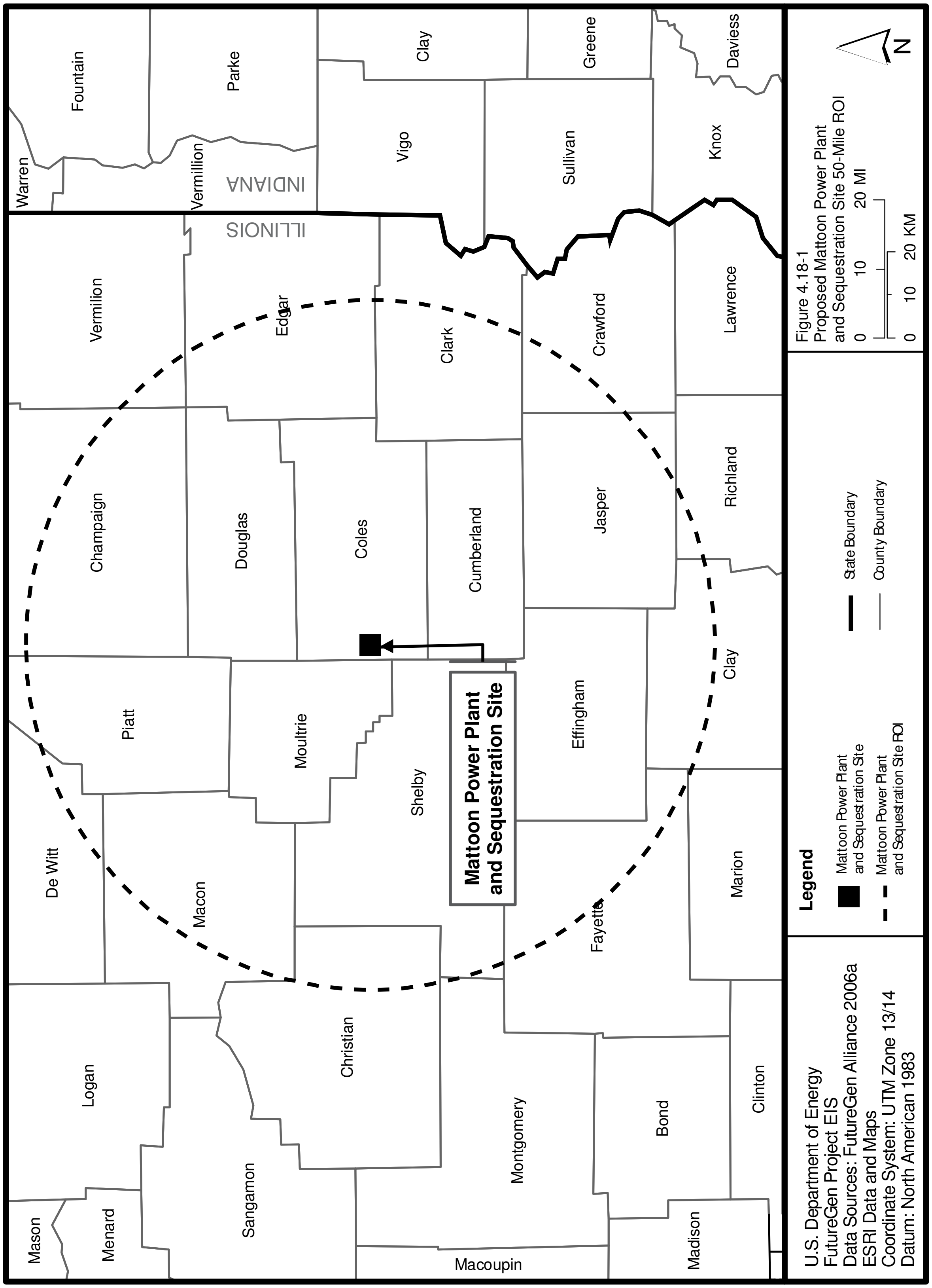

Figure 4.18-1
Proposed Mattoon Power Plant and Sequestration Site 50-Mile ROI

- Conflict with local or regional management plans for health care services;
- Affect on local schools; and
- Conflict with local or regional management plans for local schools.

4.18.2 AFFECTED ENVIRONMENT

4.18.2.1 Law Enforcement

Coles County is served by three municipal police departments located in Mattoon, Charleston, and Oakland, and all operate under a mutual aid agreement (UC, 2005a and FG Alliance, 2006a). Table 4.18-1 presents the staffing levels of these police departments. Seventy-four full-time and six part-time law enforcement officers work out of the three departments in Coles County (FG Alliance, 2006a and CD, 2002). Coles County is also served by the Coles County Sheriff's Office and District 10 of the Illinois State Police (UC, 2005a and ILSP, 2004).

Table 4.18-1. Staffing Levels of Police Departments in Coles County

Community	Full-Time Officers	Part-Time Officers
Mattoon	40	0
Charleston	33	6
Oakland	1	0
Total	74	6

Source: FG Alliance, 2006a and CD, 2002.

Clark, Cumberland, Douglas, Effingham, Moultrie, and Shelby counties in Illinois are served by a total of 25 municipal police departments and each county has its own Sheriff's Office (UC, 2005a). Clark, Cumberland, and Effingham counties are served by District 12 of the Illinois State Police and Douglas, Moultrie, and Shelby counties are served by District 10 of the Illinois State Police (ILSP, 2004). The other Illinois counties located in the ROI are served by a total of 73 municipal police departments, their own County Sheriff's Office, and the Illinois State Police (UC, 2005a and ILSP, 2004). Vigo County in Indiana is served by two municipal police departments, their own county Sheriff's Office, and District 32 of the Indiana State Police (UC, 2005b and INSP, 2006).

The U.S. has an average of 2.3 police officers per thousand residents (Quinlivan, 2003). In Coles County, the ratio is approximately 1.4 officers per thousand residents based on the 2005 projected population and the equivalent of 77 full-time law enforcement officers. Although the ratio of police officers is well below the national average, crime in Coles County is extremely low. Index offenses, which include criminal sexual assault, robbery, aggravated assault, burglary, theft, motor vehicle theft and arson, are a way of measuring and comparing crime statistics (ICJIA, 2004). The State of Illinois averaged 3,844 index offenses per 100,000 residents in 2003, whereas Coles County reported 376 per 100,000 residents for the same year (The Disaster Center, 2005).

