5. TUSCOLA SITE

5.1 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 Tuscola 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.

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:

| 5.2 Air Quality | 5.12 Aesthetics |
|------------------------------|--|
| 5.3 Climate and Meteorology | 5.13 Transportation and Traffic |
| 5.4 Geology | 5.14 Noise and Vibration |
| 5.5 Physiography and Soils | 5.15 Utility Systems |
| 5.6 Groundwater | 5.16 Materials and Waste Management |
| 5.7 Surface Water | 5.17 Human Health, Safety, and Accidents |
| 5.8 Wetlands and Floodplains | 5.18 Community Services |
| 5.9 Biological Resources | 5.19 Socioeconomics |
| 5.10 Cultural Resources | 5.20 Environmental Justice |
| 5.11 Land Use | |

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 site, 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.

5.1.1 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.

5.1.2 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.

5.1.3 TUSCOLA SITE

The proposed Tuscola Site consists of approximately 345 acres (140 hectares) of farmland located approximately 1.5 miles (2.4 kilometers) west of the City of Tuscola, in Douglas County, Illinois. Key features of the Tuscola Site are listed in Table 5.1-1. Township Road (TR) 86 (750E) borders the western side of the proposed plant site and TR 47 (1050N) runs along its northern border. A CSX Railroad runs along its southern border. Potable water would be supplied through an existing water line along the southern border of the proposed site. Process water would be pumped from a water holding pond fed by the Kaskaskia River and located at the nearby Lyondell-Equistar Chemical Company. Sanitary wastewater would be treated either through a new on-site WWTP or by constructing a new sanitary force-main to the wastewater treatment system at the Lyondell-Equistar



Proposed Tuscola Power Plant Site

plant. The proposed power plant would connect to the power grid via existing or new high voltage transmission lines. Natural gas would be delivered through an existing line that runs through the proposed plant site. The proposed sequestration site is currently farmland situated 11 miles (17.7 kilometers) directly south of the proposed plant site. A new CO₂ pipeline would be constructed within the existing road and utility ROWs, and new ROWs running parallel to existing ROWs if required. Following Table 5.1-1, Figures 5.1-1, 5.1-2, and 5.1-3 illustrate the Tuscola Power Plant Site, utility corridors, and sequestration site, respectively.

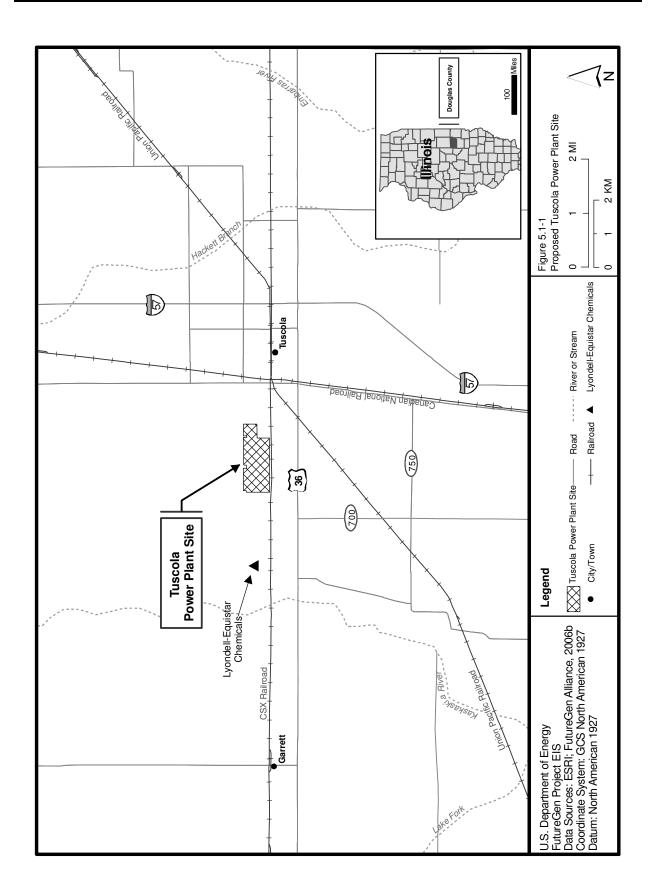
Table 5.1-1. Tuscola Site Features

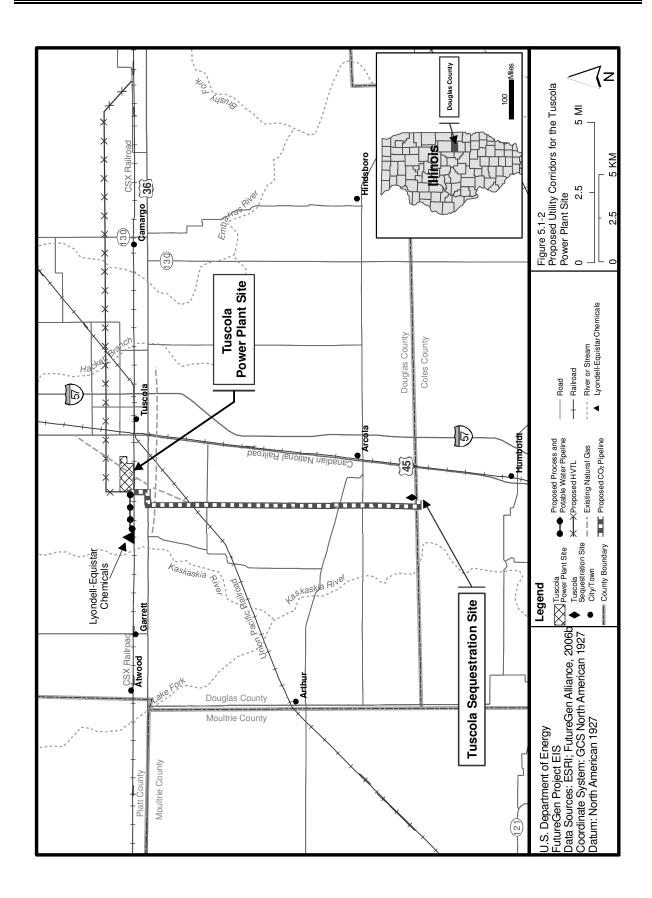
| _ |
|---|
| Description |
| The proposed Tuscola Site consists of approximately 345 acres (140 hectares) located in east-central Illinois, 1.5 miles (2.4 kilometers) west of the City of Tuscola within Douglas County. TR 86 (750E) runs along the west border of the proposed plant site and TR 47 (1050N) runs along its northern border. |
| The Site Proponent is a group consisting of the State of Illinois (through the Illinois Department of Commerce and Economic Opportunity), the City of Tuscola, Douglas County, and Tuscola Economic Development, Inc. |
| The proposed site is currently privately owned, but the Site Proponent has an option to purchase the site title, which would be conveyed to the Alliance. The proposed site is located on flat farmland near an industrial complex, which is immediately west of the proposed site. The areas to the immediate north, east, and south are rural with a very low population density. |
| The proposed sequestration site is located in a rural area, approximately 2 miles (3.2 kilometers) south-southwest of the small town of Arcola in Douglas County in east-central Illinois. The proposed site is located 11 miles (17.7 kilometers) south of the proposed power plant site and is 3 miles (4.8 kilometers) west of I-57. |
| The proposed sequestration site would be located on a land trust, where the trustee is the First National Bank of Arcola. The trustee has been authorized by the beneficiaries of the trust to sell the property. The proposed site is a 10-acre (4-hectare) portion of a larger parcel of 80 acres (32.4 hectares). The proposed sequestration site is located in Arcola Township, Douglas County, approximately 0.25 mile (0.4 kilometer) east of CR 750E along 000N, the Douglas-Coles County line. The site consists primarily of agricultural land with row crops. |
| Injection would occur within the Mt. Simon saline-bearing sandstone, at a depth of between 1.3 to 1.5 miles (2.1 to 2.4 kilometers). The Mt. Simon formation is overlain by a thick (500- to 700-foot [152- to 213-meter]) regional seal of low permeability siltstones and shales of the Eau Claire Formation and is underlain by Precambrian granitic rock. |
| The St. Peter sandstone is proposed as an optional target reservoir. It occurs at a depth of 0.9 mile (1.4 kilometers), which is about 0.4 mile (0.6 kilometer) above the Mt. Simon formation. The St. Peter reservoir is estimated to be over 100 feet (30.5 meters) thick with state-wide lateral continuity. Both the Mt. Simon and St. Peter reservoirs have been successfully used for natural gas storage in other parts of Illinois. |
| To estimate the size of the plume of injected CO ₂ , the Alliance used numerical modeling to predict the plume radius from the injection well. This modeling estimated that the plume radius at the proposed Tuscola injection site could be as large as 1.1 miles (1.8 kilometers) after injecting 1.1 million tons (1 MMT) of CO ₂ annually for 50 years. The dispersal and movement of the injected CO ₂ would be influenced by the geologic properties of the reservoir, and it is unlikely the plume would radiate in all directions from the injection point in the form of a perfect circle. However, for reference purposes, this modeled radius corresponds to a circular area equal to 2,432 acres (984 hectares). |
| A recent two-dimensional (2D) seismic line across the proposed injection site indicated that the continuity of seismic reflectors on this seismic line suggest that there is no significant faulting cutting the plane of the seismic line within 1 mile (1.6 kilometers) to the west and 2.5 miles (4.0 kilometers) to the east of the Tuscola Sequestration Site (Patrick Engineering, 2006). |
| |
| Potable water would be supplied to the proposed power plant by tapping an existing 8-inch (20.3-centimeter) water line operated by the Illinois American Water Company. This line runs along the southern boundary of the property along the CSX Railroad. Tapping into the existing water line would require less than 1 mile (1.6 kilometers) of new construction. |
| |

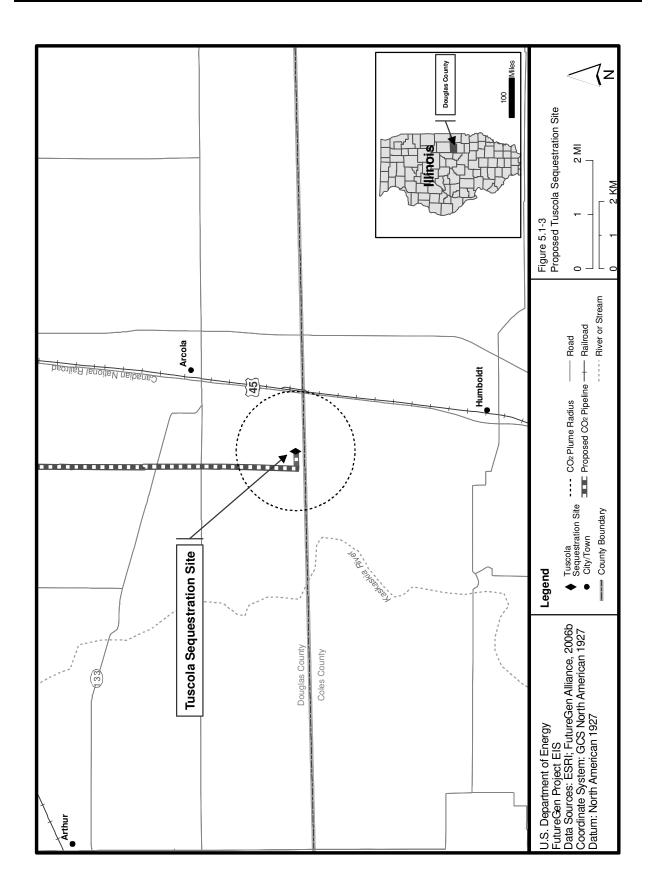
Table 5.1-1. Tuscola Site Features

| Feature | Description |
|--------------------------------|--|
| Process Water | The proposed power plant would receive its process water from an existing 150 million-gallon (568 million-liter) water holding pond at the Lyondell-Equistar Chemical Company located west of the proposed site. This pond contains raw water pumped from the adjacent Kaskaskia River. A 1.5-mile (2.4-kilometer) force main would be constructed to pump water from the pond to the plant, crossing property owned by Lyondell-Equistar Chemical Company and Cabot Corporation, as well as an existing township ROW. |
| Sanitary Wastewater | Option 1: Under Option 1, an on-site WWTP would be constructed at the proposed plant site. The treated effluent from this facility could then be discharged into an on-site reservoir (if constructed) and then reused as process water. Option 2: Under Option 2, a 0.9-mile (1.4-kilometer) sanitary force-main would be constructed to the existing wastewater treatment system at the Lyondell-Equistar Chemical Company. Once treated, this effluent could potentially be discharged into the existing 150-million-gallon (568-million-liter) reservoir to be reused as process water for the proposed power plant. There is an abandoned 8-inch (20.3-centimeter) potable water pipeline at the property that could potentially be used as a sanitary force-main to the Lyondell-Equistar WWTP. This line would require hydraulic testing before it could be put into service. |
| Electric Transmission Lines | Option 1: The nearest electric transmission line to the proposed power plant site is a 138-kV line located 0.5 mile (0.8 kilometer) north of the proposed site. This line is owned and operated by Ameren Corporation. The connection to this line would require additional ROW. Under Option 1, the proposed plant would tie into this existing 138-kV line. Option 2: If the interconnection of the proposed plant to the electric grid required use of a 345-kV line, a new 345-kV line that would parallel or replace the existing 138-kV line would be constructed for approximately 17 miles (27.4 kilometers) and connect to a substation where the line currently joins the 345-kV Sidney-Kansas line. Approximately 3 miles (4.8 kilometers) of new ROW would be required. An interconnection study has been requested and would dictate the ultimate line requirements. |
| Natural Gas | Natural gas would be delivered to the proposed plant from an existing natural gas mainline that runs through the proposed power plant site. Because the pipeline is a high-pressure line, a new tap and delivery station would be required. |
| CO ₂ Pipeline | A new 11-mile (17.7-kilometer) pipeline would be constructed to transport CO ₂ to the proposed sequestration site 10 miles (16.1 kilometers) due south of the proposed plant site. The pipeline would be constructed across existing State of Illinois, Douglas County, and Township ROWs and would occupy new ROWs where needed. The pipeline corridor would run parallel to CR 750E and 700E to the injection location. |
| Transportation Corridors | There are four railroads nearby: CSX Transportation (borders site), Union Pacific (1.5 miles [2.4 kilometers]), Canadian National (1.5 miles [2.4 kilometers]), and Norfolk Southern (approximately 30 miles [48 kilometers]). The proposed site is bordered by TR 86 and TR 47. Illinois is located within the East North Central Demand Region for coal, which also includes Ohio, Indiana, Wisconsin, and Michigan. According to the Energy Information Administration (EIA, 2000), the East North Central Demand Region is ideally situated for access to coal, which it receives from each of the major U.S. supply regions. In 1997, the average distance that a coal shipment traveled to reach a destination in this region was about 830 miles (1,336 kilometers) (EIA, 2000). In terms of a straight line distance, Tuscola is approximately 300 miles (483 kilometers) from the Pittsburgh Coalbed (near south-central Ohio in the northern Appalachian Basin), 900 miles (1,448 kilometers) from the PRB (eastern Wyoming), and within 35 miles (56.3 kilometers) of the nearest active coal mines in the Illinois Basin (Vermillion County, Illinois). |

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







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5.2 AIR QUALITY

5.2.1 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 Tuscola Power Plant Site and sequestration site. The FutureGen Project would use integrated gasification combined-cycle (IGCC) technology and would capture and sequester carbon dioxide (CO₂) 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.

5.2.1.1 Region of Influence

The ROI for air quality includes the area within 50 miles (80.5 kilometers) of the boundaries of the proposed Tuscola Power Plant Site and within 50 miles (80.5 kilometers) of the boundaries of the proposed Tuscola Sequestration Site. Sensitive receptors that have been identified within the ROI are discussed in Section 5.2.2.3.

5.2.1.2 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.

Based on the above criteria, DOE assessed potential air quality impacts from the construction and operational activities related to the FutureGen Project at the proposed Tuscola Power Plant Site 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

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.

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 5.2-1). 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 5.2-1 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 5.2-1. Yearly Estimates of Maximum Air Emissions from the FutureGen Project¹ (tpy [mtpy])

| (171 171) | | | | | | |
|---|--------|--------|--------|--------|-------------------------------|--|
| Pollutant | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 Onward ² | |
| Sulfur Oxides ³ (SO _x) | 543 | 322 | 277 | 255 | 100 | |
| | (492) | (292) | (251) | (231) | (90.7) | |
| Nitrogen Oxides ⁴ (NO _X) | 758 | 754 | 753 | 753 | 750 | |
| | (687) | (684) | (683) | (683) | (680) | |
| Particulate Matter ⁵ (PM ₁₀) | 111 | 111 | 111 | 111 | 111 | |
| | (100) | (100) | (100) | (100) | (100) | |
| Carbon Monoxide ⁵ (CO) | 611 | 611 | 611 | 611 | 611 | |
| | (554) | (554) | (554) | (554) | (554) | |
| Volatile Organic Compounds ⁵ (VOCs) | 30 | 30 | 30 | 30 | 30 | |
| | (27.2) | (27.2) | (27.2) | (27.2) | (27.2) | |
| Mercury ⁵ (Hg) | 0.011 | 0.011 | 0.011 | 0.011 | 0.011 | |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | |

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).

Source: FG Alliance, 2007.

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 (SO₂).

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 (NO₂). 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 metric tpy).

⁵ Values for PM₁₀, CO, VOCs, and Hg would remain constant between Year 1 through 5 because unplanned restarts would not affect these emissions. Conversely, SO₂ and NO₂ 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.

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 5.2.3.2. *Appendix E provides additional details*.

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.