4.18.2.2 Emergency and Disaster Response

The Coles County Sheriff's Office operates the county's 911 center and dispatches fire and rescue, ambulances, and emergency medical personnel. Coles County and the entire ROI are served by 48 ambulance services, one air ambulance service, and the Illinois State Police (FG Alliance, 2006a; ILSP, 2004; and YYP, 2006a). Through the established Mutual Aid Box Alarm System, up to 120 ambulances from throughout Illinois could be made available for local response within an hour of notification (FG Alliance, 2006a).

4.18.2.3 Fire Protection

Coles County has 10 fire departments with trained fire services personnel (ISFM, 2006). The ROI is served by a total of 194 fire departments in Illinois and at least 10 fire departments in Vigo County in Indiana (ISFM, 2006 and YYP, 2006b). All Illinois fire departments are members of the region's mutual aid association and would assist in an emergency if called upon.

The Decatur, Charleston, Mattoon, Oakland, Urbana and Champaign fire departments have the capability to provide a high angle, vertical or confined space rescue (FG Alliance, 2006a).

4.18.2.4 Hazardous Materials Emergency Response

The Illinois counties within the ROI would be entirely served by Illinois' 36 statewide Hazardous Materials (HazMat) teams (IHS, 2003). All 36 teams are members of the mutual aid association and would respond to a hazardous materials emergency if so directed (IHS, 2003). HazMat materials units respond and perform functions to handle and control actual or potential leaks or spills of hazardous substances (OSHA, 1994).

4.18.2.5 Health Care Service

A total of ***27*** hospitals and medical centers serve the ROI, with ***23*** in Illinois counties and 4 in Vigo County in Indiana (IHA, 2006 and IDOH, 2006a). Coles County is served by the Sara Bush Lincoln Health Center ***and the Carle Foundation Physicians*** in Mattoon and by four other regional hospitals, including Decatur Memorial Hospital in Decatur, Paris Community Hospital in Paris, Kirby Hospital in Monticello, and Memorial Medical Center in Springfield. There are approximately ***4,261*** beds in the ***27*** hospitals and medical centers in the ROI (***Cook, 2007*****;** HD, 2006; IDOH, 2006a; and IDOH, 2006b). Based on the ***2010*** total projected population for the ROI, there are 3.***8*** beds per thousand people within the ROI.

4.18.2.6 Local School System

Coles County has seven elementary schools, two junior high schools, three high schools, one specialty school, and as many as three private schools (Swager, 2006 and CD, 2002). Table 4.18-2 shows the expenditure per pupil per school year and the student-teacher ratios for Coles County, the State of Illinois, and the U.S.

Table 4.18-2. School Statistics for Coles County, Illinois and the U.S. in 2005

	Expenditure per Pupil per School Year ($)	Pupils per Teacher (Elementary/Secondary)
Coles County	12,300	17.7/20.4
Illinois	14,000	18.9/18.4
Nationwide	8,287	15.4/15.4

Source: FG Alliance, 2006a; USCB, 2006; and NCES, 2005.

4.18.3 IMPACTS

4.18.3.1 Construction Impacts

As discussed in Section 4.19, the need for construction workers would be limited in duration, but would likely cause an influx of temporary residents. Construction workers could be drawn from a large labor pool within the ROI; however, some temporary construction workers with specialized training and workers employed by contractors from outside the ROI would also likely be employed to construct the facilities. Some of these workers would be expected to commute to the construction site on a daily or weekly basis, while others would relocate to the area for the duration of the construction period.

Law Enforcement

The temporary construction jobs created by the proposed FutureGen Project could cause an influx of temporary residents to the communities within the ROI. The increased temporary population could affect the working capacities of individual local police departments, depending on where the workers chose to reside. The affected locations would depend on the degree to which the construction workers would be dispersed throughout the communities within the ROI. As discussed in Section 4.19, temporary construction workers would likely reside in short-term housing. Coles County does not have enough hotel rooms, when occupancy rates are taken into account, to accommodate all of the temporary workers (FG Alliance, 2006a). Therefore, it is anticipated that the availability of local lodging would effectively disperse workers throughout communities within the ROI and law enforcement would not be affected.

The population in the ROI is expected to grow on average by 3 percent, or approximately 27,479 people, by 2010 (FG Alliance, 2006a). Additional police and other law enforcement services would be required to accommodate the growing population. Although the current number of Coles County law enforcement officers is below the U.S. average, county crime rates are extremely low, which is an indication that law enforcement is appropriately staffed (FG Alliance, 2006a; CD, 2002; and Quinlivan, 2003). The exact number of construction workers and their families who would temporarily relocate to the area for the proposed project is unknown, but any additional population is not anticipated to create a permanent unsustainable increase in the demand for law enforcement.

Construction activities would not impede effective law enforcement or conflict with regional plans.

Fire Protection

As discussed in Section 4.17, construction of the proposed facility would involve the use of flammable and combustible materials that pose an overall increase in risk of fire or explosion at the project site. However, the probability of a significant fire or explosion during construction of the proposed project is low. Incidents during construction of the proposed facilities would not increase the demand for fire protection services beyond the available capacity of currently existing services. Illinois fire departments would have the capacity to respond to a major fire emergency at the proposed power plant and sequestration site. Currently, 194 fire departments within the ROI are members of the State's mutual aid agreement. Any of these fire departments would be available to assist in a fire emergency if needed.

Emergency and Disaster Response

As discussed in Section 4.17, it is anticipated that construction of the proposed facilities would result in an average of 20 total recordable injury cases per year with a peak maximum of 39 total recordable injury cases per year. Based on the number of emergency response organizations, the proposed power plant and sequestration site would be adequately served in an emergency. Coles County and the entire ROI are served by 48 ambulance services and one air ambulance service, and a total of 120 ambulances from throughout Illinois could be made available for local response within an hour of notification. Emergencies during construction of the proposed facilities would not be expected to increase the demand for emergency services beyond current available capacity. While it is not anticipated that actual conflicts would arise, the nature and timing of accidents could result in an increased response time when there are other accidents in the area, thereby increasing the demand for emergency services.

Health Care Service

The 350 to 700 temporary construction jobs created by the proposed FutureGen Project could cause an influx of temporary residents to the communities within the ROI. Currently, the ROI has 3.*8* hospital beds per thousand residents, whereas the U.S. average is 2.9 hospital beds per thousand residents. Even if all 700 temporary workers relocated within the ROI, the reduction in health care capacity would be extremely small. The ratio of hospital beds per thousand residents would remain at approximately 3.*8* and, therefore, no impacts are expected.

The **Hill-Burton Act of 1946** established the objective standard for the number of hospitals, beds, types of beds, and medical personnel needed for every 1,000 people, by county (Everett, 2004). It called for states to "afford the necessary physical facilities for furnishing adequate hospital, clinic, and similar services to all their people." The Hill-Burton standard is 4.5 beds per thousand residents (Everett, 2004). However, the U.S. average in 2001 was 2.9 beds per thousand residents, which is about 24 percent fewer beds per thousand residents than the current ratio within the ROI (Everett and Baker, 2004).

Local School System

Although some portion of the temporary construction workers may relocate to the ROI with their families, a large influx of school-aged children would not be anticipated. Because construction of the proposed facilities would create temporary work, it is unlikely that the construction workers would relocate with their families. It is more likely that temporary workers, who permanently reside outside of the ROI, would seek short-term housing for themselves during the work week. As a result, any influx of school-aged children would result in a minimal impact to local schools and their resources.

Project construction would not displace existing school facilities or conflict with school system plans.

4.18.3.2 Operational Impacts

As discussed in Section 4.19, the operational phase of the proposed facilities would require approximately 200 permanent staff. Although the exact number of permanent staff who would relocate to the ROI is unknown, the increase in population would be very small, even if all 200 positions were filled by staff relocating to the ROI. Based on the 2005 projected population and the average family size within the ROI, the relocation of 200 workers would result in a population increase of 500 people, representing a 0.05 percent increase in population within the ROI.

Law Enforcement

Law enforcement in the ROI would be sufficient to handle the 0.05 percent increase in population during facility operation. A 0.05 percent increase in population in the ROI would result in an imperceptibly small decrease, less than 0.02, in the ratio of law enforcement officers per thousand residents. In addition, the average crime rate in Coles County, which is consistent with crime rates in rural communities in Illinois, is well below the national average. This is an indication that law enforcement is appropriately staffed and would be sufficient to handle a minor increase in population.

Project operation would not impede effective law enforcement or conflict with regional plans.

Fire Protection

As discussed in Section 4.17, operation of the proposed power plant would involve the use of flammable and combustible materials that pose an overall increase to risk of fire or explosion at the project site. However, the probability of a significant fire or explosion during operation of the proposed project is low. Incidents during the operational phase of the proposed facilities would not increase the demand for fire protection services beyond the available capacity of currently existing services. Illinois fire departments would have the capacity to respond to a major fire emergency at the proposed power plant site. There are currently 194 fire departments within the ROI that are members of the state's mutual aid agreement. Any of these fire departments could assist in a fire emergency if needed.

Emergency and Disaster Response

As indicated in Section 4.17, it is anticipated that the operational phase of the proposed facilities would result in an average of 6.6 total recordable injury cases per year. Based on the number of emergency response organizations, the proposed power plant and sequestration site would be adequately served in an emergency. Coles County and the entire ROI are served by 48 ambulance services and one air ambulance service, and a total of 120 ambulances from throughout Illinois could be made available for local response within an hour of notification. Emergencies during construction of the proposed facilities would not be expected to increase the demand for emergency services beyond current available capacity. While it is not anticipated that actual conflicts would arise, the nature and timing of accidents could result in an increased response time when there are other accidents in the area, thereby increasing the demand for emergency services.

Health Care Service

It is anticipated that the 200 permanent jobs created by FutureGen Project operations could cause an influx of permanent residents to the communities within the ROI. This influx would result in an increase in population of 0.05 percent, representing approximately 500 new residents. Currently, health care capacity in the ROI is greater than the national average, with 3.*8* hospital beds per thousand residents. The U.S. average is 2.9 hospital beds per thousand residents. Although the proposed project would increase the number of residents requiring medical care, the reduction in health care capacity would be extremely small. The ratio of hospital beds per thousand residents would remain at approximately 3.6 and, therefore, no impacts are expected.

Local School System

While the actual number of the 200 permanent staff who would relocate to the ROI with their families to work at the facility is unknown, based on the average family size and the percent of school-aged children within the ROI, it can be estimated that a maximum of 119 new school-aged children could relocate to the ROI (FG Alliance, 2006a). The projected 2007 public school enrollment for the Illinois counties within the ROI is 141,622 for kindergarten through 12th grade (ISBE, 2005). An additional 119 new school-age children would represent a 0.08 percent increase in the number of students who would share the current schools' resources in the ROI.

Project operation would not displace existing school facilities or conflict with school system plans.

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4.19 SOCIOECONOMICS

4.19.1 INTRODUCTION

This section addresses the region's socioeconomic resources most likely to be affected by the construction and operation of the proposed FutureGen Project. This section discusses the region's demographics, economy, sales and tax revenues, per capita and household incomes, sources of income, housing availability, and the potential effects that construction and operation of the proposed project could have on socioeconomics.

4.19.1.1 Region of Influence

The ROI for socioeconomics includes the land area within 50 miles (80.5 kilometers) of the boundaries of the proposed power plant and sequestration site and utility and transportation corridors. As shown in Figure 4.18-1, the ROI for the proposed FutureGen Project includes all land area in the following counties: Coles, Clark, Cumberland, Douglas, Effingham, Moultrie, and Shelby in Illinois. The ROI also includes some land area in the following counties: Champaign, Christian, Clay, Crawford, DeWitt, Edgar, Fayette, Jasper, Macon, Marion, Montgomery, Piatt, Richland, Sangamon, and Vermillion in Illinois and Vigo in Indiana. Therefore, this section focuses on the socioeconomic environment at the county level rather than by the proposed power plant and sequestration site and utility and transportation corridors.

A few counties have a relatively small portion of land within the ROI and were, therefore, excluded from the analysis as not materially affecting the aggregate socioeconomics of the ROI. Logan County in Illinois and Sullivan and Vermillion counties in Indiana contain no more than two small communities and were also excluded from the ROI. Although the analysis addresses the entire ROI, the affected environment and environmental consequences focus more on the proposed power plant and sequestration site in Coles County.

4.19.1.2 Method of Analysis

DOE reviewed U.S. Census data, the Alliance EIVs, and other information to determine the potential for impacts based on whether the proposed FutureGen Project would:

- Displace existing population or demolish existing housing;
- Alter projected rates of population growth;
- Affect the housing market;
- Displace existing businesses;
- Affect local businesses and the economy;
- Displace existing jobs; and
- Affect local employment or the workforce.