5.2.2 AFFECTED ENVIRONMENT

5.2.2.1 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 (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), ozone (O₃), lead (Pb), and inhalable particles, which are also known as respirable particulate matter (PM). The PM₁₀ 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 Tuscola Power Plant Site and sequestration site are located in Douglas County, Illinois. Douglas County is part of the East Central Illinois Intrastate Air Quality Control Region (AQCR). No ambient air monitoring data are recorded in Douglas County (FG Alliance, 2006b); however, in the East Central Illinois Intrastate AQCR, monitors are located in Champaign County, which is within the proposed Tuscola Power Plant Site ROI, and McLean County, which is outside the ROI. These monitors measure O₃ and PM_{2.5} concentrations. The East Central Illinois Intrastate AQCR has no history of nonattainment for the six criteria pollutants. The nearest SO₂ monitor within the ROI of the proposed site is in Macon County in the West Central Illinois Intrastate AQCR. This monitor indicates attainment with the SO₂ NAAQS. Neither the East Central Illinois Intrastate AQCR nor other AQCRs within the ROI of the proposed Tuscola Power Plant Site and sequestration site has monitors for NO_X, PM₁₀, 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 5.2-2 provides monitored background data of O₃, PM_{2.5}, and SO₂ for the proposed Tuscola Power Plant 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 Tuscola Power Plant Site. The nearest non-attainment areas are located in Indianapolis, Indiana (86.3 miles [138.9 kilometers] away) and Vigo County, Indiana (71 miles [114.3 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 Tuscola Site is selected.

| Monitoring Site Location | | | Monitored Data ¹ | Primary/ Secondary Standard ¹ | | |
|--|-----------|---|--------------------------------|--|--|--|
| Bondville, Illinois | 28 (45.1) | PM _{2.5} (Annual) | 12.6 | 15 | | |
| Champaign County | | PM _{2.5} (24-hour) | 31.8 | 35 | | |
| East Central Illinois Interstate AQCR | | | | | | |
| Champaign, Illinois | 29 (46.7) | O ₃ (1-hour) | 0.082 | 0.12 | | |
| Champaign County | | O ₃ (8-hour) | 0.079 | 0.08 | | |
| East Central Illinois Interstate AQCR | | PM _{2.5} (Annual) PM _{2.5} (24-hour) | 12,5 31.9 | 15 35 | | |
| Decatur, Illinois | 38 (61.2) | O ₃ (1-hour) | 0.093 0.081 | 0.12 | | |
| Macon County | | O ₃ (8-hour) | | 0.08 | | |
| West Central Illinois Interstate AQCR | | PM _{2.5} (Annual) PM _{2.5} (24-hour) | | 15 35 | | |
| | | SO ₂ (Annual) SO ₂ (24-hour) SO ₂ (3-hour) | 0.004 0.024 0.040 | 0.03 0.14 None | | |
| Normal, Illinois | 77 (123) | O ₃ (1-hour) | 0.093 | 0.12 | | |
| McClean County | | O ₃ (8-hour) | 0.082 | 0.08 | | |
| East Central Illinois Interstate AQCR | | PM _{2.5} (Annual) PM _{2.5} (24-hour) | 12.7 34.3 | 15 35 | | |

Table 5.2-2. Monitoring Stations and Ambient Air Quality Data

5.2.2.2 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 Tuscola Power Plant 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. Tuscola is not within 50 miles (80.5 kilometers) of any of the 10 largest cities in Illinois. The closest of the 10 largest cities to Tuscola is Springfield to the west. The greater metropolitan Chicago area is approximately 155 miles (249.4 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 115 miles (185.1 kilometers) southwest of Tuscola, shares the Metropolitan St. Louis Interstate AQCR with many counties in Illinois and is also in non-attainment for O_3 and $PM_{2.5}$.

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

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 Tuscola than the greater metropolitan Chicago area. 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 Tuscola include Carmargo, Garrett, Arcola, Atwood, Arthur, Pesotum, and Ivesdale, 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. Additionally, the medium-sized city of Decatur is located about 35 miles (56.3 kilometers) due west and is in a prevalent upwind direction from the proposed Tuscola Power Plant Site. According to the EPA

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 HAPs 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.*

Envirofacts website (http://www.epa.gov/enviro), the major sources of criteria pollutants and HAPs within a 10-mile (16.1-kilometer) radius, but outside a 1-mile (1.6-kilometer) radius, are Panhandle Eastern Pipeline Company and Masterbrand Cabinets (EPA, 2006c). Other sources include the vehicle traffic in Tuscola and surrounding areas. A small oil field exists about 3 miles (4.8 kilometers) to the southwest, and a few wells are scattered around to the north and west of the site. Gas storage wells are located to the immediate north of the planned CO₂ injection wells. Oil and gas wells and pipelines could be a minor source of fugitive emissions of hydrocarbons.

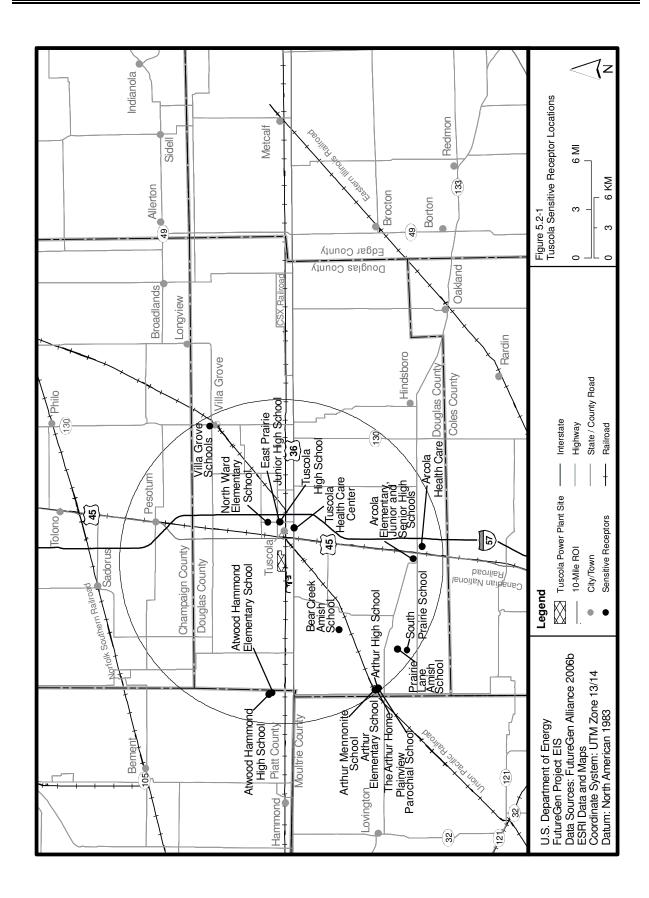
Local

There are several existing major air emissions sources within 1 mile (1.6 kilometers) of the proposed Tuscola Power Plant Site. These include the Cabot Corporation (a chemical company) and the Lyondell-Equistar Chemical Company, both located immediately west of the proposed Tuscola Power Plant Site. Trunkline Gas Company and TriGen-Cinergy Solutions of Tuscola are located a few thousand feet due south of the proposed plant site.

The area surrounding the proposed Tuscola Power Plant 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, during cultivation, tilling of the soil may cause some dust suspension or render the soil more susceptible to wind erosion for short periods of time.

5.2.2.3 Sensitive Receptors (Including Class I Areas)

The proposed Tuscola Power Plant Site is located in a rural area. Three single-family residences are located along the northern boundary of the site on CR 1050N, which is 600 feet (182.9 meters) from the center of the site. Within 0.5 mile (0.8 kilometer) of the site, two residences are located to the north on or near CR 1150N, and five residences are located to the south on or near State Route (SR) 36. Several dozen residences are located within 1 mile (1.6 kilometers) on the western edge of the City of Tuscola. There are no hospitals, schools, or nursing homes within 1 mile (1.6 kilometers) of the proposed plant site (FG Alliance, 2006b). There are 16 schools and three nursing homes within a 10-mile (16.1-kilometer) radius of the proposed Tuscola Power Plant Site and 12 schools and three nursing homes within a 10-mile (16.1-kilometer) radius of the proposed sequestration site (see Figure 5.2-1) (FG Alliance, 2006b).



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: SO₂, NO₂, and PM₁₀. 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 5.2-3).

Table 5.2-3. 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 |

 $\mu g/m^3$ = micrograms per cubic meter.

Source: EPA, 2005a.

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 204 miles (328.3 kilometers) from the proposed Tuscola Power Plant Site and sequestration site (see Table 5.2-4), 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 Tuscola Power Plant Site and sequestration site are located in Class II areas.

Table 5.2-4. Nearest Class I Areas to Proposed Tuscola Power Plant Site

| Class I Area/Location | Distance (miles) | Distance (kilometers) | Direction |
|--|---------------------|--------------------------|-----------|
| Mammoth Cave National Park, Kentucky | 204 | 328.3 | SE |
| Mingo National Wildlife Refuge, Missouri | 220 | 354.1 | SW |

Source: FG Alliance, 2006b.

5.2.2.4 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, 2006b). Additionally, these officials have no knowledge of specific local needs or concerns for air quality management at the proposed Tuscola Power Plant Site and sequestration site.

5.2.3 IMPACTS

5.2.3.1 Construction Impacts

Construction at the proposed power plant site, sequestration site, utility corridors, and transportation corridors would result in localized increases in ambient concentrations of SO₂, 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 Site

DOE assumed that up to 200 acres (81 hectares) of the proposed 345-acre (140-hectare) site would be directly affected for the purposes of the air impact analysis. DOE estimates that construction of the proposed Tuscola Power Plant would take 44 months. 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 SO₂, 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.

Sequestration Site

While the proposed sequestration site contains over 80 acres (32 hectares) (FG Alliance, 2006b), only a small fraction (10 acres [4 hectares]) of the land area would be disturbed by either exploratory investigations (e.g., geophysical surveys) or construction of the sequestration facilities. Construction-related impacts on air quality at the proposed sequestration site would be limited to preparation of well drilling sites and the drilling of wells, as discussed in Chapter 2. Exploratory wells would be installed to sample and test the underground reservoir systems, and injection wells and monitoring wells would be installed to inject CO₂ and monitor its fate. Site preparation and construction activities would involve grading and surface preparation by earth-moving equipment and would result in localized fugitive dust air emissions during construction. Impacts 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.

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 3 to 6 weeks. The emissions from construction would include SO₂, 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 Tuscola Power Plant Site would be primarily via County Road (CR) 750E on the west boundary of the site and CR 1050N on the north boundary. Additionally, the CSX Transportation Decatur Subdivision Rail Line and a CSX rail siding borders the proposed site on the south. Delivery to and from the proposed site could be accomplished by either railway or roadway. The existing roadway meets the needs of current traffic in the area of the proposed power plant site; however, if Tuscola is chosen for the FutureGen Project, an upgrade of existing roadways may be needed. Because it is unclear how much (if any) road construction or reconstruction would be needed, potential air emissions impacts cannot be evaluated at this time. Impacts associated with upgrading the existing roadway would be dependent on the extent of construction activities required.

5.2.3.2 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 5.2-1) 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 5.2.2.1, Douglas County is in attainment or unclassified with the NAAQS for all pollutants. Additionally, Douglas County is not designated as a maintenance area. Consequently, no conformity determination is needed (see Section 5.2.2.4).

Criteria Pollutant Emissions

DOE conducted refined modeling using AERMOD. Table 5.2-5 presents the results of the AERMOD modeling for the operational phase of the proposed Tuscola Power Plant. Limited amounts of background air concentration data for the Tuscola area were available for use in this EIS. For SO₂ and PM_{2.5}, representative background data were available from monitors within the same AQCR as Douglas County or within the ROI. For NO₂, PM₁₀, 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 PM₁₀ 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 the period of 3 years (2003 to 2005) was used (see Appendix E).

Table 5.2-5 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 SO₂ concentrations could approach Class II PSD increment limits during plant upset from emissions associated with unplanned restart events. These unplanned restart emissions of SO₂ would typically be higher than steady-state SO₂ 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 SO₂ Class II PSD increment at the proposed Tuscola Power Plant Site during periods of plant upset is 0.22 percent and zero percent during normal operating scenarios. The probability of the proposed power plant exceeding the 24-hour SO₂ Class II PSD increment at the proposed Tuscola Power Plant Site is zero. Maximum concentrations of the pollutants would be limited to a radius of less than 2.6 miles (4.2 kilometers) from the center of the proposed Tuscola Power Plant Site. Currently, three single-family residences are approximately 600 feet (182.9 meters) from the site, and seven additional residences are within 0.5 mile (0.8 kilometer). These residences would be impacted.

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 (O₂) in the gasifier instead of air, the use of a catalytic shift reactor to convert CO to CO₂, and CO₂ capture and sequestration features.

Table 5.2-5. Comparison of Maximum Concentration Increases with 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 | 0.54 | 123.57 | 1,300 | 512 | 0.10 | 1.75 (2.8) |
| 24-hour | 0.20 | 70.87 | 365 | 91 | 0.22 | 0.65 (1.0) |
| SO ₂ (upset scenario) ³ 3-hour | 511.96 | 634.99 | 1,300 | 512 | 99.91 | 2.55 (4.1) |
| 24-hour | 67.00 | 137.67 | 365 | 91 | 73.63 | 2.55 (4.1) |
| SO ₂ Annual ⁴ | 0.05 | 10.52 | 80 | 20 | 0.24 | 0.73 (1.2) |
| NO ₂ ^{4, 5} Annual | 0.07 | 30.16 | 100 | 25 | 0.27 | 0.73 (1.2) |
| PM/PM ₁₀ ^{4, 6} 24-hour | 0.39 | 57.73 | 150 | 30 | 1.31 | 0.65 (1.0) |
| Annual | 0.01 | 26.01 | 50 | 17 | 0.06 | 0.73 (1.2) |
| PM/PM _{2.5} ^{4, 6} 24-hour | 0.39 | 32.33 | 35 | n/a | n/a | 0.65 (1.0) |
| Annual | 0.01 | 12.51 | 15 | n/a | n/a | 0.73 (1.2) |
| CO ⁷ 1-hour | 9.47 | 5,620.90 | 40,000 | n/a | n/a | 1.71 (2.8) |
| 8-hour | 4.73 | 3,462.66 | 10,000 | n/a | n/a | 0.59 (1.0) |

¹ Value based on site-specific meteorological and terrain data. Except for the 3-hour SO₂ 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 SO₂ averaging time during the upset scenario, the 82nd highest maximum predicted concentration is provided. Although the highest maximum 3-hour SO₂ concentration could exceed the PSD increment during the upset scenario, the 3-hour increment would not be exceeded at least 99.78 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.

Source: AERMOD modeling results (see Appendix E).

Predicted HAP emissions are presented in Table 5.2-6. 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 5.17.

²The 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.

⁵There are no short-term NAAQS for NO₂.

⁶ There are no unplanned restart emissions of PM₁₀ 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.

Table 5.2-6. Annual Hazardous Air Pollutant Emissions¹

| Chaminal Campaund | Combustion Turbine E | | |
|--------------------------|----------------------|----------|--|
| Chemical Compound | 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. 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.

tpy = tons per year; mpty = 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-

² Compounds that are considered to be PM are in bold text.

³ Conservatively assumed all chromium to be hexavalent.

MW equivalent electrical output and that would sell more than one-third of their potential electrical output. Under CAMR, each 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. The 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 (9.82x10⁻⁷ micrograms per cubic meter) would *result* within 0.73 mile (1.7 kilometers) 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 coalfired 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 CO₂ 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 CO₂. DOE estimates that up to 0.28 million tons (0.25 million metric tons [MMT]) per year of CO₂ would be released into the atmosphere. A goal of the FutureGen Project is to capture and permanently sequester at least 90 percent of the CO₂ 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 CO₂ in geologic formations, the FutureGen Project aims to prove one technological option that could virtually eliminate future CO₂ emissions from similar coalbased power plants.

DOE's Energy Information Administration (EIA) report (DOE, 2006a) indicates that U.S. CO₂ emissions have grown by an average of 1.2 percent annually since 1990 and energy-related CO₂ emissions constitute as much as 83 percent of the total annual CO₂ emissions. DOE reviewed EPA's Emissions and

Generation Resource Integrated Database (eGRID) to gain an understanding of the scale of the estimated CO₂ emissions from the proposed FutureGen Project compared to existing coal-fueled plants (EPA, 2006b). 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, CO₂ 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 CO₂ 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 CO₂ (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 CO₂ emissions.

Acid Rain Program and Clean Air Interstate Rule Requirements

Acid rain or acid deposition can occur when acid precursors (such as SO₂ and NO_x) are released into the atmosphere, and they react with O₂ 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 SO₂, NO_X, and CO₂, 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 SO₂. 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 SO₂ and NO_X emission allowances to cover actual SO₂ 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 NH₃ 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 the over 25 residences within 1 mile (1.6 kilometers) of the proposed Tuscola Power Plant Site.

Local Plume Visibility, Shadowing, Fogging, and Water Deposition

The proposed Tuscola 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 Tuscola Site proposes to use process water from the Lyondell-Equistar Chemical Plant that is held in surface ponds. This water would potentially contain a high concentration of solids (see Table 5.7-2). 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 Tuscola Power Plant 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 CR 750E, which borders the western side of the plant site and CR 1050N, which borders the north side of the plant site. Because the proposed Tuscola Site has 345 acres (140 hectares) and the FutureGen Project footprint requires 60 acres (24 hectares), it is unlikely that the boundary of the power plant would be built within 300 feet (91.4 meters) of either road; therefore, fog from the plant would have dissipated and deposition of solids on the road would not occur. Overall, solar loss, fogging, icing, or salt deposition from the proposed Tuscola 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 Tuscola Power Plant as a result of future economic growth. Section 5.19 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 Tuscola 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 5.2-7). 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 5.2-7. Screening Analysis for Effects on Vegetation and Soils

| Pollutant | Averaging Period ¹ | Maximum Total Concentration ² (μg/m³) | Screening Concentrations ³ (µg/m ³) | Secondary NAAQS (μg/m³) |
|-----------------|----------------------------------|--|--|-------------------------------|
| SO ₂ | 3-hour | 634.99 | 786 | 1,300 |
| NO ₂ | Annual | 30.16 | 94 | 100 |

¹ Maximum concentration for shortest averaging period available.

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.

² Maximum concentration including background data (see Table 5.2-5).

³ The most conservative values were utilized, based on the highest vegetation sensitivity category. μg/m³ = micrograms per cubic meter.

Sequestration Site

The proposed CO_2 sequestration would be within bedrock layers located approximately 1.2 to 1.5 miles (1.9 to 2.4 kilometers) beneath the ground surface, far below the soil zone, *groundwater table*, and overlying unsaturated zone (see Section 5.5 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 CO₂ 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 Tuscola 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 CO₂.

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 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 98 tons (88.5 metric tons) of CO₂. A number of tracers would also be

used to track the fate and transport of the injected CO₂. Descriptions of these compounds are provided in Section 5.16. 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 CO₂. 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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5.3 CLIMATE AND METEOROLOGY

5.3.1 INTRODUCTION

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

5.3.1.1 Region of Influence

The ROI for climate and meteorology includes the proposed Tuscola Power Plant Site, sequestration site, and the utility and transportation corridors.

5.3.1.2 Method of Analysis

DOE reviewed the Tuscola EIV (FG Alliance, 2006b) 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 Tuscola 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.

5.3.2 AFFECTED ENVIRONMENT

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

5.3.2.1 Local and Regional Climate

The proposed Tuscola Power Plant Site is located in Douglas County in the east-central region of Illinois near the city of Tuscola. 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

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).

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 summer 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 (51 centimeters); however, only one snowfall per year generally exceeds 6 inches (15 centimeters) (FG Alliance, 2006b).

Winters in the region are generally cold, and summers are generally hot. Average high and low January temperatures are around 34.4°F (1.3°C) and 18.0°F (-7.8°C), respectively. On average, the temperature falls below 0°F (-17.8°C) six days a year during the winter. In mid-summer, average high temperatures reach 88°F (31.1°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 5.3-1 summarizes representative temperature, precipitation, and wind speed data.

| Weather Parameter | Spring | Summer | Fall | Winter |
|--|-------------|-------------|-------------|-------------|
| Average Daily Temperature, °F (°C) | 67.2 (19.6) | 77 (25) | 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) | 1.1 (2.8) | 0.0 (0.0) | 5.4 (13.7) | 16.6 (42.2) |
| 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) |

Table 5.3-1. Seasonal Weather Data

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 5.3-1. 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 University of Illinois Willard Airport located about 19 miles (31 kilometers) north of the proposed power plant site. As the wind rose indicates, the most common wind directions are from the south, the west, and the south-southwest (FG Alliance, 2006b). 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 10.5 mph (16.9 kmph), and winds from the south through southwest are most prevalent. Calm winds (below 1.5 mph [2.4 kmph]) prevail 4.6 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 and 31.5 kmph). The most prevalent winter winds are from the south through southwest, with a milder spike of occurrences from the 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 to 19.6 mph (20.4 to 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), and calm conditions occur around 6 percent of the time. The most prevalent wind directions in the summer are from the south through 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, 2006b).

[°]F = degrees Fahrenheit; °C = degrees Celsius. Source: FG Alliance, 2006b.

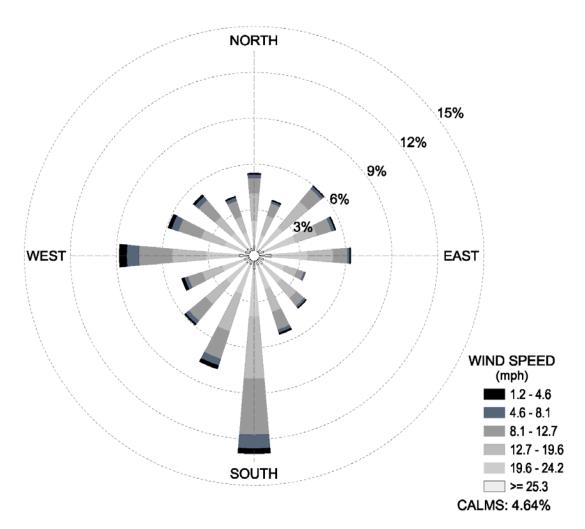


Figure 5.3-1. Wind Rose for the Tuscola Region

The proposed power plant site and sequestration site are 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 Douglas 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 centimeters) or more, and 11 ice storms (FG Alliance, 2006b).

5.3.2.2 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 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 Douglas County region receives an average of 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 2006, 25 tornados were reported in Douglas County, including 15 F0 tornadoes, four F1 tornadoes, five F2 tornadoes, and one F3 tornado (NOAA, 2006). Based on historical tornado activity within Douglas County, there could be 9 F1 or greater tornadoes in the county (over 812 square miles [2,103 square kilometers]) over the possible 50 year lifespan of the FutureGen Project. For comparison purposes with the other candidate sites, using

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).

a nominal county size of 850 square miles (2,202 square kilometers), the tornado frequency would equate to approximately 10 F1 or greater tornadoes over 50 years.

Floods

The city of Tuscola is located about 4.5 miles (7.2 kilometers) east of the Kaskaskia River and about 5.1 miles (8.2 kilometers) west of the Embarras River. During heavy rains, these rivers can overflow and cause localized flash floods. The NOAA database shows that, between 1999 to 2006, 11 floods have been reported in Douglas County. The most severe flood effects were generally localized near the Embarras and Kaskaskia rivers, although minor flood effects were sustained in Tuscola as well. The presence of these nearby rivers and the relative flat topography of the region contribute to the potential for flood events in the region (FG Alliance, 2006b). As noted in Section 5.8.2.2, the proposed power plant and sequestration sites are 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.

5.3.3 IMPACTS

5.3.3.1 Construction Impacts

Power Plant Site

Severe temperature or weather conditions may 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 relatively 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 10 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 5 to 6 years and the power plant site represents 0.07 percent of the land area in the county. Therefore the 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, 2006b).

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

Construction impacts at the proposed sequestration site would be the same as those discussed for the 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. The entire CO₂ corridor would be outside of the 100-year floodplain, so the potential for impact from flood would be low. Small portions of the proposed electrical transmission corridor would be within the 100-year floodplain; however, because this corridor would cross such a small portion of the 100-year floodplain and construction activities in the utility corridor would occur over such a limited time span, the potential for a flood to have direct or indirect impact on construction would be low.

Transportation Corridors

There are no proposed new transportation facilities. All transportation infrastructure corridors are existing and have previously been designed to handle predetermined flood conditions. Specific guidelines and flood frequency requirements would apply to any improvements to the existing transportation network such as roadways and bridges.

5.3.3.2 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 5.2 provides further discussion.

Hail, ice glaze, or large snowfall 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 strong 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 strong tornado struck nearby communities and affected the ability of workers or supplies to reach the site. The tornado frequency is equivalent to approximately 10 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 5 to 6 years and the power plant site represents 0.07 percent of the land area in the county. Therefore, the chance for significant direct and indirect impacts from a tornado would be low (FG Alliance, 2006b).

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

Operations at the proposed sequestration site could be impacted by climate conditions in the region. Ice glaze, hail storms, or extremely cold temperatures could damage proposed sequestration site equipment; however, these conditions are not frequent and the equipment would be designed to operate under the anticipated weather conditions.

A flood could impact operations at the proposed sequestration site; however, the chance for a flood would be very small because much of the proposed sequestration site is outside of the 500-year

floodplain. The potential for impact from a flood could be mitigated through selection of topographically favorable locations for injection equipment installation at the proposed sequestration site.

A strong tornado could impact operations at the proposed sequestration 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 (Coles County) is approximately 1 every 3 to 4 years (see Section 4.3.3.1) and the sequestration site represents 0.003 percent of the land area in the county. Therefore, the probability for impact from a tornado would be low (FG Alliance, 2006b).

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 utility corridors could be impacted 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 sequestration site. A significant ice glaze could down transmission lines and temporarily interrupt electrical service to the proposed power plant.

The entire CO₂ corridor would be outside of the 100-year floodplain, so the potential for impact from a flood would be low. Minor portions of the proposed electrical transmission corridor would cross small areas within the 100-year floodplain; however, the utility corridors 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 impacted 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 corridors 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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5.4 GEOLOGY

5.4.1 INTRODUCTION

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

5.4.1.1 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 Tuscola Power Plant Site 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 (1.0 MMT) of CO_2 per year for 50 years would be 1.1 miles (1.8 kilometers), equal to an area of 2,432 acres (984 hectares) (FG Alliance, 2006b). The plume radius and land area above the CO_2 plume are shown in Figure 5.4-1. The third ROI is a wider area (100 miles [160.9 kilometers]) that was evaluated to include potential effects from seismic activity.

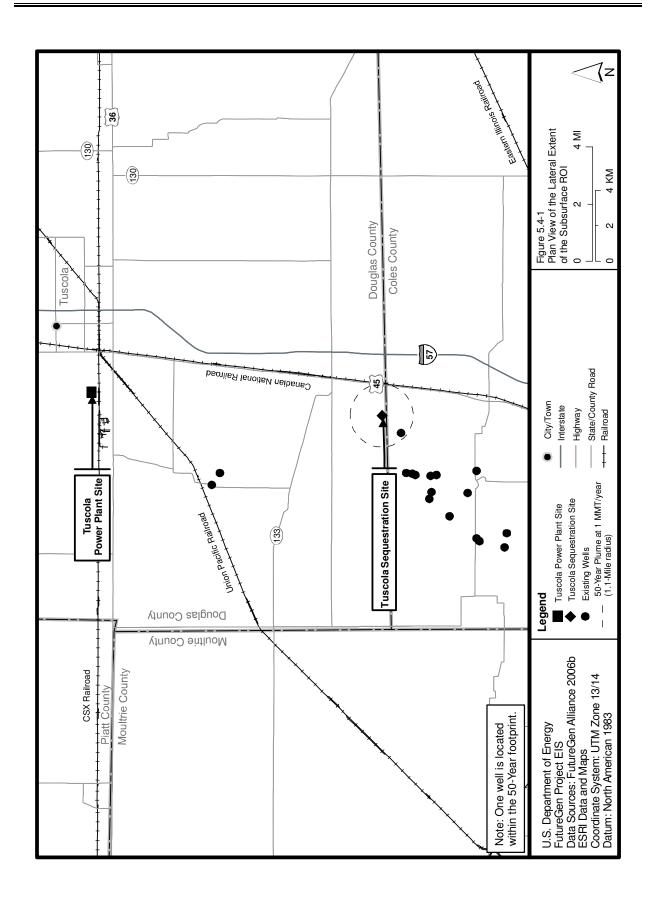
5.4.1.2 Method of Analysis

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 CO₂ 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 Tuscola EIV (FG Alliance, 2006b).

DOE identified uncertainties in relation to geological resources at the Tuscola Site. These include the porosity and permeability of the target formation where CO₂ 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 formations at the sequestration site.



5.4.2 AFFECTED ENVIRONMENT

5.4.2.1 Geology

The proposed Tuscola Power Plant *S*ite is 345 acres (140 hectares) in size. The site is essentially flat with an average slope of approximately 0.5 percent. The elevation of the proposed site varies from a high of 686 feet (209 meters) above mean sea level (AMSL) in the center to a low of 679 feet (207 meters) AMSL along the eastern border.

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 5.4-2 is a stratigraphic column of the geology beneath the proposed Tuscola sequestration site. The geology at the proposed plant site and other areas where construction would occur is similar. The surficial Quaternary glacial deposits are approximately 250 feet (76 meters) thick at the proposed injection site and these deposits are likely less than 100 feet (31 meters) thick at the proposed plant site, and vicinity. The glacial deposits are underlain by the Pennsylvanian age McLeansboro Group. This group includes coal seams over shale-limestone-shale formations. The McLeansboro Group is over 0.2 mile (0.3 kilometer) thick and is underlain by about 0.9 mile (1.4 kilometers) of shale, limestone, and dolomites with some interbedded sandstones.

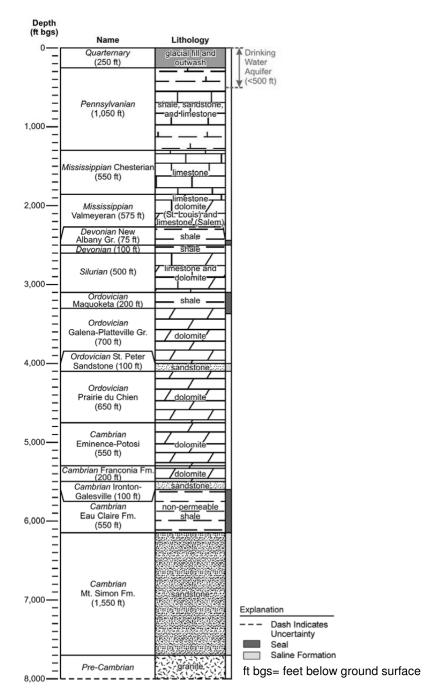
Lying below these strata is the proposed target formation (or sequestration reservoir) for CO_2 injection, the Mt. Simon sandstone formation. This formation is brine saturated and is likely about 0.3 mile (0.5 kilometer) thick below the project site. The CO_2 injection target would occur at a depth of 1.2 to 1.5 miles (1.9 to 2.4 kilometers). It is the oldest formation of the Paleozoic Era rocks 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 5.4-2). At the Tuscola Site, the St. Peter is estimated to be over 100 feet (30 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, 2006b).

The dominant structural feature of Douglas County is the Tuscola Anticline. This fold, which extends northward into the southern portion of Champaign County, is 25 miles (40.2 kilometers) long by 10 miles (16.1 kilometers) wide, and has more than 700 feet (213.4 meters) of structural closure. The fold axis trends slightly west of north and the western flank is much steeper than the eastern. This

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

anticline contains trapped oil reserves and is the source for six oil fields in the Tuscola area. The western flank of this anticline is present 3 to 4 miles (4.8 to 6.4 kilometers) east of the proposed Tuscola Sequestration Site. This setting of a steep flank of an anticline may contain some faults and fractures, but to date none have been found or mapped in the area of review by the Illinois Department of Natural Resources (FG Alliance, 2006b).



Source: FG Alliance, 2006b

Figure 5.4-2. Stratigraphy of the Tuscola Injection Area

The Tuscola Anticline is part of the greater La Salle Anticlinorium, the largest enclosed anticline in Illinois extending from west-south Indiana to north-central Illinois. The La Salle Anticlinorium is a compound anticline, consisting of a series of subordinate anticlines and synclines, the whole having the general contour of an arch. Although direct evidence is not available, the western limb of the Tuscola Anticline likely overlies a high-angle reverse fault in the pre-Cambrian igneous basement rocks. This

faulting was a product of the Ancestral Rockies mountain-building event during late Paleozoic time. Faults probably extend upward from Precambrian into Paleozoic cover and may reach the bedrock surface. However, most fault locations are inferred because there is little surface expression of faults due to the surficial glacial deposits (FG Alliance, 2006b).

Because of the likelihood of faults associated with the Tuscola Anticline and the greater La Salle Anticlinorium, a regional geologic stress analysis was conducted to yield insight into 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, 2006b).

Geological Resources in the Tuscola Area

Aggregate or construction quality Silurian and Devonian carbonates (mostly dolomite) lie near the surface along the Tuscola Anticline. An active quarry, located about 4 miles (6.4 kilometers) east of the proposed Tuscola Power Plant Site and about 11 miles (17.7 kilometers) north of the proposed Tuscola sequestration site, currently mines these rocks for use in construction. The potential for mining carbonate aggregates diminishes away from the Tuscola Anticline to the east and west. At both the plant and sequestration sites, these rocks are buried too deeply to be commercially mined. Sand and gravel deposits are absent or are too thin or deeply buried in the immediate area to be economically mined. Thin sand and gravel deposits may be present along the Embarras River and elsewhere. These deposits would not be disturbed by the proposed project, and may provide small amounts of low-quality aggregate for local use, such as trench backfill or for road base and shoulder work on secondary roads (FG Alliance, 2006b).

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 800 to 900 feet (244 to 274 meters) in the Tuscola 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, 2006b).

The proposed Tuscola Power Plant Site is located 330 feet (100.6 meters) east of Ficklin Field, a 70-acre (28-hectare) oil field that has produced 40,000 barrels of oil. Oil has been produced from the Mississippian Spar Mountain sandstone at a depth of approximately 0.3 mile (0.5 kilometer), and gas has been produced from one well completed in a Devonian sandstone at a depth of approximately 0.5 mile (0.8 kilometer). Records show that the field was discovered in 1969, and that all producing wells have been plugged and abandoned (FG Alliance, 2006b). Due to its location near the proposed power plant site, this oil field is not within the subsurface ROI related to the proposed sequestration site.

One oil and gas exploration well was drilled within the perimeter of the proposed plant site. In 1967, the Pflum No.1 well was drilled to a depth of 0.5 mile (0.8 kilometer) below the surface. The well was dry, and was therefore abandoned and plugged. An additional abandoned exploration well, the Scable Community No. 1, was drilled 330 feet (100.6 meters) south of the boundary of the plant site. This well was drilled in 1967 to a depth of 0.5 mile (0.8 kilometer) and has since been plugged.

The proposed injection site is located within the far northeastern portion of the Cooks Mills Consolidated Oil Field. This portion of the field was drilled and developed in 1956. Beginning in 1965, some of the dry wells were abandoned and plugged, with most of the wells in this portion of the field being abandoned by the mid 1970s. Plugging procedures during the 1960s through the 1970s were similar to present procedures. The surface facilities were removed, casing was cut off and capped at least 4 feet (1.2 meters) below ground surface, and cement plugs were set across the base of surface casings and across any open well intervals.

Records show that one active well is located 0.75 miles (1.2 kilometers) south of the proposed sequestration site, one is located 1.2 miles (1.9 kilometers) southwest of the site, and several are located over 2 miles (3 kilometers) southwest of the site. Wells in this field are reported to be shallow (FG Alliance, 2006b); they are seated several thousand feet above the proposed sequestration reservoir in the Mississippian age strata, and are likely no deeper than 0.4 mile (0.6 kilometer).

The Cooks Mills gas storage project is active and has three separate storage reservoirs in the area. These are located approximately 0.5 mile (0.8 kilometer), 1.25 miles (2.0 kilometers), and 2.3 miles (3.6 kilometers) from the proposed sequestration site boundary. The storage reservoirs for the Cooks Mills Project are the Mississippian Cypress sandstone at a depth of approximately 0.3 mile (0.5 kilometer) below ground surface.

5.4.2.2 Seismic Activity

The proposed Tuscola Power Plant Site is located roughly 60 to 70 miles (96.6 to 112.7 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 230 miles (370 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, 30 earthquakes have occurred within 120 miles (193 kilometers) of the approximate midway point between the proposed power plant and sequestration site. The Richter magnitude of the earthquakes ranged from 2.4 to 5.1. The most recent seismic event, on December 6, 2005, was a 2.7 magnitude earthquake centered 101 miles (162.5 kilometers) from the midpoint between the power plant and sequestration site. The closest earthquake to the proposed power plant site was a magnitude 3.0 earthquake that occurred on April 24, 1990, approximately 12.4 miles (20 kilometers) from the plant-sequestration site midpoint (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 80 miles (129 kilometers) south-southeast of the Tuscola Plant 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 U.S., 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 U.S., it caused serious damage only in the immediate Charleston area (ISGS, 1995b).

5.4.2.3 Target Formation Properties

Characteristics

The thickest and most widespread saline reservoir in the Illinois Basin is the Cambrian-age Mt. Simon sandstone. It is overlain by the Eau Claire formation, a regional shale of very low permeability and is underlain by Precambrian igneous rocks that form the "basement." The Mt. Simon is a regionally extensive formation, as document by several wells in central Illinois that indicate the depth and thickness of the Mt. Simon. It is anticipated that greater than 0.3 mile (0.5 kilometer) of Mt. Simon is present at the proposed Tuscola injection site. Drilling at the Weaber-Horn No.1 well, located 56 miles (90.1 kilometers) south of the Tuscola injection site, penetrated over 0.2 mile (0.3 kilometer) of Mt. Simon sandstone before reaching the Precambrian basement (FG Alliance, 2006b). Because of the structure of the Illinois Basin, the Mt. Simon likely thins to the south of the Tuscola sequestration site, indicating that the Mt. Simon at the Tuscola sequestration site is likely thicker than the Mt. Simon encountered at the Weaber-Horn No.1 well.

Depth

The top of the Mt Simon at the proposed Tuscola Sequestration Site is estimated to be between 1.0 and 1.2 miles (1.6 and 1.9 kilometers) below ground surface and the thickness is estimated to be about 0.3 mile (0.5 kilometer). 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, 2006b). The 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 a depth of 0.9 mile (1.4 kilometers) above the Mt. Simon formation.

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 using one CO₂ 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 (FutureGen Site Proposal [Tuscola, Illinois], 2006). Furthermore, reservoir modeling indicates that the proposed injection rate could be met using one injection well, even if permeabilities are an order of magnitude less than those of the gas storage reservoirs, and the thickness of porous sandstone is actually found to be as low as approximately 200 feet (61 meters) instead of the currently estimated 600 feet (182.9 meters) (FG Alliance, 2006b).