4.19.2 AFFECTED ENVIRONMENT

4.19.2.1 Regional Demographics and Projected Growth

The regional demographics for the ROI are provided in Table 4.19-1. In 2000, the total population for the counties within the ROI was 1,089,578 (USCB, 2000a). The total population of the ROI is anticipated to increase by approximately 3 percent by 2010 to 1,117,057 (FG Alliance, 2006a).

The 2000 Illinois population was 12,419,293 and is anticipated to increase by approximately 4 percent by 2010 to 12,916,894 (USCB, 2005a). The 2000 U.S. population was 282,125,000 and is anticipated to increase by approximately 9.5 percent by 2010 to 308,936,000and approximately 19 percent by 2020 to 335,805,000 (USCB, 2000b). Thus, the ROI is anticipated to grow at a slower rate than the U.S. and Illinois (FG Alliance, 2006a). Coles County had a year 2000 total population of 53,196 (FG Alliance, 2006a)and has the sixth largest population within the ROI and a growth rate less than the ROI's average growth rate. The median age of residents in 2000 was 35.3 years for the U.S., 34.7 years for Illinois, and 30.8 years for Coles County (USCB, 2000c and USCB, 2000d).

Table 4.19-1. Population Distribution and Projected Change for Counties Containing Land Area Within the ROI

County	Year 2000					2010 Projected Total Population	Projected Change 2000 to 2010 (percent)
	Total	Under 18	18-64	65 and over	Average Family Size		
Counties Located Completely Within the ROI							
Coles	53,196	10,477	35,652	7,067	2.3	54,178	982 (2.0)
Clark	17,008	4,233	9,714	3,061	2.4	17,734	726 (4.0)
Cumberland	11,253	2,976	6,495	1,782	2.6	11,511	258 (2.0)
Douglas	19,922	5,388	11,354	3,180	2.6	21,032	1,110 (5.0)
Effingham	34,264	9,784	19,713	4,767	2.6	36,558	2,294 (7.0)
Moultrie	14,287	3,670	8,093	2,524	2.6	14,928	641 (4.0)
Shelby	22,893	5,728	13,088	4,077	2.5	23,087	194 (0.8)
Subtotal or Average	**172,823**	**42,256**	**104,109**	**26,458**	**2.5**	**179,028**	**6,205 (3.6)**
Counties Located Partially Within the ROI							
Champaign	179,669	37,819	124,380	17,470	2.3	186,883	7,214 (4.0)
Christian	35,372	8,521	20,757	6,094	2.4	37,212	1,840 (5.0)
Clay	14,560	3,483	8,285	2,792	2.4	14,703	143 (0.9)
Crawford	20,452	4,664	12,391	3,397	2.4	20,978	526 (3.0)
De Witt	16,798	4,126	10,006	2,666	2.4	19,084	2,286 (3.0)
Edgar	19,704	4,701	11,509	3,494	2.4	19,901	197 (0.1)
Fayette	21,802	5,188	13,150	3,464	2.5	21,860	58 (0.2)
Jasper	10,117	2,620	5,830	1,667	2.6	10,174	57 (0.5)
Macon	114,706	28,171	69,054	17,481	2.4	115,199	493 (0.4)
Marion	41,691	10,622	24,144	6,925	2.5	42,449	758 (2.0)
Montgomery	30,652	7,275	18,162	5,215	2.4	30,808	156 (0.5)
Piatt	16,365	4,115	9,721	2,529	2.5	16,815	450 (3.0)
Richland	16,149	3,964	9,343	2,842	2.4	16,330	181 (1.0)
Sangamon	188,951	47,147	116,280	25,524	2.4	190,721	1,770 (0.9)

Table 4.19-1. Population Distribution and Projected Change for Counties Containing Land Area Within the ROI

County	Year 2000					2010 Projected Total Population	Projected Change 2000 to 2010 (percent)
	Total	Under 18	18-64	65 and over	Average Family Size		
Vermilion	83,919	20,972	49,522	13,425	2.4	84,471	552 (3.0)
Vigo, IN	105,848	24,216	66,584	15,048	2.4	110,441	4,593 (4.0)
Subtotal or Average	**916,755**	**217,604**	**569,118**	**130,033**	**2.4**	**938,029**	**21,274 (2.3)**
Total	**1,089,578**	**259,860**	**673,227**	**156,491**	**2.5**	**1,117,057**	**27,479 (3.0)**
Illinois	**12,419,293**					**12,916,894**	**49,760 (3.9)**
U.S.	**282,125,000**					**308,936,000**	**2,681,100 (9.5)**

Source: FG Alliance, 2006a and USCB, 2000a.

4.19.2.2 Regional Economy

Income and Unemployment

Table 4.19-2 provides information about the workforce, and per capita and median household incomes for the counties located within the ROI. Based on regional data reported for Decatur, Illinois, the average unemployment rate for the ROI was 6.2 percent and approximately 34,880 were unemployed in July 2006 (USBLS, 2006a). The average unemployment rate in July 2006 was 4.8 percent in the U.S., and 4.7 percent in Illinois (USBLS, 2006a and 2006b). Thus, the unemployment rate within the ROI is higher than that for either Illinois or the U.S.

Table 4.19-2. Employment and Income for Counties Within the ROI

County	Employment		Income	
	2004 Labor Force	July 2006 Unemployment Rate[1]	1999 Per Capita Income	1999 Median Household
Counties Located Completely Within the ROI				
Coles	27,110	n/a	$17,370	$32,286
Clark	8,840	n/a	$17,655	$35,967
Cumberland	5,685	n/a	$16,953	$36,149
Douglas	10,796	n/a	$18,414	$39,439
Effingham	18,182	n/a	$18,301	$39,379
Moultrie	8,218	n/a	$18,562	$40,084
Shelby	122,782	n/a	$17,313	$37,313
Subtotal or Average	**201,613**	**n/a**	**$17,795**	**$37,231**