Storage Capacity

The storage capacity of a reservoir depends on its porosity, permeability, thickness and lateral extent. The uppermost Mt. Simon sandstone is composed of thin (10 to 20 feet [3.0 to 6.1 meters]) sandstone beds that are interbedded with thin (less than 1 foot [0.3 meters]) shale and siltstone beds. However, parts of the lowermost Mt. Simon have thick-bedded sandstone with some beds being greater than or equal to 100 feet (30.5 meters) in thickness. 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 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 Tuscola sequestration site. The average porosity of the 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, respectively.

At the Manlove anticline (located 33 miles [53.1 kilometers] north of the Tuscola sequestration 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 just the uppermost 200 feet (61 meters) of Mt. Simon sandstone. This is equivalent to approximately 25 million tons (22.7 MMT) of CO₂. The Mt. Simon sandstone likely contains 500 permeable feet (152 permeable meters) to inject and sequester CO₂ below the proposed Tuscola Site. The Tuscola Site would have a much larger volume of reservoir in which to inject CO₂ 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, 33 miles (53.1 kilometers) to the north, shows that the Eau Claire shale has vertical and horizontal permeabilities of less than 0.1 md (FutureGen Site Proposal [Tuscola, Illinois], 2006).

The Weaber-Horn No.1 well, 56 miles (90 kilometers) to the south, penetrates over 500 feet (152.4 meters) of shale overlying the Mt. Simon. It is estimated that the Tuscola injection site has a minimum of 300 to 400 feet (91.4 to 121.9 meters) of shale that would serve as the primary seal (FutureGen Site Proposal [Tuscola, 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 80 miles (129 kilometers) to the north of Tuscola, 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 [Tuscola, 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 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 5.4-2). These formations are located between 0.5 and 0.6 mile (0.8 and 1.0 kilometer) below the ground surface in the project area and are likely between 100 and 200 feet (30.5 and 61.0 meters) thick.

In addition to the primary and secondary seals, there are numerous other fine-grained formations that would act as areas of low permeability, both within the estimated 0.3 mile (0.5 kilometer) of Mt. Simon rocks, and also in the estimated 1 mile (1.6 kilometers) between the top of the Mt. Simon and the ground surface. These seals are capable of retarding CO₂ vertical migration.

Relation of Primary Seal to Active or Transmissive Faults

As previously discussed, the Tuscola Anticline located about 3 to 4 miles (4.8 to 6.4 kilometers) east of the Tuscola Sequestration Site *may contain some faults and fractures, although none have been found or mapped to date*. However, the stable tectonic setting and compressive regional stress regime indicate that any fracture zones or faults that penetrate the seal are most likely to be sealing, and not transmissive (FG Alliance, 2006b). In addition, because Tuscola and the surrounding area are not seismically active and no major earthquakes have affected this area, it is not expected that seismic vibrations would activate existing faults.

Because of its location in relation to the La Salle Anticlinorium and Tuscola Anticline, the Tuscola Sequestration Site likely has some very distinctive tectonic elements, including potential fractures or faults. Vertical 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 injection site ROI, they could promote vertical migration of CO₂. However a recent 2D seismic line indicated no major faulting in the north-south direction at the injection site (Patrick Engineering, 2006).

5.4.2.4 Geologic Sequestration Studies, Characteristics and Risk Assessment

Currently, there are four CO₂ sequestration projects worldwide under detailed study. These are the Rangely, Weyburn, In Salah, and Sleipner projects. They are located in the U.S., 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 (Section 5.17). 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) provides support 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 5.17 and Appendix D.

5.4.3 IMPACTS

5.4.3.1 Construction Impacts

Power Plant Site

The surficial geology of the power plant site includes glacial deposits that are likely 40 to 250 feet (12.2 to 76.2 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 near the proposed plant site 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 5.16.

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

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 1.3 mile (2.1 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.

5.4.3.2 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 Tuscola Sequestration 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 6.5 to 3.3 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, this acidification of the brine solution would not be expected to substantially alter the Mt. Simon formation.

CO₂ emitted from the power plant would include some H₂S. Because of the significant expense required to separate these two elements, it is possible that the Alliance may conduct tests where greater concentrations of H₂S 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 H₂S into the reservoir formation was conducted. It was concluded that, because of the mineralogy of the Eau Claire formation, there was no reaction mechanism that could serve as a major sink to decrease the concentration of injected H₂S. It was also noted that the chemical reactions would be unlikely to significantly change the dynamics of the injection behavior of the CO₂ and H₂S mixture, although H₂S can cause precipitation of minerals that would reduce the porosity of the formation (FG Alliance, 2006b).

Increases in pore pressure associated with the injection of CO₂ can decrease friction on existing faults and may cause the faults to become transmissive or to slip. Injection-induced seismicity at the Tuscola 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 up to 600 feet (183 meters) and it is laterally continuous for hundreds of miles.
- The general compressive tectonic regime of the Tuscola 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 1000 md). Only narrow faults were evaluated because fracture/fault zones larger than 33 feet (10 meters) wide could be detected 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 Tuscola Site indicate that, for permeabilities of 1 md and higher, the amount of CO₂ leakage through the fault is at least 2 percent of the total amount injected, as measured by the CO₂ flux rates, extent of the plume, and CO₂ 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 for the first 60 years would be about 1.1 million tons (1 MMT) of CO₂ or 2 percent of the *total* 55 million tons (50 MMT) *injected*. The maximum plume extent occurred for the higher permeability faults and was 2.5 miles (4 kilometers) at year 100 and was still expanding. 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, 2006b).

The potential for leakage of CO₂ from the sequestration reservoir by means other than faults would also be a potential impact of concern. The injection and backup wells themselves (and any deep monitoring wells in the target formation) would be one of the likely paths for CO₂ migration from the reservoir, as by their nature they perforate all seals present. Unknown wells and improperly plugged wells within the ROI could potentially leak CO₂. The Tuscola Site subsurface ROI is surrounded by operating and abandoned petroleum exploration and production wells, with several hundred within 5 miles (8.0 kilometers) of the proposed injection site, and **between** 100 **and 200** within 2 miles (3.2 kilometers). The primary oil-bearing formations are shallow, but one of these wells reportedly penetrates the New Albany secondary seal above the estimated Tuscola plume footprint. None of the known wells is deep enough to penetrate the primary seal, the Eau Claire. There are a number of wells in the area whose status is not known in the area, and there is a likelihood of improperly plugged oil wells existing within the subsurface ROI (FG Alliance, 2006b). However, as part of the site-specific assessment to be conducted on the selected site, geophysical surveys will be conducted to locate lost wells. If such wells were found to be improperly abandoned, they could be plugged and abandoned consistent with state regulations to prevent leakage. The risk assessment estimates the probability of leakage from such wells (Appendix D).

A search for wells deep enough to penetrate the primary seal (the Eau Claire formation) in an area with a radius of 15 miles (24.1 kilometers) around the proposed plant site was also conducted. Twenty wells were found that penetrated the primary seal; most were located approximately 5 miles (8 kilometers) north of the site and were primarily associated with the Tuscola Gas Storage project,

although a few are exploratory wells. All of the wells that penetrate the Eau Claire formation have been plugged to the surface with the exception of the Lewis Shaw No. 1, which was plugged with drilling fluid and cement to a depth of 165 feet (50.3 meters) and was left open for use as a water well. This well is located less than 1 mile (1.6 kilometers) west of the proposed plant site and was reported to have penetrated 100 feet (30.5 meters) into the Mt. Simon formation (ISGS, 1968).

An earthquake has the potential to affect the injection well. If a fracture was penetrated by the well bore, the injection well's casing could be sheared if movement occurred on that fracture 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 Tuscola was 1.9 miles [3.1 kilometers]). Thus, it is unlikely that the well's casing would be sheared.

There are several sequestration features that indicate that CO₂ would be retained in the proposed injection formation, the Mt. Simon sandstone, including:

- The Mt. Simon formation likely has up to 700 feet (213 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 0.2 mile [0.3 kilometer]) of the Mt. Simon formation that are less permeable should act as barriers to the upward migration of CO₂.
- The predominantly quartz mineralogy of the Mt. Simon formation would cause geochemical reactions to be primarily simple dissolution of the CO₂ in the brine formation water, although the presence of feldspar could cause some geochemical trapping of the CO₂ to occur as well.
- The primary seal, the Eau Claire formation, is a low-permeability shale with an estimated thickness of 500 to 700 feet (152 to 213 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 kilometers]).
- The IEPA has stated that the Tuscola 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 Tuscola Sequestration Site (FG Alliance, 2006b).

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 Tuscola Sequestration 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 Douglas County as an area with a high potential for radon to exceed their recommended upper limit for air concentrations within buildings. Thus, if CO₂ 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 CO₂ should be retained in the sequestration reservoir. If CO₂ were to leak, however, radon transport induced by CO₂ leakage would be highly localized over the point of CO₂ leakage. The risk assessment conducted for this EIS addressed the potential for adverse impacts from radon displacement (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 CO₂, 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 Tuscola Site.

An option for 10 acres (4 hectares) for subsurface and mineral rights has been agreed upon. Complete title searches for subsurface rights at the injection site and surrounding area have not been performed. Searches will be conducted if the site is selected. All necessary mineral rights will be negotiated.

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.

5.4.3.3 Fate and Transport of Injected/Sequestered CO₂

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 will 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).

Numerical modeling indicates that the plume radius from injecting 1.1 million tons (1.0 MMT) of CO_2 per year for 50 years would be 1.1 miles (1.8 kilometers), equal to an area of 2,432 acres (984 hectares). A plan view of the projected extent of the plume is shown in Figure 5.4-1.

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 with up to 600 feet (182.9 meters) of high porosity and permeability sub-layers overlain by up to 600 feet (182.9 meters) of low permeability shale; and over 1.1 miles (1.8 kilometers) 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 was present in the subsurface ROI, CO₂ could migrate along its path. Horizontal open fractures within the Mt. Simon would cause the CO₂ 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 CO₂. In order for the CO₂ to reach shallow potable groundwater or the biosphere, such fractures would need to penetrate and be open through, or connect in networks through, over 6,000 feet (1,829 meters) 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 CO₂. See Section 5.17 for a detailed discussion of CO₂ transport assumptions and potential associated risks.

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5.5 PHYSIOGRAPHY AND SOILS

5.5.1 INTRODUCTION

This section addresses the physiography and soils associated with the Tuscola Power Plant Site, sequestration site, and related corridors.

5.5.1.1 Region of Influence

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

5.5.1.2 Method of Analysis

DOE reviewed reports from the U.S. Department of Agriculture (USDA), information provided in the Tuscola EIV (FG Alliance, 2006b), 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 Tuscola 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 5.11.

5.5.2 AFFECTED ENVIRONMENT

5.5.2.1 Physiography

The proposed Tuscola Power Plant Site and sequestration site are located in Douglas County and lie entirely within the Bloomington Ridged Plain of the Central Lowland physiographic province. Proposed transmission 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.

Douglas 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 occurs in areas along major drainageways, where stream downcutting has caused 50- to 65-foot (15- to 20-meter) drops in elevation from the adjacent uplands (USDA, 2006). The elevation in the county ranges from about 600 feet (183 meters) to about 720 feet (220 meters) above mean sea level with the highest elevation located near the village of Newman

on the West Ridge Moraine. The lowest elevation is where the Embarras River exits the county southwest of Oakland.

The floodplains along the Kaskaskia and Embarras rivers and their tributaries are generally flooded annually, and the soils in these areas often have a high seasonal water table. Because Douglas County has such low relief, ponding occurs on many soils (USDA, 2006).

Most areas are sufficiently drained for commonly grown crops. Subsurface tile drains have been installed in most of the fields, and an extensive system of drainage ditches supplements the natural drainage and windblown deposits of the most recent glacial stage, the Wisconsinan. The central part of Douglas County is surrounded by glacial moraines from different ice advances and retreats. The Arcola Moraine lies to the south and west, and the Pesotum and West Ridge Moraines are to the north. A large part of Douglas County was covered by a glacial lake between these moraines (USDA, 2006).

The presence of a series of end moraines in Douglas County represents successive advances and retreats of the glacial ice front. The end moraines have slopes that are quite variable, commonly ranging from gently sloping to very steep. Ground moraines of the Wisconsinan Stage, which occur between the end moraines, generally consist of broad, nearly level to gently sloping interfluves. The relief on ground moraines is less variable than the relief on end moraines, and the loess deposits are thicker. Catlin and Flanagan soils are found on ground moraines (USDA, 2006).

5.5.2.2 Soils

The following section describes the different predominant soils at the proposed power plant site, sequestration site, and utility and transportation corridors. Descriptions of the soil type characteristics and uses are found in Table 5.5-1.

The soils found within the ROI are agricultural, which is indicative of favorable characteristics for growing vegetation. Seven different soil types occur within the proposed power plant site and five different types on the proposed sequestration site. These soils found on the proposed power plant site are Drummer-Milford silty clay loams, Flanagan silt loam, Elburn silt loam, Harpster silty clay loam, Catlin silt loam, Peotone silty clay loam, and Blackberry silt loam (FG Alliance, 2006b). The five soils found on the proposed sequestration site are Drummer, Milford, Elburn, Blackberry, Harpster, and Brenton. The soils found in the proposed utility corridors are: Drummer-Milford silty clay loams, Flanagan silt loam, Elburn silt loam, Harpster silty clay loam, Catlin silt loam, Peotone silty clay loam, and Blackberry silt loam (FG Alliance, 2006b).

Table 5.5-1. Predominant Soil Types, Characteristics, and Uses in the Proposed Power Plant and Sequestration Sites and Related Corridors

| Soil Type | Characteristics | Uses | |
|------------|---|-----------------------------------|--|
| Blackberry | Moderately well drained soils formed in loess and other silty sediments and the underlying loam materials on till plains, outwash plains and stream terraces. Slopes range from 0 to 5 percent, potential for runoff is low, and permeability is moderate. Surface soil located from 0 to 16 inches (0 to 41 centimeters) deep is very dark grayish brown and dark brown, neutral, silt loam. | Most area is prime farmland. | |
| Brenton | Somewhat poorly drained soils formed in loess or silty sediments and in the underlying loamy stratified outwash on outwash plains and stream terraces. Slopes range from 0 to 5 percent, potential runoff is negligible to medium, and permeability is moderate. | Most areas are used for cropland. | |

Table 5.5-1. Predominant Soil Types, Characteristics, and Uses in the Proposed Power Plant and Sequestration Sites and Related Corridors

| Soil Type | Characteristics | Uses | |
|-----------|---|---|--|
| Catlin | Moderately well drained soils formed in loess or other silty material on till plains. Slopes range from 0 to 15 percent, potential for surface runoff is low to medium, and permeability is moderate. Surface soil located from 0 to 11 inches (0 to 28 centimeters) deep is very dark brown, neutral, silt loam. | Most areas are used for cropland. | |
| 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 for this soil type. | |
| Elburn | Some what poorly drained soils formed in loess over loamy stratified outwash on outwash plains, till plains, and stream terraces. Slopes range from 0 to 5 percent, surface runoff is negligible to low, and permeability is moderate in the loess and moderate to moderately rapid in the outwash. Surface soil located from 0 to 16 inches (0 to 41 centimeters) deep is very dark grayish brown, lightly acid to neutral, silt loam. | Most areas are cultivated. | |
| 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. Surface soil located from 0 to 18 inches (0 to 46 centimeters) deep is characterized by very dark gray, very dark brown, and very dark grayish brown, slightly acidic, silt loam. | Most areas are used for cultivated crops. | |
| Harpster | Poorly drained soils formed in silty material derived from calcareous loess or glacial drift on nearly level or depressional outwash plains, till plains, or stream terraces. Slopes range from 0 to 2 percent, potential for surface runoff is negligible, and permeability is moderate surface soil located 0 to 18 inches (0 to 46 centimeters) deep is characterized by black and very dark gray, moderately alkaline, silty clay loam. | Most areas are used for cropland. | |
| Milford | Poorly and very poorly drained soils formed in lacustrine sediments on glacial lake plains. Slopes range from 0 to 2 percent, the potential for runoff is negligible to low, and permeability is moderately slow. | Most areas are used for cultivated crops. | |
| Peotone | Very poorly drained soils formed in colluvial sediments in depressions on till plains. Slopes are less than 2 percent, potential for surface runoff is negligible, and permeability is moderately slow. Surface soil located from 0 to 13 inches (0 to 33 centimeters) deep is black, neutral, silty clay loam. | Areas are used for cropland when drained and idle when undrained. | |

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

5.5.3 IMPACTS

5.5.3.1 Construction Impacts

Direct impacts that could be caused during construction of the proposed power plant 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. BMPs would be used to minimize impacts (see Section 3.1.5).

Generally moderately permeable soils coupled with a water table ranging from 10 to 20 feet (3 to 6 meters) makes the chances of groundwater contamination due to spills low.

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 5.11.

Sequestration Site

The construction of the injection wells at the proposed sequestration site would result in the removal of up to 10 acres (4 hectares) of soil. Direct impacts would include the removal of soil, soil-blowing, and compaction. Indirect impacts would include some soil erosion due to runoff and wind. After completion of drilling, soil would be replaced using BMPs as discussed in Section 3.1.5 or would be disposed of off site. Removing and replacing these soils would likely result in changes to soil composition and characteristics, such as infiltration rate, within the proposed 10-acre (4-hectare) footprint. The impacts expected at the proposed sequestration site would be similar to those on the proposed power plant site, but at a much smaller scale (duration and magnitude).

Utility Corridors

The direct and indirect impacts to soil from the construction of the proposed utility corridors would be similar to those described for the proposed power plant site, though at a lesser duration and magnitude. The aerial extent of direct and indirect impacts due to the construction of towers for the proposed transmission line corridors would depend on the number of towers built. Regardless, the overall

permanent impacts would occur only at the actual footprint of the tower where a relatively small amount of soil would have to be removed and compacted to set the structure.

The proposed transmission line would be up to approximately 17 miles (27.4 kilometers) long with all but up to 3 miles (5 kilometers) on existing ROW. The amount of soil disrupted would depend on the interval of the towers to be constructed. The proposed process water pipeline would be approximately 1.5 miles (2.4 kilometers) long and it is estimated that a disturbance width of 20 feet (6 meters) would be required (FG Alliance, 2006b). This would require the removal of up to 3.6 acres (1.5 hectares) of soil during construction. The proposed wastewater line would be 0.9 mile (1.4 kilometers) long and 20 feet (6 meters) wide that would impact up to 2.1 acres (0.8 hectare) of soil. This pipeline would most likely be constructed adjacent to the water supply line; therefore, no additional impacts to the soils would occur above the estimate for the water supply pipeline. Construction of the proposed CO₂ pipeline would cause direct impacts to 26.7 acres (10.8 hectares) of soil due to soil removal or compaction. Indirect impacts include soil erosion due to runoff and wind, a decline in nearby surface water quality due to increased sedimentation, contamination due to spills, and a decrease in biodiversity due to changing soil characteristics. Impacts would be temporary (during construction) and areas would be restored after construction. Up to 32.4 acres (13.1 hectares) of disturbed land could be susceptible to removal, erosion, or compaction of soils due construction of utility corridors.

Impacts to soil from construction of the proposed utility corridors are expected to be small in terms of area and magnitude, because the soil removed could be stored and used later to grade other areas such as temporary access roads.