Table 4.19-2. Employment and Income for Counties Within the ROI

County	Employment		Income	
	2004 Labor Force	July 2006 Unemployment Rate[1]	1999 Per Capita Income	1999 Median Household
Counties Located Partially Within the ROI				
Champaign	102,196	n/a	$19,708	$37,780
Christian	17,334	n/a	$17,937	$36,561
Clay	6,972	n/a	$15,771	$30,599
Crawford	9,446	n/a	$16,869	$32,531
De Witt	49,909	n/a	$20,488	$41,256
Edgar	10,411	n/a	$17,857	$35,203
Fayette	10,399	n/a	$15,357	$31,873
Jasper	5,373	n/a	$16,649	$34,721
Macon	18,239	n/a	$20,067	$37,859
Marion	7,413	n/a	$17,235	$35,227
Montgomery	13,607	n/a	$16,272	$33,123
Piatt	9,161	n/a	$21,075	$45,752
Richland	7,454	n/a	$16,847	$31,185
Sangamon	4,466	n/a	$23,173	$42,957
Vermilion	38,406	n/a	$16,787	$34,071
Vigo, IN	50,176	n/a	$17,620	$33,184
Subtotal or Average	**360,962**	**n/a**	**$18,107**	**$35,868**
ROI Total or Average	**562,575**	**6.2 percent**	**$17,951**	**$36,550**
Illinois	**9,968,309**	**4.7 percent**	**$23,104**	**$46,590**
U.S.	**n/a**	**4.8 percent**	**$21,587**	**$41,994**

[1] Unemployment data were not available for Illinois counties for July 2006.
n/a = not available.
Source: FG Alliance, 2006a; USCB, 2000e; USCB, 2000f; USCB, 2000g; USCB, 2000h; USCB, 2000i; and USCB, 2000j.

In 1999, the average median household income for the ROI was $36,550 and the average per capita income in 1999 was $17,951 (FG Alliance, 2006a and USCB, 2000f). Respectively, the median household income for the U.S. was $41,994, and the per capita income was $21,587 (USCB, 2000e and USCB, 2000f). The State of Illinois had a median household income of $46,590 and a per capita income of $23,104 (USCB, 2000g). Coles County had a median household income of $32,286 and a per capita income of $17,370 (FG Alliance, 2006a). Based on 2000 Census data, both Coles County and the ROI have median household and per capita incomes less than Illinois and U.S. averages.

Coles County collected $45 million in property taxes in 2003 and $9.2 million in sales taxes in 2004 (FG Alliance, 2006a). The counties located within the ROI each collected an average of ***approximately*** $***10*** million in sales taxes (FG Alliance, 2006a).

Table 4.19-3 provides minimum and maximum hourly wages for Coles County in November 2005 for trades that would be required for construction of the proposed project. Average wages for these trades were not available. Although actual wage costs would not be known until contractor selection, it is expected that wages for construction of the proposed FutureGen Project would be typical for construction trades in Coles County adjusted for inflation.

Table 4.19-3. Minimum and Maximum Hourly Wages by Trade in Coles County, Illinois, in November 2005

Trade	Minimum and Maximum Wages
Boilermaker	\$27.75 - \$30.25
Cement Mason	\$25.83 - \$27.08
Electric Power Equipment Operator	\$28.84 - \$34.10
Electric Power Groundman	\$19.79 - \$34.10
Electric Power Lineman	\$32.04 - \$34.10
Electrician	\$29.48 - \$32.42
Iron Worker	\$24.45 - \$25.75
Laborer	\$22.92 - \$23.92

Source: IDOL, 2006.

Housing

Table 4.19-4 provides total housing and vacant units by county within the ROI. As of 2006, there were 469,983 existing housing units within the ROI, with Coles County accounting for 22,768 of those (FG Alliance, 2006a). Of the existing housing units within the ROI, 7.2 percent, or 33,605, were vacant (FG Alliance, 2006a). Of the total vacant units within the ROI, there were 14,253 units for rent and 6,225 units for sale (FG Alliance, 2006a). In addition, there were at least 4,336 short-term hotel and motel rooms within the ROI (FG Alliance, 2006a).

In the City of Mattoon, there were 11 new developments with at least 178 building lots for sale (FG Alliance, 2006a). There are two residences located adjacent to, two residences located within 0.25 mile (0.5 kilometer) of, and 20 additional residences located within 1 mile (1.6 kilometer) of the 444-acre (180-hectare) proposed power plant and sequestration site.

4.19.2.3 Workforce Availability

Construction

In 2004, there were approximately 562,575 people within the ROI workforce (FG Alliance, 2006a). Because construction workers represented 6.3 percent of the workforce in Illinois, there were approximately 35,000 construction workers within the ROI (USCB, 2005b and FG Alliance, 2006a). This indicates that there could be a large local workforce from which some or all of the construction workers could be drawn.

Table 4.19-4. Total Housing Units Within the ROI in 2006

County	Total Housing Units	Vacant Units			
		For Rent	For Sale	Seasonal Use	Other Vacant
Counties Located Completely Within the ROI					
Coles	22,768	714	249	215	364
Clark	7,816	255	117	113	286
Cumberland	4,876	79	92	134	140
Douglas	8,005	115	87	32	137
Effingham	13,959	282	156	201	231
Moultrie	5,743	56	81	31	132
Shelby	10,060	1,004	132	170	166
Subtotal	**73,227**	**2,505**	**914**	**896**	**1,456**
Counties Located Partially Within the ROI					
Champaign	75,280	2,306	653	214	1,189
Christian	14,992	341	202	63	348
Clay	6,394	119	138	41	188
Crawford	8,785	362	214	56	243
De Witt	7,282	184	97	51	114
Edgar	8,611	175	140	57	314
Fayette	9,053	158	129	207	311
Jasper	4,294	87	53	30	143
Macon	50,241	1,628	554	139	981
Marion	18,022	312	202	100	601
Montgomery	12,525	203	211	93	367
Piatt	6,798	57	62	24	129
Richland	7,468	272	150	83	257
Sangamon	85,459	2,715	1,131	240	2,137
Vermilion	36,349	1,077	533	141	911
Vigo, IN	45,203	1,752	842	302	701
Subtotal	**396,756**	**11,748**	**5,311**	**1,841**	**8,934**
Total	**469,983**	**14,253**	**6,225**	**2,737**	**10,390**

Source: FG Alliance, 2006a.

Operations

Utility workers made up 0.7 percent of the workforce in Illinois in 2004, resulting in approximately 4,200 utility workers within the ROI (USCB, 2005b). Operations workers could be drawn from this workforce.

4.19.3 IMPACTS

4.19.3.1 Construction Impacts

Population

The need for construction workers would be limited to the estimated 44-month construction period, and a potential influx of temporary residents is not expected to cause an appreciable increase in the regional population. Monthly employment on the proposed power plant and sequestration site would average 350 workers during construction, with a peak of 700 workers (FG Alliance, 2006e). Approximately 35,000 general construction workers residing within the ROI would provide a local workforce. Temporary construction workers with specialized training and workers employed by contractors from outside the ROI could also construct the proposed power plant facilities. Some of these workers could be expected to commute to the construction site on a daily or weekly basis, while others would relocate to the area for the duration of the construction period. Although it is not known how many workers would relocate, the required number of construction workers represents less than 0.1 percent of the population within the ROI. Therefore, impacts on population growth within the ROI would be small.

Employment, Income, and Economy

Construction of the proposed facilities could result in 350 to 700 new jobs in Coles County. These new jobs would represent a 0.06 to 0.1 percent increase in the number of workers employed in Coles County (FG Alliance, 2006a). These workers would be paid consistent with wages in the area for similar trades. Wages for trades associated with power plant construction for November 2005 are provided in Table 4.19-3, although it is likely that actual wages could be higher than those presented because of inflation. Therefore, a direct, but small, positive impact on employment rates and income could occur within the ROI during the construction period.

Illinois and Coles County could benefit from temporarily increased sales tax revenue resulting from project-related spending on payroll and construction materials. It is anticipated that construction workers would spend their wages on short-term housing, food, and other personal items within the ROI. Additional sales tax revenues would result from taxes that are embedded in the price of consumer items such as gasoline. Therefore, an indirect and positive impact could be expected for the local economy from increased spending and related sales tax revenue.

The properties potentially being acquired for the proposed FutureGen Project would receive tax abatements on property tax revenues for a period of 10 years. This would result in a loss of revenue to the taxing bodies associated with the County, including: Coles County, Coles County Pension, Coles County Airport Authority, Illinois Municipal Retirement Fund, Mattoon Township, the Mattoon Township Pension, School District 2 and School Pension, Wabash Fire District, Mattoon Township Park, Community College 517, and Social Security. The total loss of revenue would be $10,188 per year based on current tax structures.

The proposed FutureGen Project could directly impact agriculture-related employment and income by converting up to 200 acres (81 hectares) of agricultural land for the proposed power plant and sequestration site. Similar impacts could also occur on the additional 244 acres (99 hectares) of the proposed site if these areas were removed from agricultural use. These impacts would be limited to those who till and harvest these properties. Indirect impacts related to incremental reduction in the supplies and equipment needed to farm the land, and in the amount of corn and soybeans being brought to market would also occur. These impacts would be minor when evaluated in the context of agricultural activities within the ROI.

Housing

A potential influx of construction workers may increase local housing demand, which would have a beneficial short-term impact on the regional housing market. The ROI has approximately 14,253 vacant housing units for rent with Coles County accounting for approximately 714 of these units. There are at least 4,336 hotel rooms within the ROI, with Coles County accounting for approximately 461 of these rooms. In 2005, Illinois had an average occupancy rate of 61.8 percent (IHI, 2006). Therefore, depending upon the percentage of construction jobs that could be filled by existing residents, the influx of workers from outside the region could increase the occupancy rate within the ROI by as much as 12.2 percent. This increase would result in a hotel occupancy rate of 74 percent and a positive, direct impact for the hotel industry within the ROI.

Power Plant Site

There are two residences located adjacent to, two residences located within 0.25 mile (0.4 kilometer) of, and 20 additional residences located within 1 mile (1.6 kilometer) of the 444-acre (180-hectare) proposed power plant site that may have an unobstructed view of the construction site. Although construction activities could adversely impact these properties (e.g., increased traffic), construction would not cause the displacement of residents or demolition of houses. Potential impacts to property values are discussed in Section 4.19.3.2.

Sequestration Site

The proposed sequestration site is located on the same property as the proposed power plant; therefore, the impacts would be the same.

4.19.3.2 Operational Impacts

Population

Operation of the proposed power plant could result in a very small increase in population growth. It is anticipated that power plant operation could require approximately 200 permanent workers. Based on the 2005 projected population and average family size within the ROI, the relocation of 200 workers could result in a population increase of 492 people. This would represent a 0.04 percent increase in population within the ROI and a 0.9 percent increase in Coles County.

Employment, Income, and Economy

The operational phase of the proposed FutureGen Project could have a direct and positive impact on employment by creating 200 permanent jobs in Coles County. These new jobs could represent a 0.04 percent increase in the total number of workers employed in the Coles County (FG Alliance, 2006a).

Each new operations job created by the proposed FutureGen Project could generate both indirect and induced jobs. An indirect job supplies goods and services directly to the plant site. An induced job results from the spending of additional income from indirect and direct employees. A job multiplier is used to determine the approximate number of indirect and induced jobs that would result. The Illinois Venture Capital Association reported a job multiplier of 2.2 for venture capital projects in Illinois (IVCA, 2006). A job multiplier of 2.2 means that, for every direct job, 1.2 indirect or induced jobs would result (IVCA, 2006). Based on this multiplier, the proposed FutureGen Project could have an indirect impact on employment by creating approximately 240 indirect or induced jobs in and around Coles County.

The proposed FutureGen Project would also have annual operation and maintenance needs that could benefit Coles County. Local contractors could be hired to complete specialized maintenance activities that could not be undertaken by permanent staff, and items such as repair materials, water, and chemicals could be purchased within the ROI. The 200 employees who would fill new jobs created by the proposed FutureGen Project could generate tax revenues from sales and use taxes on plant materials and maintenance. The property tax from the proposed power plant could be substantially greater than current property taxes paid for the properties to be acquired. Based on similar power plants, the increase in total property tax revenue would be in the millions of dollars each year. This increase would have a direct and positive impact on the total property tax revenue for Coles County and Illinois. However, projected increases to property or sales tax revenues from the FutureGen Project may be less than anticipated if the state or local government were to waive or reduce usual assessments as an element of its final offer to the Alliance. Illinois would likely benefit from a public utility tax it would levy when power is produced by the proposed FutureGen Project.

Housing

During operation of the proposed power plant, employees relocating to the area would likely be distributed between owned and rental accommodations. Although it is not known how many of the permanent staff would relocate within the ROI, if all 200 permanent employees relocated, the increased demand for housing would be small. In Illinois, approximately 69.9 percent of housing units are owner-occupied (USCB, 2005c). Using this value, operation of the proposed facilities would result in a 2.2 percent decrease in residences for sale and a 0.4 percent decrease in residences for rent within the ROI.