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. If road upgrades are needed, impacts would be minimal due to the current road system in place in the area of the proposed site. The rail loop track and main track connections for the rail would require 1.1 miles (1.7 kilometers) of 50-foot (15-meter) wide track construction (approximately 6.7 acres [2.7 hectares]). Construction of temporary access roads would result in soil compaction. These areas could be returned to near pre-existing conditions after construction is complete or, if needed, these roads would remain in use during operations.

5.5.3.2 Operational Impacts

Direct impacts that could occur from operations include soil contamination due to leaks and spills, increased CO₂ concentration in soils due to CO₂ pipeline failures, and soil erosion due to wind and movement of machinery. Indirect impacts include disruption of plant growth and subsurface organisms, and groundwater contamination. It is expected that the impacts during operations would remain at a minimum due to the limited extent and current vegetative status of the site. Generally moderately permeable soils coupled with a water table ranging from 10 to 20 feet (3 to 6 meters) below ground surface greatly lowers the potential for groundwater contamination due to spills. It is anticipated that any spills could be identified and addressed before reaching groundwater sources. The BMPs that would be put in place during operation, such as revegetation, could also improve the state of the soil in those areas that are not directly impacted by construction.

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 as risk abatement and safety procedures would be in place. Though it is highly unlikely, because of the high volatility of CO₂ at atmospheric pressure, an increase of CO₂ 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] underground; see Section 5.9). 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 CO₂ injection at the proposed Tuscola Site would be at great depth and into very well consolidated rocks, the risks of any 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 Tuscola 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 minimal indirect and direct impact to the soil due to transportation corridor use and maintenance. Impacts could include soil contamination due to spills, soil-blowing, soil compaction, and soil removal.

5.6 GROUNDWATER

5.6.1 INTRODUCTION

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

5.6.1.1 Region of Influence

The ROI for groundwater resources includes aquifers that underlie the proposed power plant site, 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.
- During drought conditions, a limited quantity of groundwater could be used to supplement the power plant's water supply. The distance affected by pumping would depend on specific aquifer properties of the formations being used and well design. Because a specific aquifer has not been identified, the distance affected by pumping for the plant has not yet been determined.
- A distance of 1.1 miles (1.7 kilometers) from each sequestration injection well defines the area that could be affected by potential leaks of CO₂ from the target reservoir to overlying aquifers. This distance is based on modeling that indicates that CO₂ could migrate up to 1.1 miles (1.7 kilometers) from the site of each injection well.
- 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.

5.6.1.2 Method of Analysis

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

Uncertainties identified in relation to groundwater resources at the Tuscola 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 an underground source of drinking water (USDW) through acidification of the aquifer due to migration of CO₂; toxic metal dissolution and mobilization; displacement of groundwater with brine due to CO₂ 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.

5.6.2 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.

5.6.2.1 Groundwater Quality and Uses

Groundwater resources in the project area are available in limited quantities from the sand and gravel deposits that are contained in the unconsolidated glacial material above the bedrock surface and from some shallow bedrock aquifers. An existing surface reservoir located at the Lyondell-Equistar Chemicals facility would provide the plant's process water. The Kaskaskia River is the primary source of water for this reservoir, but the reservoir is supplemented by groundwater from the Mahomet aquifer, from wells located near Bondville, Illinois, during low-flow conditions.

Private well logs obtained from the Illinois State Water Service's (ISWS) online well database show that the sand and gravel deposits in the vicinity of the proposed power plant site range in depth from approximately 70 to 100 feet (21 to 31 meters) below the ground surface. These sand and gravel deposits are sufficient groundwater resources for domestic and agricultural uses with an average withdrawal rate of up to approximately 10 gallons (38 liters) per minute. Data from a well located just over 1 mile (1.6 kilometers) from the proposed power plant site show the water table to be about 10 to 20 feet (3 to 6 meters) below the ground surface (FG Alliance, 2006b). No sole source aquifers have been designated in the vicinity of the proposed project area (EPA, 2006).

Eight wells were identified within approximately 1 mile (1.6 kilometers) of the proposed power plant site. These are all private wells that were identified by the ISGS and all are classified as domestic- and agricultural-use wells. *However, other USDWs may exist at the Tuscola power plant and sequestration sites*.

Several private and commercial/industrial wells receive groundwater from the shallow Pennsylvanian and Mississippian bedrock. These units consist primarily of thin, interbedded sandstones and limestones, which provide up to approximately 10 gallons (38 liters) per minute (FG Alliance, 2006b). Below depths of several hundred feet, the groundwater is brine and is not suitable for most applications.

ISWS personnel estimated that recharge capacity in the vicinity of the proposed power plant site is likely equal to or less than 1 inch (2.5 centimeters) per year, and that wells installed in the sand and gravel units have specific capacities ranging from 1 to 2 gallons per day per foot (12.4 to 24.8 liters per day per meter) of drawdown, equating to estimated transmissivity values of 1,440 to 2,880 gallons per day per foot (17,884 to 35,768 liters per day per meter). Transmissivity is low because water is found in thin sand and gravel

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

layers (averaging 10 to 20 feet [3.0 to 6.1 meters] thick) within unconsolidated glacial till. The specific capacities of wells installed in the bedrock ranged from 1 to 6 gallons per minute per foot, giving transmissivity values of 1,915 to 11,490 gallons per day per foot (23,783 to 164,668 liters per day per meter) (FG Alliance, 2006b).

No water quality data were available for the shallow aquifer, although since it is used for domestic/agricultural and commercial purposes, the aquifer's quality is likely fair to good at a minimum.

In addition, no data were discovered that indicated the potential for existing contamination at the proposed power plant site (FG Alliance, 2006b).

No data were available on the annual amount withdrawn from either the sand and gravel or bedrock aquifers in the vicinity of the proposed power plant site. A report published by Southern Illinois University at Carbondale provides current and projected annual total water usage for Douglas County, Illinois. The report shows that, in 2000, Douglas County used a total of 0.47 million gallons (1.78 million liters) per day, with a projected water usage of 2.04 million gallons (7.72 million liters) per day in 2025 (FG Alliance, 2006b).

Tuscola receives its public water solely from the Champaign Division of Illinois-American Water Company (IAWC). The source of supply for the Champaign County District is groundwater, primarily from wells screened in the Mahomet aquifer in the Champaign area about 20 miles (32 kilometers) north of Tuscola. This aquifer is present under much of central Illinois and is the major groundwater resource for east-central Illinois. The aquifer underlies 1.26 million acres (509,903 hectares), of land and spans 15 counties. The Mahomet aquifer ranges from 4 to 15 miles (6.8 to 30.5 kilometers) wide and 50 to 200 feet (15.2 to 61.0 meters) thick, although the average thickness is 100 feet (30.5 meters). The aquifer is confined over much of its extent. Over its entire area, the aquifer is thought to have many millions of gallons per day of additional capacity, but local depletion is a concern in the Champaign area, as water levels have dropped over the past several decades.

Twenty-one wells deliver potable water to two municipal water treatment plants located about 20 miles (32 kilometers) north of Tuscola: the East Plant located in Urbana, and the West Plant located in Champaign. The wells are primarily located in two areas. The north wellfield taps the Glasford aquifer and consists of eight wells that supply the East Plant. The west wellfield consists of 13 wells that draw from the Mahomet aquifer and supply water to both the East and West Plants. The wells range from 150 to 366 feet (45.7 to 111.6 meters) in depth (City of Tuscola, 2003).

As proposed, the FutureGen plant would draw about 4.3 million gallons (16.3 million liters) per day of process water from an existing 80-acre (32-hectare), 150-million-gallon (568-million-liter) raw water holding pond located 1.5 miles (2.4 kilometers) west of the site at the Lyondell-Equistar Chemical Company. Lyondell-Equistar Chemicals currently draws its raw water supply from an existing intake structure along the Kaskaskia River, and supplements its water supply during low-flow conditions by pumping water from wells near Bondville, Illinois, which are screened in the Mahomet aquifer. This supplemental water is conveyed to the intake structure at Lyondell-Equistar Chemicals via the Kaskaskia River.

Total water usage from the Mahomet aquifer in the Champaign area is reported to be 30 million gallons (113.6 million liters) per day and the additional capacity of the area is estimated by the ISWS to be 16 to 17 million gallons (60.6 to 64.4 million liters) per day (The News Gazette, 2006).

The target formation for CO₂ sequestration is the Mt. Simon formation. In northern Illinois (within about 80 miles [129 kilometers] of the Wisconsin border, and about 200 miles [322 kilometers] north of Tuscola), 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 Tuscola, 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, 2006) of an USDW, which includes any aquifer or part of an aquifer that:

• Supplies any public water system;

- *Contains* 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.

5.6.3 IMPACTS

5.6.3.1 Construction Impacts

Power Plant Site

Construction activities would not be expected to disturb the groundwater resources beneath the plant or other facilities. 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 20 feet [3 to 6 meters]). Section 5.5 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

The above discussion for the power plant site also applies to the sequestration site, located 11 miles (18 kilometers) south of the 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 1.2 and 1.5 miles (1.9 and 2.4 kilometers) to reach the target injection formation, the Mt. Simon formation. Injection well drilling would use a series of conductor casings to protect shallow groundwater.

Utility and Transportation Corridors

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

5.6.3.2 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 5.5 provides further detail regarding soil properties, including permeability.

At the proposed power plant site, groundwater would only be used as a source for process water during drought conditions, when the intake from the surface reservoir would be supplemented with groundwater from the Mahomet aquifer. Total water usage from the Mahomet aquifer in the Champaign area is reported to be 30 million gallons (113.6 million liters) per day and the additional capacity is estimated by the ISWS to be 16 to 17 million gallons (60.6 to 64.4 million liters) per day. The FutureGen Project's estimated needs of almost 4.3 million gallons (16.3 million liters) per day would account for about 26 percent of this capacity if all of the plant's water were obtained from the Mahomet aquifer. Only in severe drought conditions would the Mahomet aquifer supply 100 percent of the necessary process water. Therefore, operations would have a minor impact on groundwater levels and 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:

- CO₂ exceeds capillary pressure and passes through the caprock;
- CO₂ leaks into the upper aguifer via a transmissive fault;
- CO₂ escapes through a fracture or more permeable zone in the caprock into a shallower aquifer;
- Injected CO₂ migrates up dip, and increases reservoir pressure and permeability of an existing fault; or
- CO₂ escapes via improperly abandoned or unknown wells.

 CO_2 would be injected into the Mt. Simon formation at a depth of 1.2 to 1.5 miles (1.9 to 2.4 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 CO₂ 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 0.9 mile (1.4 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 0.9 mile (1.4 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, then dissipate 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 30 miles [48 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 0.9 mile (1.4 kilometers) of various types of rock to allow CO₂ 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 strongly suggests a lack of major north-south trending vertical faults at the proposed Tuscola 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 1.1 miles (1.8 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 Clare 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 formation 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, CO₂ 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 CO₂ would dissolve (IPCC, 2005). Once CO₂ 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 Tuscola 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 the 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 Tuscola 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 CO₂ 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.

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5.7 SURFACE WATER

5.7.1 INTRODUCTION

Surface water is an important resource in Illinois from which communities receive much of their drinking water. Ready access to an abundant supply for water is an important consideration in siting power plants, as 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.

5.7.1.1 Region of Influence

The ROI consists of the proposed power plant site, 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.

The ROI for the greatest potential for impacts to surface water resources is limited in most cases to the proposed power plant and sequestration site and related utility corridors. Because of the types of land disturbing activities that would occur during construction of the proposed power plant, this area would be susceptible to erosion and changes in surface water flow patterns. This is also an area that could be affected by spills associated with construction or operations.

The ROI for surface water extends beyond the power plant property. Construction and operation activities would impact a larger area in cases where flow patterns were modified or contamination was carried downstream by surface water drainages.

5.7.1.2 Method of Analysis

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

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

- Alter stormwater discharges, which could 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 impacted; or
- Conflict with applicable flood management plans or ordinances.

DOE reviewed reports from USGS, U.S. EPA, and IEPA, and reviewed information provided in the Tuscola EIV (FG Alliance, 2006b) to assess the potential impacts of the proposed FutureGen Project on surface water resources. Surface water data analysis was limited to locations that had 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.

5.7.2 AFFECTED ENVIRONMENT

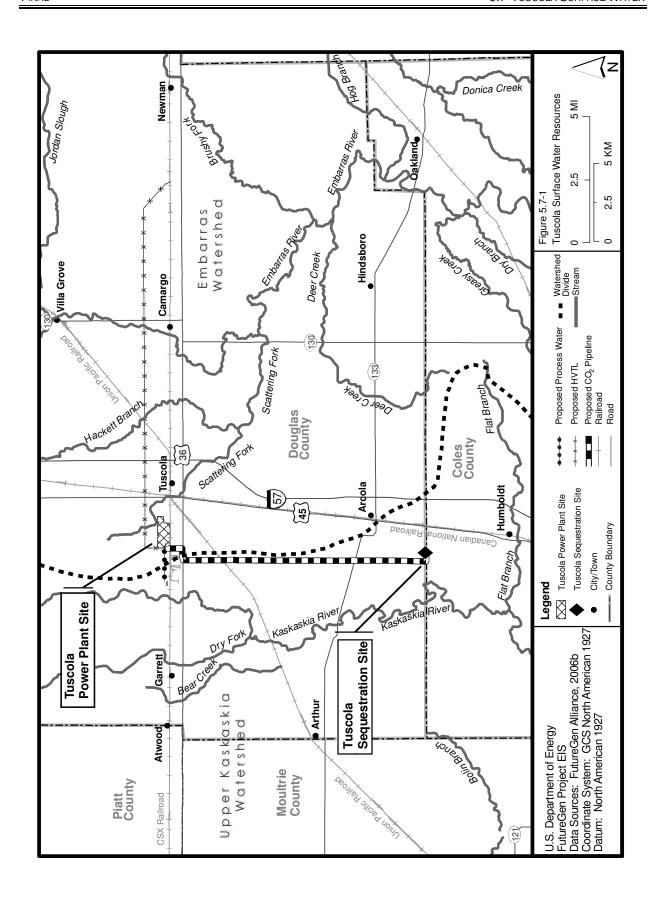
The proposed plant site consists of 345 acres (140 hectares) located 1.5 miles (2.4 kilometers) west of Tuscola, Illinois. Figure 5.7-1 shows the proposed power plant site, sequestration site, proposed utility corridors, and surface water resources in the area. The nearest water body to the proposed power plant site is Scattering Fork Creek, located approximately 0.6 mile (1 kilometer) to the east of the site. Scattering Fork Creek flows eastward into the Embarras River watershed. To the west of the site is the Upper Kaskaskia River watershed and the Kaskaskia River is located about 2 miles (3.2 kilometers) west of the proposed site.

Tuscola receives 40 inches (102 centimeters) of precipitation annually and local storms have been known to produce flash floods and torrential rainfall, resulting in decreased infiltration and increased surface water runoff (ISWS, 2002 and NOAA, 2005).

As noted in Section 5.5, there are seven different soil types on the proposed power plant site. These soils are Drummer-Milford silty clay loams, Flanagan silt loam, Elburn silt loam, Harpster silty clay loam, Catlin silt loam, Peotone silty clay loam, and Blackberry silt loam (ISWS, 2004). In general, these soils are poorly drained to moderately wet, having the affinity to retain moisture. Soils are discussed in further detail in Section 5.5, but are mentioned briefly here to facilitate the discussion of surface water impacts (e.g., erosion).

Power Plant Site

The proposed power plant site lies within the Embarras River watershed, east of the Embarras/Kaskaskia River watershed divide (Figure 5.7-1). This boundary also serves as the watershed divide between the Upper Mississippi and Ohio River basins. Surface runoff from the proposed power plant site drains to the Embarras River via overland flow, roadside ditches, and Scattering Fork Creek. The majority of the surface water runoff from the proposed power plant site, including the proposed electricity corridor, ultimately drains to the Embarras River, with the exception of the proposed process water line corridor and proposed injection line corridor, which drains to the Kaskaskia River.



Sequestration Site

The proposed sequestration site lies in the Upper Kaskaskia watershed. Figure 5.7-1 details the watershed boundaries and sequestration sites.

Utility Corridors

The proposed 345-kV transmission would be located near three surface water bodies: the Hayes and Hackett Branches of the Embarras River, and the Embarras River itself. The Hayes Branch supports aquatic life, whereas the Hackett Branch is listed as impaired for total phosphorus and dissolved oxygen, attributed to municipal point sources, urban runoff/storm sewers, and non-irrigated crop production (IEPA, 2006). There are no lakes, ponds, or surface reservoirs along the proposed corridor.

The proposed CO₂ pipeline would be located within the Kaskaskia River watershed, with a small length of the line south of the site within the Embarras River watershed. Surface water resources located near the proposed transmission line include the Tuscola No. 4 drainage ditch and one unnamed tributary, drainage ditch No. 5 drainage, Scattering Fork Creek, and three unnamed tributaries to the Kaskaskia River. There are no lakes, ponds, or surface reservoirs along the proposed corridor.

The proposed process water supply line would be located within the Kaskaskia River watershed, with an additional one-third located within the Embarras River watershed. Surface water resources located near the proposed process water supply line are existing 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.

5.7.2.1 Surface Water Quality

There are limited water quality and quantity monitoring data for surface waters within the ROI of the site because many of the surface waters have intermittent flows. Surface water quality and quantity data were not collected on the roadside ditches and unnamed tributaries within the ROI. Scattering Fork Creek, the nearest surface water to the proposed plant site, has been assessed by the IEPA and has been determined to meet its designated use (e.g., not impaired) to be impaired due to stream alterations and nutrients (IEPA, 2006). Other surface waters near the proposed Tuscola site that are on the IEPA's list of impaired waters are presented in Table 5.7-1 (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 5.7-1 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 5. The water quality standard is not attained.

| Segment | Assessment | Cat. | Segment Length (miles | Designated | Cause(s) of | Source(s) of |
|--------------------------|------------|------|--------------------------|---|--|---|
| Name | Unit ID | | [kilometers]) | Use | Impairment | Impairment |
| Scattering Fork Creek | IL_BER-01 | 5 | 13.4 (21.5) | Aquatic Life, Fish Consumption, Primary and Secondary Contact, Aesthetic Quality | Alteration in stream-side or littoral vegetative covers, Nitrogen (total), Phosphorous (total) | Animal Feeding Operations (nonpoint source), Channelization, Crop Production |
| Kaskaskia River | IL_O-08 | 5 | 23.0 (37.0) | Aquatic Life, Fish Consumption, Primary and Secondary Contact, Aesthetic Quality | Fecal coliform | Source Unknown |
| | IL_O-10 | 2 | 8.7 (13.9) | | n/a | n/a |
| | IL_O-32 | 2 | 6.6 (10.6) | | n/a | n/a |

Table 5.7-1. Water Resources Near the Proposed Power Plant Site Listed on State of Illinois 2006 303(d) List¹

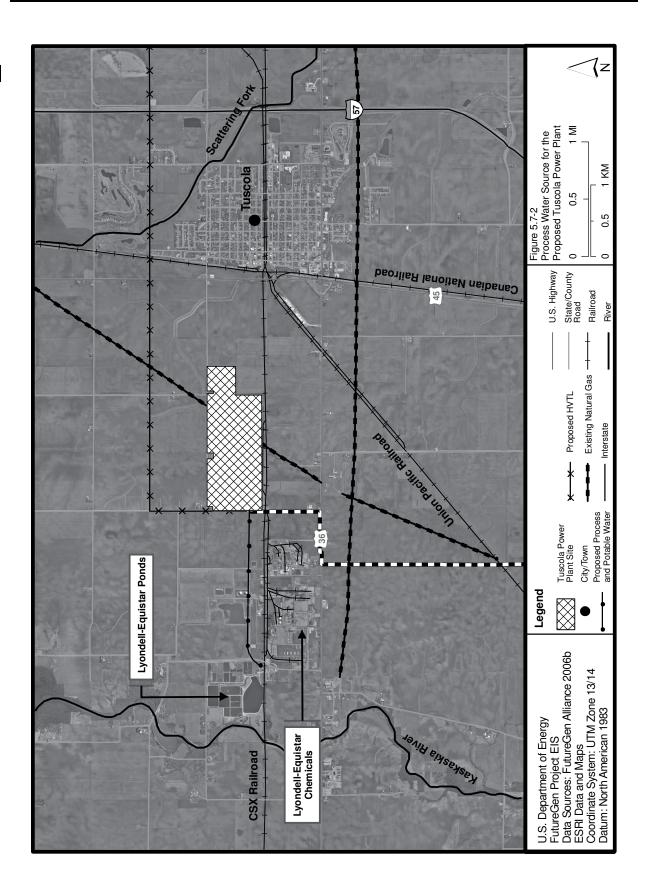
Source: IEPA, 2006.