Power Plant Site

There are two residences located adjacent to, two residences located within 0.25 mile (0.5 kilometer) and 20 additional residences located within 1 mile (1.6 kilometer) that may have an unobstructed view of the facility. Direct and adverse long-term impacts on property values in relation to comparable property values in Mattoon may occur for these properties. The degree to which property values could be affected is uncertain because there are many variables associated with real estate markets and public sentiment.

Sequestration Site

The proposed sequestration site is located on the same property as the proposed power plant site; therefore, the impacts would be the same.

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4.20 ENVIRONMENTAL JUSTICE

Specific populations identified under Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 *Federal Register* 7629), are examined here along with the potential effects on these populations from construction and operation of the proposed FutureGen facility. In the context of this EIS, Environmental Justice refers specifically to the potential for minority and low-income populations to bear a disproportionate share of high and adverse environmental impacts from activities within the project area and the municipalities nearest to the proposed Mattoon Power Plant and Sequestration Site, and related corridors.

> The U.S. Department of Energy defines "**Environmental Justice**" as: The fair treatment and meaningful involvement of all people—regardless of race, ethnicity, and income or education level—in environmental decision-making. Environmental Justice programs promote the protection of human health and the environment, empowerment via public participation, and the dissemination of relevant information to inform and educate affected communities. DOE Environmental Justice programs are designed to build and sustain community capacity for meaningful participation for all stakeholders in DOE host communities (DOE, 2006).

4.20.1 INTRODUCTION

Executive Order 12898 directs federal agencies to achieve Environmental Justice as part of their missions by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. Minorities are defined as individuals who are members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. To classify as a minority population, an area must have a population of these groups that exceeds 50 percent of the total population, or the minority population percentage of the affected area should be meaningfully greater than the minority population percentage in the general population or appropriate unit of geographical analysis (59 *Federal Register* 7629).

The Council on Environmental Quality (CEQ) guidance recommends that low-income populations in an affected area be identified using data on income and poverty from the U.S. Census Bureau (CEQ, 1997). Low-income populations are groups with an annual income below the poverty threshold, which was $19,971 for a family of four for calendar year 2006.

4.20.1.1 Region of Influence

The ROI includes the land area within 50 miles (80.5 kilometers) of the boundaries of the proposed power plant and sequestration site, reservoir, and utility and transportation corridors. The proposed sequestration site and reservoir are located on the same property as the proposed plant site. The ROI includes the following counties in Illinois: Coles, Champaign, Christian, Clark, Clay, Crawford, Cumberland, DeWitt, Douglas, Edgar, Effingham, Fayette, Jasper, Macon, Marion, Montgomery, Moultrie, Piatt, Richland, Sangamon, Shelby and Vermilion. The ROI also includes Vigo County in Indiana. Section 4.19.1.1 describes the rationale for including these counties in the ROI.

4.20.1.2 Method of Analysis

DOE collected demographic information from the U.S. Census Bureau 2000 census to characterize low-income and minority populations within 50 miles (80.5 kilometers) of the proposed Mattoon Power Plant and Sequestration Site. Census data are compiled at various levels corresponding to geographic areas and include, in order of decreasing size, states, counties, census tracts, block groups, and blocks. In order to accurately characterize and locate minority and low-income populations, DOE followed CEQ Guidance (CEQ, 1997) to determine minority and low-income characteristics using U.S., State of Illinois, regional (defined by the 23-county ROI), and individual county data. The data presented in Table 4.20-1 show the overall composition and makeup of both minority and non-minority populations, and low-income populations within the ROI. Where available, DOE obtained U.S. Census data for local jurisdictions (i.e., towns and cities) to further identify the presence of minority or low-income populations. DOE used Census block group data (FG Alliance, 2006a) to examine the distribution of minority and low-income populations within the ROI.

DOE used potential environmental, socioeconomic, and health impacts identified in other sections of this EIS to assess potential impacts to Environmental Justice that could occur with the proposed construction and operation of the FutureGen Project.

DOE assessed the potential for impacts based on the following criteria:

- A significant and disproportionately high and adverse effect on a minority population; or
- A significant and disproportionately high and adverse effect on a low-income population.

Table 4.20-1. County, Regional and National Population and Low-Income Distributions (2000)[1]

County	Total Population	White (percent)	Black (percent)	American Indian/ Alaska Native (percent)	Asian (percent)	Native Hawaiian/ Pacific Islander (percent)	Hispanic or Latino (all races) (percent)	Low-Income (percent)
Counties Completely Located Within the ROI								
Coles	53,196	95.4	2.3	0.2	0.8	<0.1	1.4	17.5
Clark	17,008	98.8	0.2	0.2	0.1	<0.1	0.3	9.2
Cumberland	11,253	98.8	0.1	0.2	0.2	<0.1	0.6	9.5
Douglas	19,922	97.3	0.3	0.2	0.3	<0.1	3.5	6.4
Effingham	34,264	98.7	0.2	0.2	0.3	<0.1	0.7	8.1
Moultrie	14,287	98.9	0.2	0.2	0.1	<0.1	0.5	7.8
Shelby	22,893	98.9	0.2	0.1	0.2	<0.1	0.5	9.1
Counties Partially Located Within the ROI								
Champaign	179,669	78.8	11.2	0.2	6.5	<0.1	2.9	16.1
Christian	35,372	96.3	2.1	0.2	0.4	<0.1	1.0	9.5
Clay	14,560	98.5	0.1	0.2	0.5	<0.1	0.6	11.8
Crawford	20,452	93.6	4.5	0.3	0.3	<0.1	0.5	11.2
DeWitt	16,798	97.8	0.5	0.2	0.3	<0.1	1.3	8.2

Table 4.20-1. County, Regional and National Population and Low-Income Distributions (2000)[1]

County	Total Population	White (percent)	Black (percent)	American Indian/ Alaska Native (percent)	Asian (percent)	Native Hawaiian/ Pacific Islander (percent)	Hispanic or Latino (all races) (percent)	Low-Income (percent)
Edgar	19,704	97.1	1.8	0.2	0.2	<0.1	0.8	10.5
Fayette	21,802	94.0	4.9	0.1	0.2	<0.1	0.8	12.2
Jasper	10,117	99.1	0.1	0.1	0.2	<0.1	0.5	9.9
Macon	114,706	83.5	14.1	0.2	0.6	<0.1	1.0	12.9
Marion	41,691	94.0	3.8	0.2	0.6	<0.1	0.9	11.3
Montgomery	30,652	94.9	3.7	0.2	0.2	<0.1	1.1	13.4
Piatt	16,365	98.8	0.2	0.1	0.1	<0.1	0.6	5.0
Richland	16,149	98.2	0.3	0.1	0.6	<0.1	0.8	12.9
Sangamon	188,951	87.4	9.7	0.2	1.1	<0.1	1.1	9.3
Vermilion	83,919	85.8	10.6	0.2	0.6	<0.1	3.0	13.3
Vigo (IN)	105,848	90.7	6.0	0.3	1.2	<0.1	1.2	14.1
Regional and National Statistics								
23-County ROI	1,089,578	94.6	3.4	0.2	0.7	<0.1	1.1	10.8
Illinois	12,419,293	73.5	15.1	0.2	3.4	<0.1	12.3	10.7
U.S.	281,421,906	75.1	12.3	0.9	3.6	0.1	12.5	12.4

[1] Some of the minority population counted themselves as more than one ethnic background, thus the counts do not add up to 100 percent.
Source: USCB, 2006.