5.7.2.2 Process Water Supply and Quality

The proposed power plant would require 3,000 gallons per minute (11,356 liters per minute) or 4.3 million gallons per day (MGD) (16.4 million liters per day [MLD]). The proposed site would draw about 4.3 MGD (16.4 MLD) of process water from an existing 80-acre (32.4-hectare), 150-million-gallon (567.8-million-liter) raw water holding pond located 1.5 miles (2.4 kilometers) west of the proposed site at the Lyondell-Equistar Chemical Company (see Figure 5.7-2). Lyondell-Equistar is proposing to provide the process water for the proposed plant site from their on-site wastewater facilities and reservoir. All surface water runoff from the Lyondell-Equistar plant is collected and routed to Lyondell-Equistar's main fresh water reservoir. The raw water supply for this reservoir is from an existing intake structure along the Kaskaskia River.

Lyondell-Equistar Chemical currently draws its raw water supply from an existing intake structure along the Kaskaskia River, and supplements its water supply during low-flow conditions by pumping water from the Mahomet aquifer wells near Bondville, Illinois. This supplemental water is conveyed to the intake structure at Lyondell-Equistar Chemical via the Kaskaskia River. The primary purpose of supplemental pumping at Bondville is based on Lyondell-Equistar's existing NPDES permit. Under the current permit, Lyondell-Equistar can only discharge their treated effluent at a rate of 1 to 5. They currently discharge at a rate of approximately 1 million gallons (3.8 million liters) a day, thus the river must be flowing at a minimum of 5 million gallons (19 million liters) a day. Lyondell-Equistar is considering the option of becoming a zero discharge facility; with this option the need to supplement the river to meet a discharge requirement (by permit) would be eliminated. The main advantages of this change would be a reduced consumption of raw river water by the Equistar plant, and increased availability of water within its current holding ponds. This would increase the available process water for the proposed FutureGen Power Plant by up to 2 MGD (7.5 MLD). There would still potentially be a need to extract from the Mahomet aquifer if the zero discharge option is exercised; however, it would be as a result of water needed for the industrial processes, not at part of a discharge requirement. Also, a zero

¹ Portions of the Kaskaskia River are not impaired. All other water resource segments exhibit some level of impairment. n/a = not applicable.



discharge concept at Lyondell-Equistar would equate into a total reservoir capacity of approximately 290 million gallons (1.1 billion liters). This would be obtained by using the treatment lagoons as additional reservoir capacity.

Water quality data are available downstream of the site at a current USGS gage station at Cooks Mills, Illinois (USGS, 2006). These data include data collected from the USGS National Water Information System Web Interface, and data collected from U.S. EPA's STORET Web Interface. Zinc levels in the holding ponds at the Lyondell-Equistar Plant measure 0.013 milligrams per liter (Behl, 2006). Table 5.7-2 summarizes water quality data available for the proposed process water sources.

| Table 5.7-2. | Water | Quality | y Data | Summary |
|--------------|-------|---------|--------|---------|
|--------------|-------|---------|--------|---------|

| Constituent | Formula | Units | Design Value | SD SW (E1), I Disc | champaign Effluent NPDES harge 11901 2004 | Lyondell- Equistar Chemical Plant | Kaskaskia River at Cooks Mills, USGS Gage 05591200 ¹ |
|--------------|------------------|-------|-----------------|--------------------------|--|--|---|
| Calcium | Ca | mg/L | 75 | 31 | - | ND | 70 |
| Magnesium | Mg | mg/L | 16 | 16 | - | ND | 31 |
| Potassium | K | mg/L | 3 | 9.5 | - | ND | 2 |
| Sodium | Na | mg/L | 20 | 67 | - | ND | 22 |
| Bicarbonates | HCO₃ | mg/L | 240 | 0.002 | - | ND | 238 |
| Chlorides | CI | mg/L | 25 | - | - | ND | 34 |
| Silica | SiO ₂ | mg/L | 4 | - | - | ND | - |
| Sulfates | SO ₄ | mg/L | 58 | - | - | ND | 52 |
| Nitrate | NO ₃ | mg/L | 7 | - | - | ND | - |
| TDS | TDS | mg/L | 460 | - | - | ND | 211 |
| TOC | TOC | mg/L | 3 | | - | ND | 5 |
| Temperature | - | ۴ | 60 | 21.0 | 21.5 | ND | 57 |
| рН | рН | - | 8.0 | 7.5 | 8.0 | ND | 7.4 |

 $^{^1}$ Values shown are averages for period of record; Period of Record 01-01-1990 to 09-30-2006. mg/L = milligrams per liter; $^{\circ}$ F = degrees Fahrenheit; ND = no data.

Source: IEPA, 1997, 2004; USGS, 2006.

Average and Low-Flow Water Volume

Table 5.7-3 lists 2003-2005 flow data for the Kaskaskia River near the intake for the 150-million-gallon (567.8-million-liter) holding pond. The data include river flow at the intake and return/consumption discharge rates by Equistar Chemical (Behl, 2006). On average, 1.3 to 1.7 MGD (5.1 to 6.6 MLD) of process water is available from the Lyondell-Equistar Chemical plant.

During normal river flows, water is pumped into the holding pond from the Kaskaskia River on a regular basis. Equistar Chemical currently does not typically pump water into the 150-million-gallon (567.8-million-liter) holding pond during low-flow periods. Its typical practice is to draw water from the holding pond, then pump from the river once flow has increased. Equistar Chemical can currently use water from the holding pond without pumping from the river for approximately 30 to 45 days. When needed, the plant would supplement its flows by pumping from the Mahomet aquifer.

Table 5.7-3. Discharge Data at Equistar Chemical Intake

| | 2003 MGD | 2004 MGD | 2005 MGD | | | |
|------------------|------------------|-------------|-------------|--|--|--|
| River Flow | River Flow | | | | | |
| Maximum | 345 | 477 | 487 | | | |
| Minimum | 4.0 | 5.0 | 3.0 | | | |
| Average | 19 | 36.59 | 8.85 | | | |
| Return Discharge | Return Discharge | | | | | |
| Maximum | 5.81 | 5.62 | 8.54 | | | |
| Minimum | 0.39 | 0.44 | 0.3 | | | |
| Average | 1.56 | 1.73 | 1.34 | | | |
| Consumption Rate | | | | | | |
| Maximum | 3.0 | 3.01 | 2.6 | | | |
| Minimum | 1.83 | 1.69 | 1.71 | | | |
| Average | 2.19 | 2.01 | 1.96 | | | |

MGD = million gallons per day.

Source: Behl, 2006.

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, such as the 7Q10 flow, as acceptable methods. The 7Q10 is the lowest 7-day average flow that occurs (on average) once every 10 years. From 7Q10 low-flow maps provided by the ISWS, the Kaskaskia River has a 7Q10 low-flow of 3.3 MGD (12.5 MLD) near the existing intake for Equistar Chemical (Figure 5.7-2). Flows in the Kaskaskia River are sustained by wastewater effluents from the Urbana-Champaign Sanitary District treatment plant (SDTP), located approximately 23 miles (37 kilometers) upstream along Copper Slough, a tributary to the Kaskaskia River.

Due to increased development in the area, the SDTP has been expanded in the last year to accommodate increased wastewater flows. The current average daily discharge from the Urbana-Champaign SDTP is approximately 6 MGD (22.7 MLD), with an available maximum daily treatment capacity of over 27 MGD (102.2 MLD) (FG Alliance, 2006b). The Kaskaskia River flow is also supplemented by wastewater effluent flows from the villages of Tolono and Sadorus. Based on conversation with the City of Tolono, their current average daily effluent discharge is 0.17 MGD (0.64 MLD), with a design capacity of 0.59 MGD (2.2 MLD) (FG Alliance, 2006b).

5.7.3 IMPACTS

5.7.3.1 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 the NPDES Permit. Proposed grades in paved areas and for building first floor elevations would be 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 Site

Scattering Fork Creek is the nearest water body to the proposed power plant, approximately 0.6 mile (1 kilometer) east of the site and drains east to the Embarras watershed. Once constructed, increases in impervious surfaces would decrease the available surface area to allow infiltration from precipitation. Presently, 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 reduce the impacts to downstream surface water resources.

Sequestration Site

The proposed sequestration site is an 80-acre (32.4-hectare) site. Up to 10 acres (4 hectares) of the site would be required for placement of the injection wells. The proposed sequestration site is approximately 11 miles (17.7 kilometers) directly south of the proposed plant site (see Figure 5.7-1). The area above the site is rural, consisting primarily of agricultural land with row crops. The radius is expected to be 1.1 miles (1.8 kilometers) from the injection point. The area of the sequestration plume is estimated to be 2,432 acres (985 hectares).

The sequestration site does not have any lakes, ponds or surface reservoirs within the ROI. An existing unnamed tributary to the Kaskaskia River runs west through the site directly to the Kaskaskia River. The nearest major water body is the Kaskaskia River estimated at 1.4 miles (2.3 kilometers). Surface runoff from the site is conveyed to the Kaskaskia River via overland flow and the existing

unnamed tributary. No surface water quality data are available for the sequestration site, and there are no other current surface water uses for the unnamed tributary. It is expected that no process and potable water would be needed for the site. No effects upon surface water resources would be anticipated from construction of the injection area.

Utility Corridors

The construction of new utility lines would potentially create temporary impacts to surface waters. The probability of these impacts to occur would increase the closer construction activities are located to surface water resources. The maximum extent of impacts would occur when the utilities cross one of these surface water resources. Temporary impacts to surface waters for utility line crossings using trenching methods would include stream diversion/piping flows around the crossing, increased turbidity and sedimentation during construction, streambed disturbance, and removal of streambank vegetation. Directional drilling of utility lines would avoid these impacts. Construction conducted near surface water resources could indirectly create sedimentation from runoff and turbidity of waters. BMPs required through Section 404 permitting would be implemented both during and after construction. The BMPs would reduce temporary impacts by controlling sedimentation and turbidity, restoring stream crossings to their original grade, and to stabilize streambanks post-construction. Potential surface water resources which may be affected by these activities are further discussed below.

The proposed site would include a 500-foot-wide (150-meter-wide) corridor to co-locate utilities, in an effort to reduce environmental impacts. This width has been determined to be of adequate size for the ensuing discussion. Utilities would be buried whenever possible.

The construction of new pipelines along the utility corridors would require hydrostatic testing of the lines to certify the material integrity 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 would 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 Lyondell-Equistar. Both of these sources have sufficient capacity to enable this test. The amount of water required to complete these tests on all newly constructed pipelines is unknown until preliminary designs for the proposed power plant, including the sequestration site, 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.

Process Water Supply Line

The proposed process water supply line would run east approximately 1.5 miles (2.4 kilometers) to the proposed site from an existing 150-million-gallon (567.8-million-liter) surface water storage facility operated by Lyondell-Equistar. The existing surface water facility is located to the west of the site along the Kaskaskia River. Lyondell-Equistar currently receives water from an intake structure located along the river, west of the storage facility. All surface runoff from Lyondell-Equistar is routed to the storage facility. Surface runoff within the Kaskaskia River watershed drains to the river via overland flow, existing roadside ditches, and via Lyondell-Equistar's surface runoff conveyance system. Surface runoff within the Embarras River watershed drains via overland flow, existing roadside ditches, and the Scattering Fork Creek to the Embarras River. The Kaskaskia River, the 150 million-gallon (567.8 million-liter) surface water facility (from which the actual supply water would be drawn), and several wastewater and settling ponds are within the ROI of the proposed water supply line.

Approximately two-thirds of the proposed process water supply line corridor lies within the Kaskaskia River watershed; the remaining line, approximately one-third, lies within the Embarras River watershed. The proposed process water supply line, in general, would follow the existing roadway, which does not cross any surface reservoirs, lakes or ponds. Efforts to reduce or avoid impacts to surface water bodies would be evaluated during the engineering and design phase. Mitigating actions may include directional drilling where appropriate.

Power Transmission Corridor

The proposed 345-kilovolt (kV) transmission line would run north, then east of the site along an existing transmission line corridor, where it would connect with another existing transmission line east of Murdock, Illinois. The line would total approximately 17 miles (27.4 kilometers), of which 14 miles (22.5 kilometers) are existing corridors. The proposed transmission line would cross three surface water bodies: the Hayes and Hackett Branches of the Embarras River, and the Embarras River itself. The Hayes Branch supports aquatic life, whereas the Hackett Branch is listed as impaired for total phosphorous and dissolved oxygen, attributed to municipal point sources, urban runoff/storm sewers, and nonirrigated crop production (IEPA, 2006). There are no lakes, ponds, or surface reservoirs along the proposed corridor.

An option to establish adequate power to the proposed site would include the construction of a new interconnection facility (substation) approximately 0.5 mile (0.8 kilometer) north of the proposed power plant site (FG Alliance, 2006b).

CO₂ Pipeline

The proposed CO₂ pipeline would run south from the proposed site to the proposed sequestration reservoir southwest of Arcola, Illinois. The majority of the transmission line would be located within the Kaskaskia River watershed, with a small length of the line south of the site within the Embarras River watershed. Surface runoff along the proposed corridor within the Embarras River watershed drains to the river via roadside ditches, the Tuscola No. 4 and No. 5 drainage ditches, and the Scattering Fork Creek. The proposed CO₂ pipeline would cross *five* surface water bodies: *one wetland (pond)*, one unnamed tributary to the Tuscola No. 4 drainage ditch, and three unnamed tributaries to the Kaskaskia River. There are no lakes, ponds, or surface reservoirs along the proposed corridor.

Transportation Corridors

No new transportation corridors are proposed; however, 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.

5.7.3.2 Operational Impacts

Potential operational impacts would largely consist of surface water runoff from the proposed power plant site and potential spills (i.e., fuel, chemicals, grease, etc.). Mitigation of runoff, recycling of materials, and pollution prevention measures would reduce or eliminate the potential for operational impacts to surface water. 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 potential adverse operational impacts to surface waters.

Stormwater runoff from the proposed power plant 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 Site

The State of Illinois operates under a common law water rights system. There are no allocated water rights associated for 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 Lyondell via a newly constructed water line along a corridor from the pump station at Lyondell's 150-million-gallon (567.8 million-liter) reservoir. Water within the pond is drawn from the Kaskaskia River and is supplemented during low flow (drought) conditions by pumping water from the Mahomet aquifer. Normal operations and stream flow conditions would not affect surface water resources. In addition, treated water (including water from any pretreatment) could also be used to supplement periods of lower flows. Increased development within the region has caused expansion of the existing wastewater treatment plants to accommodate increased effluent discharges; avoiding any impacts on Kaskaskia River flows during drought conditions.

Potentially, the site could discharge sanitary sewer waste. The method of on-site waste systems has not been determined (see discussion in Section 5.15). Appropriate permits would be secured before any discharges. Discharge frequency, quantity and quality would be subject to permit requirements.

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.

Sequestration Site

The sequestration site does not have any lakes, ponds or surface reservoirs. However, there are drainages on the lower-western radial quadrant of the injection plume. These drainages flow into the Kaskaskia River to the west of the site. There are five different soil types associated with the sequestration site: Drummer-Milford silty clay loam, Elburn silt loam, Blackberry silt loam, Brenton silt loam, and Harpster silty clay loam. These soils range in permeability from very to moderately poor, which tend to abate infiltration of surface waters.

The construction of injection wells would disturb minor amounts of land, which could cause temporary indirect impacts to adjacent surface waters such as sedimentation and surface water turbidity from runoff. These impacts would be minimized or avoided through the use of BMPs.

In surface waters lacking buffering capacity, such as freshwater and stably stratified waterbodies, the pH could be significantly altered by increases in CO₂ (Benson et al., 2002). The persistence and amount of CO₂ being leaked are primary factors which determine the severity of the impacts from increased CO₂ in the soil and surface water (Damen et al., 2003). The risk of a CO₂ 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 CO₂ trapping mechanism (Reichle et al., 1999). CO₂ sequestration is maintained via a sealed caprock, which can be compromised by rapid release of CO₂ through natural events or unplugged wells, or slow leaks of CO₂ through rock fractures and fissures. These are influenced by the characteristics (e.g., porosity) of the caprock material. As discussed in Section 5.4, the potential for CO₂ leakage from the proposed Tuscola 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 5.17 (Tetra Tech, 2007).

Although the risk of a CO_2 leak is minimal, a 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). A monitoring program would be implemented to monitor CO_2 to detect a leak, should one occur. Seepage of sequestered gases from the reservoir would not affect surface water because the solubility of the CO_2 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. Mitigation measures would be implemented immediately to reduce the likelihood of adverse impacts to surface water bodies.

None of the area resources is presently impaired for pH (IEPA, 2006).

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.

5.8 WETLANDS AND FLOODPLAINS

5.8.1 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 Tuscola Power Plant Site, 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)."

5.8.1.1 Region of Influence

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

5.8.1.2 Method of Analysis

DOE reviewed research and studies in the Tuscola EIV (FG Alliance, 2006b) to characterize the affected environment. Additionally, DOE received correspondence from the Illinois Department of Natural Resources (IDNR) (IDNR, 2006) which 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.

5.8.2 AFFECTED ENVIRONMENT

5.8.2.1 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.

Hey and Associates conducted surveys to identify jurisdictional wetlands and Waters of the U.S. from August 23 to 25, 2006, using procedures outlined in the 1987 USACE Wetland Delineation Manual (USACE, 1987). IDNR conducted a detailed review based on additional site-specific information for the wetlands in the project area. The study area included the land for the proposed power plant, a 350-foot (107-meter) wide corridor along the proposed 345-kV line, a 300-foot (90-meter) wide corridor along the proposed water line, a 300-foot (90-meter) wide corridor along the proposed CO₂ line, and a 1.1-mile (1.8-kilometer) radius surrounding the sequestration site.

Available maps and related data sources, such as National Wetland Inventory (NWI) maps and Natural Resources Conservation Service (NRCS) Swampbuster maps, were reviewed before the wetland delineations. The USGS Hydrologic Atlas indicated the presence of intermittent streams with a possible hydrologic connection to the Embarras and Kaskaskia rivers, which are Waters of the U.S. that fall under USACE jurisdiction. A total of 19 wetland areas were delineated within the project area using the Cowardin et al. classification scheme (Cowardin et al., 1979) (Table 5.8-1). Wetlands encountered during field surveys were listed by size, NWI classification, vegetation community, quality, and jurisdiction, and are discussed below. Figure 5.8-1 shows the general location of mapped wetlands identified using the Cowardin et al., classification scheme (Cowardin et al., 1979).

Power Plant Site

Wetland delineations did not identify any federal or state jurisdictional wetlands in the vicinity of the proposed Tuscola Power Plant Site. No evidence of wetland hydrology or vegetation was observed during field verification surveys. The proposed site consists entirely of agricultural land (e.g., soybeans and corn).

Sequestration Site

Field surveys performed by Hey and Associates confirm that the proposed sequestration site consists of land developed for agricultural use. However, approximately 5 acres (2 hectares) of Wetland Areas 16 to 19 were identified on the land above the proposed sequestration reservoir. The areas consist mainly of an excavated pond, drainage swales, and floodplain terraces and woods along intermittent creeks that are Kaskaskia River tributaries. The dominant vegetation is silver maple (*Acer saccharinum*), reed canary grass (*Phalaris arundinacea*), pinkweed (*Polygonum pensylvanicum*), and eastern cottonwood (*Populus deltoides*). The seasonally dry creek beds are dominated by clearweed (*Pilea pumila*) and white grass (*Leersia virginica*) (FG Alliance, 2006b).

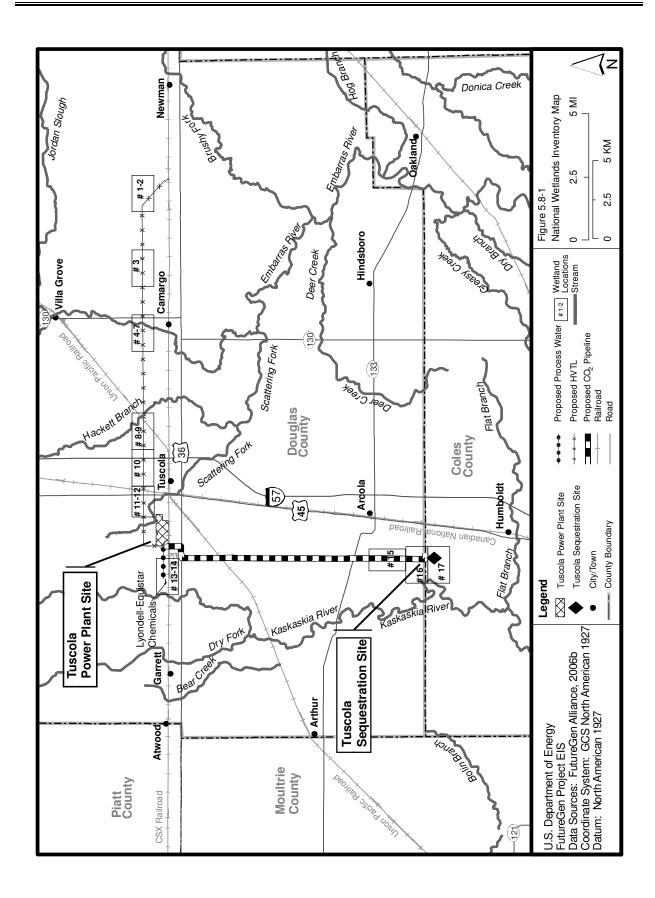
Table 5.8-1. Summary of Delineated Wetlands Within the **Proposed Tuscola Power Plant Project ROI**

| Wetland Areas | Size (acres [hectares]) | Class/Cover Type | Vegetation Community Quality ¹ | Description | Location |
|------------------|---|-------------------------------------|---|---|--------------------------------|
| 1 | 0.09 (0.04) | PEMIx | Low | Constructed drainage swale | Transmission line corridor |
| 2 | 0.2 (0.08) | PEMIx | Low | Drainage swale | Transmission line corridor |
| 3 | 0.4 (0.16) (0.3 [0.1] within corridor) | PUBGx | Low | Excavated pond | Transmission line corridor |
| 4 | 0.9 (0.4) (0.7 [0.3] within corridor) | PUBGH | Low - Moderate | Bermed pond | Transmission line corridor |
| 5 | 0.8 (0.3) | PFO1C R2OWH | Low - Moderate | Embarras River with floodplain terrace/wet meadow | Transmission line corridor |
| 6 | 0.5 (0.2) (0.02 [0.008] within corridor) | PUBGH | Low | Bermed farm pond | Transmission line corridor |
| 7 | 0.11 (0.04) | PEMU | Low | Eroded drainage swale | Transmission line corridor |
| 8 | 0.4 (0.2) (0.36 [0.15] within corridor) | PUBGx | Low - Moderate | Bermed pond | Transmission line corridor |
| 9 | 0.4 (0.16) | PEMC PFO1C R2OWH | Low - Moderate | Hackett Branch of Embarras River with floodplain/wet meadow | Transmission line corridor |
| 10 | Not included in corridor | PUBGH | Low | Excavated pond | Transmission line corridor |
| 11 | 0.2 (0.09) | PEMHx | Low | Drainage swale and Hayes Branch of Embarras River | Transmission line corridor |
| 12 | 0.2 (0.09) | PEMHx | Low - Moderate | Excavated pond | Transmission line corridor |
| 13 | Acreage dependent on future corridor construction | PUBKx, PUBGx PUBKH, L1UBHx | Low | Industrial excavated ponds, drainage swales and reservoirs | Lyondell- Equistar facility |
| 14 | Acreage dependent on future corridor construction | PEMFx R2UBH | Moderate | Constructed waterways and Kaskaskia River | Intake and outfall channels |
| 15 | 0.1 (0.04) | PUBGX | Low | Eroded drainage swale | CO ₂ corridor |
| 16 | 0.09 (0.03) | PEMAF | Low | Drainage swale | Sequestration site |
| 17 | 1.6 (0.7) | R2UBH PEMAF | Moderate | Kaskaskia River, floodplain/terrace, intermittent creeks | Sequestration site |
| 18 | 2.7 (1.1) | PFO1AF | Low | Drainage swale | Sequestration site |
| 19 | 0.5 (0.2) | POWx | Low | Excavated pond | Sequestration site |

PFO = Palustrine Forested; PEM = Palustrine Emergent; PUB = Palustrine Unconsolidated Bottom; PSS = Palustrine Scrub-Shrub; L1 = Lacustrine Limnetic; R2 = Riverine Lower Perennial.

1 Wetlands quality descriptors have been assigned based on the NWI using the vegetation communities present. Source: FG Alliance, 2006b.

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Utility Corridors

A total of 12 wetland areas (1 to 12) were identified along the 345-kV transmission corridor. The wetlands consist of constructed drainage swales, bermed ponds, two creeks, and the Embarras River. Only Wetland Area 15 consisted of an excavated drainage swale along the CO₂ pipeline corridor. The dominant vegetation in these areas is reed canary grass. The agricultural grassed waterways are broad constructed swales planted with upland vegetation that are used to prevent erosion in agricultural fields. They are designed to convey runoff during storm events and do not meet the wetland criteria.

The proposed process water line extends west from the proposed power plant across an agricultural field and the existing Lyondell-Equistar Plant to a holding pond adjacent to the Kaskaskia River. The Lyondell-Equistar Plant, Wetland Area 13, contains numerous bermed ponds, excavated ponds, settling basins, and constructed drainage swales that are used for industrial applications and local stormwater management. The dominant vegetation found in these areas is common reed (*Phragmites australis*), cattail (*Typha* spp.), and reed canary grass. Because these water features are constructed and are used for industrial applications, they would not likely fall under USACE jurisdiction.

Wetland Area 14 consists of the intake and outfall channels to the Kaskaskia River, the Kaskaskia River itself, and a pond. Water is drawn from the Kaskaskia River through a channel and pumped into the holding pond at the Lyondell-Equistar plant. Industrial wastewater and runoff is released back into the river through a channel south of the intake channel. The dominant vegetation in these areas is reed canary grass, a thin band of honey locust (*Gleditsia triacanthos*), and eastern cottonwood, with hackberry (*Celtis occidentalis*) along the shoreline.

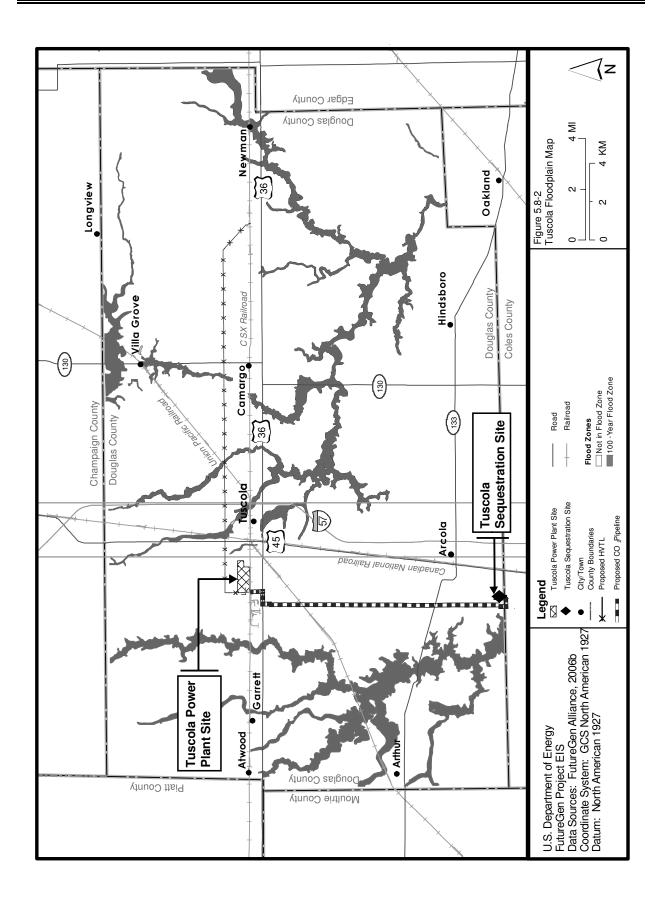
Transportation Corridors

Because no new transportation corridors are proposed outside of the proposed power plant 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.

5.8.2.2 Floodplains

A review of FEMA flood insurance rate maps for Douglas and Coles counties indicates no portion of the proposed Tuscola Power Plant Site is within the 100- or 500-year floodplains (Figure 5.8-2) (*FG Alliance*, *2006b*). In addition, no portion of the proposed process water pipeline or the proposed wastewater force main is within the 100- or 500-year floodplains.

No portion of the proposed injection site property and associated corridor is within the 100-year floodplain. There are two locations in the west and southwest portion of the ROI that are within the 100-year floodplain, as identified by FEMA. These locations are associated with Kaskaskia River tributaries and have a drainage area of less than 10 square miles (26 square kilometers). One location along the CO₂ pipeline would cross an existing drainage ditch, and three locations along the proposed 345-kV transmission line corridor would cross a 100-year floodplain.



5.8.3 IMPACTS

5.8.3.1 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 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 mitigated by minimizing 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 hectare) 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 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 Site

The wetland delineation and NWI map review did not identify any state jurisdictional wetlands in the vicinity of the proposed Tuscola Power Plant Site. Additionally, the proposed power plant site is not within the 100-year floodplain.

Sequestration Site

Four state jurisdictional Wetland Areas (16, 17, 18, and 19) totaling approximately 5 acres (2 hectares) were identified within the ROI associated with the proposed injection site. Injection wells would be constructed outside these wetland areas and; therefore, no direct impacts to these resources are anticipated. The proposed injection well locations are classified as cropland; therefore, no direct impacts are anticipated.

The proposed sequestration site is not located within the 100-year floodplain. Direct and indirect impacts to mapped floodplain areas near the proposed sequestration site would not be anticipated because there would be no need to construct a building or permanent structure within the mapped floodplain areas. Permits with the Illinois Office of Water Resources and Douglas County would therefore not be required. In addition, any required sequestration plume monitoring wells and equipment would be located outside of the existing mapped floodplain areas.

Utility Corridors

Twelve state jurisdictional Wetland Areas (1 to 12) were identified within the transmission line corridor. Construction of the proposed 345-kV line corridor could directly impact up to 4.2 acres (1.7 hectares) of wetlands by removing vegetation and causing potential soil erosion and sedimentation. During construction, wetland and other vegetation communities within the transmission line corridor would be altered. Because tall-growing vegetation would be cut and kept at a height low enough to prevent interference with the conductors, forest cover habitats would be reduced and shrub or other low-growing vegetation would eventually dominate the corridor. Overall, any potential impacts with wetlands could be minimized by locating any proposed facilities outside of identified impact locations. This effect would be minimized by limiting the areas disturbed if, based upon the results of the MISO study, it is determined that existing transmission lines are adequate or that existing corridors could be used to parallel or upgrade existing lines. Potential impacts to wetlands located along the 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 a mitigation ratio consistent with federal and state requirements.

One transmission line corridor alternative would use the existing corridor, which would result in no direct or indirect impact to Wetland Areas 1, 2, 4, 6, 7, 8, 9, 10, 11, and 12. If an upgrade is required, the utility poles would be either replaced or reused; thus, the direct impact would be minimal. In areas where utility poles could not be replaced or reused, the placement of new utility poles would avoid wetland areas to the extent feasible. The IDNR would be consulted regarding the appropriate mitigation if a utility pole must be sited in one or more wetland areas. The state-recommended mitigation ratio required for the removal of any trees in the vicinity of Wetland Area 3 would be between 1.5:1 and 3.0:1. The mitigation ratio required for impacts to forested Wetland Area 5 would be between 2.5:1 and 5.5:1. These wetland areas would be avoided by using directional boring pipeline construction techniques. Every effort would be made to not disturb this area.

One state jurisdictional wetland (Wetland Area 15) was identified within the CO_2 corridor. It is likely that the CO_2 corridor would also use existing ROWs for much of its length, minimizing the amount of wetlands to be disturbed. Impacts to this wetland (0.1 acre [0.04 hectare]) would consist of vegetation and soil disturbance and would be mitigated at a 1.0:1 ratio.

Two state jurisdictional wetlands were identified in the vicinity of the Lyondell-Equistar Plant (Wetland Area 13) and the water intake (Wetland Area 14). Temporary impacts to holding ponds in Wetland Area 13, such as vegetation and soil disturbance, could occur during construction of the process water pipeline and would be avoided as feasible. If direct impacts to Wetland Area 13 could not be avoided, disturbed areas would be restored to their original condition at a 1.0:1 mitigation ratio after piping has been installed. There would be no direct or indirect project-related impacts to Wetland Area 14 during construction.

The location where the CO₂ pipeline would cross an existing drainage ditch would be constructed using directional boring equipment and in accordance with the IDNR Office of Water Management's "State Wide Permit #8-Underground Pipelines and Utility Crossings," to reduce direct impacts to mapped floodplain areas. The locations where the proposed electric corridor would cross a mapped 100-year floodplain would be regulated under the IDNR Office of Water Resources, and 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.

Depending upon final site 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.

5.8.3.2 Operational Impacts

Power Plant Site

No jurisdictional wetland areas occur within the proposed power plant site; however, Wetland Area 13 (Equistar Pond) would be affected through water withdrawals required for process water. The resulting impact would be water level fluctuation in the pond. This impact would be minimal because Lyondell-Equistar operations cause these fluctuations and the wetland is of low value due to the existing industrial use of the pond. Studies have shown that water supply within the pond would be adequate during normal conditions (see Section 5.7).

Activities would be located outside of the 100-year floodplain; therefore, no impacts are anticipated.

Sequestration Site

Operations at the proposed sequestration site would have no impact on wetlands or floodplains. All activities would occur outside of wetland and floodplain areas.

Utility Corridors

The proposed 345-kV transmission line corridor would be maintained without trees to provide maintenance access and safety. Conversion of less than 2 acres (0.8 hectare) of forested wetlands to emergent wetlands may occur. 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 damaging indirect effect on vegetation and aquatic resources. Following approved herbicide usage instructions, however, would likely reduce this concern. The proposed CO₂ corridor would be allowed to revegetate, and there would be no additional impacts to wetlands or floodplains. Herbicides would be used to address invasive and noxious weed species.

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.

5.9 BIOLOGICAL RESOURCES

5.9.1 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.

5.9.1.1 Region of Influence

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

5.9.1.2 Method of Analysis

DOE reviewed the results of research and studies compiled in the Tuscola EIV (FG Alliance, 2006b) to characterize the affected environment. This information included data on wetland, aquatic, and threatened and endangered species. 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 population;
- Interfere with the movement of any 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 any 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 a designated critical habitat.

5.9.2 AFFECTED ENVIRONMENT

5.9.2.1 Vegetation

Aquatic

Power Plant Site

There are no surface water or wetlands within the proposed Tuscola Power Plant Site boundaries. The only aquatic macrophytes observed during field work were in industrial ponds located within the ROI

(FG Alliance, 2006b). These species include coontail (*Ceratophyllum demersum*) and milfoil (*Myriophyllum* sp.).

Sequestration Site

The only aquatic habitat located on the sequestration site is a small section of the Kaskaskia River, its associated floodplain, and several intermittent drainages. In this reach, the vegetated riparian corridor is wide with seasonal overbank flooding into the floodplain terrace.

Utility Corridors

Aquatic vegetation within the transmission line corridor, which includes both the 138-kV and the 345-kV options, occurs predominantly within the Embarras River watershed. The final route of the proposed 345-kV transmission line has not been determined at this time. The corridor could cross several streams, including upper tributary reaches of Scattered Fork, Hayes Branch, and Hackett Creek, which are all intermittent streams. The corridor could also cross the Embarras River. No information was available, and neither DOE nor the Alliance conducted surveys regarding the presence of in-stream aquatic vegetation; however, DOE did not observe any aquatic plants in any of these streams during an August 2006 site visit. Wetlands found within the transmission line and CO₂ pipeline corridors are discussed in Section 5.8.

Vegetation on the east side of the Kaskaskia River, which would provide the water source for the proposed Tuscola Power Plant Site via the Lyondell-Equistar Chemicals LP water reservoir west of Tuscola, consists of common floodplain trees, including silver maple (*Acer saccharinum*) and box elder (*Acer negundo*), along with common herbaceous species such as reed canary grass (*Phalaris arundinacea*). On the west side of the river, the same tree species line the riverbank, and the adjacent land is planted with soybeans. There is little in the way of aquatic or upland habitat in the area of the water intake. No known aquatic plant and animal management plans exist for the project area.