4.20.2 AFFECTED ENVIRONMENT

4.20.2.1 Minority Populations

Table 4.20-1 compares the minority percentage and low-income percentage of county populations within the ROI with those of Illinois and the U.S. The 2000 Census revealed a more diverse population in Illinois compared to the 1990 Census. In 2000, 26.5 percent of Illinois residents identified themselves as non-white, up from 21.6 percent in 1990 (USCB, 2006). The regional population within the ROI has non-minority populations (white) as the highest percentage (94.6 percent) compared to the state (73.5 percent) and U.S. (75.1 percent) percentages.

Areas of higher minority percentages are located within the ROI, with the highest percentages occurring within the communities of Decatur (22.4 percent non-white) and Urbana-Champaign (33 percent and 26.8 percent non-white, respectively) (USCB, 2006). Because the overall population in the ROI is far more homogeneous racially and ethnically (less than 5 percent non-white) than the general population of the state and country, a "minority population" as characterized by CEQ does not exist in the potentially affected area of the proposed project.

4.20.2.2 Low-Income Populations

The percentage of low-income populations for individuals, by county, is generally comparable to state (10.7 percent) and national (12.4 percent) percentages (Table 4.20-1). No areas of low-income population percentages approaching or exceeding 50 percent exist within the proposed Mattoon Power Plant and Sequestration Site, or associated utility and transportation corridors. The majority (89.2 percent) of households within the ROI is at or above poverty level (annual household income above $19,971) (USCB, 2006). Low-income populations exceeding the national percentages occur in Champaign (16.1 percent), Coles (17.5 percent), Macon (12.9 percent), Montgomery (13.4 percent), Richland (12.9 percent), Vermilion (13.3 percent), and Vigo (14.1 percent) counties.

4.20.3 IMPACTS

This section discusses the potential for disproportionately high and adverse impacts on minority and low-income populations associated with the proposed FutureGen Project. The CEQ's December 1997 Environmental Justice Guidance (CEQ, 1997) provides guidelines regarding whether human health effects on minority populations are disproportionately high and adverse. CEQ advised agencies to consider the following three factors to the extent practicable:

- Whether the health effects, which may be measured in risks and rates, are significant (as defined by NEPA), or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death.
- Whether the risk or rate of hazard exposure by a minority population, low-income population, or Indian tribe to an environmental hazard is significant (as defined by NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group.
- Whether health effects occur in a minority population, low-income population, or Native American tribe affected by cumulative or multiple adverse exposures from environmental hazards.

Based on the definitions in Section 4.20.1, the criteria outlined above, and the findings regarding environmental and socioeconomic impacts throughout this EIS, the analysis for Environmental Justice in this EIS was performed in the following sequence:

Using data from the 2000 Census, the potential for adverse environmental or socioeconomic impacts resulting from site-specific or corridor-specific project activities (construction or operation) to affect a minority population in the ROI and have a disproportionately high and adverse effect, as defined by CEQ and described in Section 4.20.1, was determined.

Using data from the 2000 Census, the potential for adverse environmental or socioeconomic impacts resulting from site-specific or corridor-specific project activities (construction or operation) to affect a low-income population in the ROI and have a disproportionately high and adverse effect, as defined by CEQ and described in Section 4.20.1, was determined.

Using the impacts analyzed in Section 4.17, the potential for adverse health risks in a wider radius from project sites and corridors was compared with the potential adverse health risks that could affect a minority population or low-income population at a disproportionately high and adverse rate.

Using the impacts analyzed in Section 4.17, the potential for health effects in a minority population or low-income population affected by cumulative or multiple adverse exposures to environmental hazards was determined.

4.20.3.1 Construction Impacts

As discussed in Section 4.20.2.1, no areas of minority populations, as defined by EO 12898, are located within the ROI. Therefore, no disproportionately high and adverse impacts to minority populations are anticipated.

The power plant would be located in Coles County, which has a higher percentage of low-income population when compared to the regional (6.7 percent higher), state (6.8 percent higher) and national (5.1 percent higher) percentages; however, the percentage is far below the 50 percent threshold as defined in EO 12898. Due to some of the minority population counting themselves as belonging to more than one ethnic background, DOE calculated the percentages by subtracting the White population Census number from 100 percent (e.g., 100 percent – 95.4 percent = 4.6 percent for Coles County). No disproportionately high and adverse impacts are anticipated to the low-income population. Construction activities may cause temporary air quality, water quality, transportation, and noise impacts to the general population (see Sections 4.2, 4.7, 4.13, and 4.14). Short-term beneficial impacts may include an increase in employment opportunities and potentially higher wages or supplemental income through jobs created during facility construction.

4.20.3.2 Operational Impacts

No areas of minority populations are located within the ROI for the proposed power plant and sequestration site, and associated utility and transportation corridors. Therefore, no disproportionately high and adverse impacts to minority populations are anticipated.

Aesthetics, transportation, noise and socioeconomic impacts (see Sections 4.12, 4.13, 4.14, and 4.19) resulting from operations were determined not to have a disproportionately high and adverse effect on the low-income population. A potential risk to health was determined to be from a slow, upward leakage of H_2S from an injection or existing well, which is extremely unlikely. Potential risk could also occur from a catastrophic accident, terrorism, or sabotage, however, this risk cannot be predicted (see Section 4.17). This potential would be uniform to the general population and, therefore, no disproportionately high and adverse impacts are anticipated.

Long-term beneficial impacts would be anticipated due to an increase in employment opportunities and potentially higher wage jobs associated with facility operation.

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