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 Site

The proposed power plant site consists entirely of an agricultural monoculture of corn row crops. Because the property is maintained as a monoculture, non-agricultural plant species are not present.

Sequestration Site

The proposed sequestration site also consists predominantly of monotypic agricultural cropland with several homesteads and grassed waterways. Additionally, there are areas of woodland near the southwest corner of the sequestration site containing typical upland species such as oak (*Quercus* spp.), hickory (*Carya* spp.), and white ash.

Utility Corridors

Because both a natural gas and potable water pipeline currently exist adjacent to the plant site and the vegetation in the area is predominantly a monoculture of row crops, vegetation would be the same as that described for the power plant site. The terrestrial habitat along the proposed transmission line corridor and the proposed CO₂ pipeline corridor also consists predominantly of monotypic stands of row crops. Occasional grassed waterways are constructed to drain water quickly

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

from the cropland and are planted with non-native vegetation. The riparian corridor associated with the Embarras River contains some native tree and herbaceous species such as white ash (*Fraxinus americanus*), black walnut (*Juglans nigra*), common hackberry (*Celtis occidentalis*), clearweed (*Pilea pumila*), marshpepper knotweed (*Polygonum hydropiper*), and Virginia wild rye (*Elymus virginicus*), which 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 habitat within the proposed transmission line and CO₂ pipeline corridors includes a golf course and homesteads with landscaped lawns.

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.

5.9.2.2 Habitats

Aquatic

Power Plant Site

Because no permanent aquatic habitats occur within the proposed power plant site, the site does not contain fish or aquatic invertebrates.

Sequestration Site

The only aquatic habitat at the sequestration site consists of a small section of the Kaskaskia River, its associated floodplain, and several intermittent drainages. Fish and macroinvertebrates found within this stretch of the river are expected to be similar to those found during surveys conducted in the river by the Illinois Environmental Protection Agency (IEPA) in the summer of 2002; 4 miles (6.4 kilometers) west of Hayes, Illinois (see Tables 5.9-1 and 5.9-2).

Table 5.9-1. Fishery Sampling Data, Upper Kaskaskia River, IEPA Site 0-31 (Electric Seine)¹

| Specific Fish Species Survey Results | | | | |
|--------------------------------------|----------------------------|--------------------------------------|--|--|
| Common Name | Scientific Name | Kaskaskia Ditch (no. of individuals) | | |
| Gizzard shad | Dorosoma cepedianum | 3 | | |
| Carp | Cyprinus carpio | 4 | | |
| Hornyhead chub | Nocomis biguttatus | 1 | | |
| Striped shiner | Luxilus chrysocephalus | 42 | | |
| Red shiner | Cyprinella lutrensis | 87 | | |
| Bluntnose minnow | Pimephales notatus | 247 | | |
| Bullhead minnow | Pimephales vigilax | 3 | | |
| Sand shriner | Notropis ludibundus | 129 | | |
| Silverjaw minnow | Notropis buccatus | 19 | | |
| Quillback | Carpiodes cyprinus | 12 | | |
| River carpsucker | Carpiodes carpio | 1 | | |
| Highfin carpsucker | Carpiodes velifer | 25 | | |
| Golden redhorse | Moxostoma erythrurum | 1 | | |
| Channel catfish | Ictalurus punctatus | 6 | | |
| Yellow bullhead | Ameiurus natalis | 7 | | |
| Tadpole madtom | Noturus gyrinus | 8 | | |
| Freckled madtom | Noturus nocturnus | 1 | | |
| Blackstripe topminnow | Fundulus notatus | 3 | | |
| Longear sunfish | Lepomis megalotis | 12 | | |
| Johnny darter | Etheostoma nigrum | 1 | | |
| Ove | rall Aquatic Community Res | sults | | |
| Total fish | | 612 | | |
| Total species | | 20 | | |
| Electrode minute | es | 28 | | |
| Kilograms of fish | 1 | 16.1 | | |
| Native fish spec | 19 | | | |
| Native minnow s | 7 | | | |
| Native sucker sp | 4 | | | |
| Native sunfish s | 1 | | | |
| Benthic invertive | 4 | | | |
| Intolerant specie | 2 | | | |
| Prop. specialist | 0.02 | | | |
| Prop. geneneral | 1.0 | | | |

Table 5.9-1. Fishery Sampling Data, Upper Kaskaskia River, IEPA Site 0-31 (Electric Seine)¹

| Specific Fish Species Survey Results | | | |
|--------------------------------------|-----------------|---|--|
| Common Name | Scientific Name | Kaskaskia Ditch (no. of individuals) | |
| Prop. mineral-su | 0.07 | | |
| Prop. tolerant sp | 0.2 | | |
| Extrapolated IBI | 40 | | |

¹ Data collected 07/09/02. Source: FG Alliance, 2006b.

Table 5.9-2. Macroinvertebrate Sampling Data, Upper Kaskaskia River, IEPA Site 0-31¹

| Kaskaskia Ditch (no. of individuals) |
|--------------------------------------|
| 2 |
| 2 |
| 5 |
| 2 |
| 1 |
| 25 |
| 4 |
| 1 |
| 2 |
| 2 |
| 154 |
| 8 |
| 3 |
| 1 |
| 1 |
| 1 |
| 1 |
| 1 |
| 1 |
| 1 |
| 5 |
| 63 |
| 1 |
| |

Table 5.9-2. Macroinvertebrate Sampling Data, Upper Kaskaskia River, IEPA Site 0-31¹

| Scientific Name | Kaskaskia Ditch (no. of individuals) |
|------------------------|--------------------------------------|
| Pisidiidae | 1 |
| Polypedilum convictum | 2 |
| Polypedilum illinoense | 19 |
| Procladius sp. | 3 |
| Rheotanytarsus sp. | 2 |
| Sialis sp. | 1 |
| Stenonema pulchellum | 1 |
| Tanytarsini | 2 |
| Tanytarsus sp. | 1 |
| Tricorythodes sp. | 33 |
| Count | 33 |
| MBI | 5.7 |
| %EPT | 3.1% |
| %Midge | 38.1% |
| Sum | 352 |
| Count Genus | 30 |
| Count EPT Genus | 6 |
| Count Midge Genus | 12 |

¹ Data collected 7/09/02. Source: FG Alliance, 2006b.

Utility Corridors

Aquatic habitat at the water intake area at the Lyondell-Equistar Plant consists of an excavated channel approximately 75 feet (22.9 meters) wide leading from the Kaskaskia River to the pump intake at the plant. From there, water is pumped to a series of excavated reservoirs on the plant site. Return water is released back into the river just downstream of the intake. During the field investigations, the return water from the plant was noticeably clearer than the turbid water flowing in the Kaskaskia River.

Ten mussel species were previously reported in the Chicken Bristle segment of the Kaskaskia River, a Natural Area from the Douglas-Champaign County line to the Lyondell-Equistar intake, classifying this segment as a High Mussel Diversity Area (FG Alliance, 2006b). IDNR conducted a mussel survey in August 2006 to verify the current status of this classification and determine whether any other listed mussel species might be present. The survey found very few mussels, none of which were listed. IDNR has stated that this segment of the river is unlikely to maintain its status as a Natural Area, and potential impacts to listed mussels in this reach are no longer a concern (FG Alliance, 2006b). Causes for the decrease in mussel diversity in this reach are unknown.

IEPA conducted fish and macroinvertebrate surveys in the Kaskaskia River in summer 2002, 4 miles (6.4 kilometers) west of Hayes, Illinois, and north of Chicken Bristle. Tables 5.9-1 and 5.9-2 list the

results of these surveys. As part of the fisheries survey, IEPA calculated an Index of Biotic Integrity of 40, indicating a low "B-rated" stream segment, which is classified as a Moderate Aquatic Resource. The calculated Macroinvertebrate Biotic Index for this reach was 5, which indicates an overall healthy macroinvertebrate community.

As previously discussed, the proposed transmission line would potentially cross several intermittent streams, including upper tributary reaches of Scattering Fork, Hayes Branch, and Hackett Creek, as well as the Embarras River. Actual stream crossings depend upon the final route and configuration of the line and would be determined following completion of the current MISO study. Despite seasonal low flows and the agriculturally dominant land use in the watershed, the Critical Trends Assessment Program identified the entire length of the Embarras River as a Resource Rich Area (RRA) (FG Alliance, 2006b). Species diversity and richness are high in the Embarras River, which offers a variety of habitats including gravel bars, gravel and sand raceways, sandbars, riffles, and deep pools. Two sections of the river (112.5 miles [181.1 kilometers]) are rated as Biologically Significant Streams. One section begins just downstream of the transmission line corridor crossing at US 36 (4 miles [6.4 kilometers] east of Tuscola) and continues downstream to the confluence with the Little Embarras River in Coles County upstream of the City of Charleston (INHS, 1996). This reach of the river is naturalized and 25 to 50 feet (7.6 to 15.2 meters) wide, with substrate consisting of sand and gravel with some bedrock, cobble, and silt. Mussel diversity is high.

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

The proposed power plant site, sequestration site, transmission line corridor, and CO₂ pipeline corridor all consist of predominantly monotypic agricultural croplands. As such, with the exception of riparian corridors along the Kaskaskia and Embarras rivers and their tributaries, wildlife found within the proposed project areas would be limited to common species such as raccoons (*Procyon lotor*), white-tailed deer (*Odoceilus 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 cottonwood (*Populus deltoides*) in lower areas adjacent to the river. There is also a small woodland area near the southwest corner of the sequestration site that contains similar upland species. This area could support additional common wildlife species, such as downy woodpeckers (*Picoides pubescens*), blue jays (*Cyanocitta cristata*), black-capped chickadees (*Poecile atricapilla*), chipmunks (*Tamias minimus*), and eastern gray squirrels (*Sciurus carolinensis*); however, no critical or unique habitat has been identified there by the IDNR or during site investigations.

5.9.2.3 Federally Listed Threatened and Endangered Species

According to the 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 trees and 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 in the southwest corner of the sequestration site. Pursuant to consultation between IDNR and the site proponent, the Indiana bat is not expected to occur within the proposed power plant site, sequestration site, or utility corridors.

5.9.2.4 Other Protected Species

The state-listed threatened Kirtland's snake (*Clonophis kirtlandii*) has been found 1 mile (1.6 kilometers) from the proposed transmission line corridor near Spring Lake. Kirtland's snake occurs in damp habitats, such as wet meadows and wet prairies, near water bodies. Because most of the project area consists of cropland, the only potential habitat occurs within riparian areas along the proposed transmission line corridor.

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.

5.9.3 IMPACTS

5.9.3.1 Construction Impacts

Power Plant Site

Because no permanent streams or ponds are located at the proposed power plant site, no direct impacts on aquatic resources would occur. 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), depending upon final site design. Because this cropland does not provide high-quality wildlife habitat and similar agricultural habitat 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 have no effect on the overall population. The proposed power plant site does not contain habitat for any federally or state-listed rare, threatened, or endangered species *nor habitat for migrating bird 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.

Sequestration Site

A small section of the Kaskaskia River is the only permanent stream located on the sequestration site; however, because construction of the proposed injection wells would be localized and sited to avoid this stream, direct impacts to aquatic resources would not occur. Standard stormwater management practices, as described for the impacts at the power plant site, would prevent indirect impacts to this stream and off-site surface waters.

Up to 10 acres (4 hectares) of land could be permanently lost as a result of the construction of the injection wells. The sequestration site is predominantly monotypic agricultural cropland and land disturbance associated with well construction would remove existing cropland habitat. However, because this cropland does not provide high-quality wildlife habitat and similar agricultural habitat is prevalent in the area, effects on wildlife and displacement of terrestrial communities would be minimal. Furthermore, revegetation of disturbed areas that are not used for injection wells with native plant species would limit the proliferation of noxious weeds. Temporary impacts to vegetation would result from truck access

during the required seismic surveys of the sequestration site, before injection well construction. No known federally or state-listed rare, threatened, or endangered species are present at the sequestration site.

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 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 utility lines, upgrading existing utility lines, or using existing maintained ROWs.

The length of the electric transmission line corridor would vary between 0.5 and 17 miles (0.8 and 27.4 kilometers) for the 138-kV line (Option 1) or 345-kV line (Option 2), respectively. The results of ongoing studies by MISO, the regional transmission authority, would determine the selection of electric transmission options. Option 1 would require 0.5 mile (0.8 kilometer) of new ROW. Option 2 would require approximately 14 miles (22.5 kilometers) of construction within an existing ROW and 3 miles (4.8 kilometers) of construction within a new ROW. 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 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 11-mile (17.7-kilometer) long CO₂ pipeline corridor would also use existing ROWs for much of its length. The proposed process water pipeline would be 1.5 miles (2.4 kilometers) long and would occur in agricultural land and within an existing road ROW. The proposed sanitary water pipeline under Option 2 would parallel the process water pipeline for its 0.9-mile (1.4-kilometer) length. Construction of these underground utilities would disturb habitats in primarily agricultural lands along with some riparian habitats at stream crossings. No critical habitats are located within the corridors. These pipelines would be built using standard pipeline construction techniques and directional drilling under sensitive areas such as wetlands, streams, and rivers. After construction, the land above these 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 plant community in the transmission corridor would be permanently maintained in an early-successional stage with no trees. As such, tree cover in riparian areas within any new 345-kV transmission line corridor would be permanently lost.

No known federally listed threatened or endangered species occur in any of the utility corridors. The state-listed Kirtland's snake occurs in riparian areas within the proposed transmission line corridor and could be affected during construction in the absence of appropriate protection and mitigation measures. 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 encountered individuals 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 Tuscola 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 – July 31), individual birds could be lost.

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. Any unforeseen major upgrades or new transportation corridors would require a separate analysis.

5.9.3.2 Operational Impacts

Power Plant Site

Process water for the proposed power plant would come from the existing Lyondell-Equistar Chemical Company's 150 million-gallon (568 million-liter) raw water holding pond which obtains water from an intake structure on the Kaskaskia River. During low flow conditions, Lyondell-Equistar either draws water from the holding pond and begins pumping from the river once moderate to heavy rains have increased its flow, or it pumps water from the Mahomet aquifer wells near Bondville, Illinois, to supplement water needs (see Section 5.7 for further details on proposed water use and impacts to surface water). In either case, pumping water from the chemical plant's holding pond for the FutureGen Project is expected to have minimal impacts to aquatic resources in the Kaskaskia River because of increased discharge upstream. Because of increased development upstream of the intake structure, low flow in the river has been sustained by increased effluents from the Urbana-Champaign Sanitary District WWTP. The current average daily discharge from the Urbana-Champaign WWTP is approximately 6 million gallons (23 million liters) per day (FG Alliance, 2006b). As proposed, the FutureGen plant would draw about 4.3 million gallons (16.3 million liters) per day of process water from an existing 80-acre (32-hectare), 150 million-gallon (568 million-liter) raw water holding pond located 1.5 miles (2.4 kilometers) west of the site at Lyondell-Equistar Chemical Company. This supplemental water is conveyed to the intake structure at Lyondell-Equistar Chemicals via the Kaskaskia River. Water withdrawals from the Kaskaskia River would not be expected to have an adverse impact on the aquatic habitat in the river because upstream discharges from community wastewater systems have increased by amounts greater than the projected FutureGen Project demand. As noted in the affected environment discussion, listed mussels are not present near the existing intake structure, thus impacts to listed mussels in this area are not a concern (FG Alliance, 2006b).

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 5.14). However, wildlife species that are found near the proposed power plant 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 (see Section 5.2) 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. Because there are no high-quality or sensitive aquatic or wildlife receptors near the proposed power plant site, air emissions would not impact biological communities.

Sequestration Site

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. CO₂ sequestration has the potential to destroy these localized microbial communities by altering the pH of the underground environment. However, it is also possible that CO₂ 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. Should released gas from the sequestration reservoir reach surface water, impacts to aquatic biota would be unlikely because the concentration of CO_2 in the surface water would be less than the 2 percent level at which effects to aquatic biota could occur (see Section 5.17). Plants and animals are not predicted to be impacted by gradual CO_2 releases from the reservoir, although effects in the immediate vicinity of the injection wells could result from a rapid CO_2 release (see Section 5.17). 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 a*nd* 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 CO₂ pipeline corridor would be allowed to revegetate once construction is complete; therefore, no impacts would be likely during operations.

If a leak or rupture in the CO₂ pipeline occurred, respiratory effects to biota due to atmospheric CO₂ concentrations would be limited to the immediate vicinity along the pipeline where the leak or rupture occurred. While heat generated from the supercritical fluid in the CO₂ 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 5.17).

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, 2006) would minimize the potential for these effects.

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 environment. Any potential upgrades to existing transportation corridors are anticipated to occur in existing maintained ROWs. Any unforeseen major upgrades or new transportation corridors would require a separate analysis.

5.10 CULTURAL RESOURCES

5.10.1 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[1][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).

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 the 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

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.

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 a historic preservation in the state.

5.10.1.1 Region of Influence

The ROI for cultural resources includes (1) the proposed power plant and sequestration site 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.

5.10.1.2 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
 - o Paleontological Resources Cause the potential for loss, isolation, or alteration of a paleontological resource eligible for listing as a National Natural Landmark (NNL).
 - o 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 the IHPA (FG Alliance, 2006b). 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, 2006b).

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 Douglas 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's 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).

5.10.2 AFFECTED ENVIRONMENT

5.10.2.1 Archaeological Resources

Review of the Illinois Archaeological Survey site files identified four previously recorded archaeological sites and six previously recorded isolated finds in the ROI (FG Alliance, 2006b). Table 5.10-1 lists the four archaeological sites with their cultural or temporal affiliation and the ROI within which they are located. The cultural and temporal affiliation of the six isolated finds is not given; however, five are within the power plant ROI and a sixth is within the electrical transmission line corridor ROI.

An archaeological survey was conducted of areas that would be subject to direct impact from construction, including the proposed plant site, waterline west of Tuscola, CO₂ corridor, the Arcola injection site, and Segment 1 of the proposed electrical transmission line corridor (Finney, 2006). Segment 2 of the proposed electrical transmission line corridor follows an existing transmission line

corridor that has not been surveyed. Segment 3 of the proposed electrical transmission line would occupy a new ROW that has not been surveyed.

Site Number Site Type ROI 11Do92 Prehistoric, indeterminate age and Power plant historic late 19th – early 20th century Historic, late 19^{th} – early 20^{th} century 11Do93 Power plant/Electrical transmission line corridor Historic, late 19th - early 20th century 11Do94 Power plant Historic, late 19th - early 20th century 11Do148 Electrical transmission line corridor, Segment 2

Table 5.10-1. Previously Recorded Archaeological Sites Within ROI

Source: FG Alliance, 2006b.

Background research before the survey identified one previously recorded isolated find in the survey area, but no archaeological sites had been recorded. Three of the archaeological sites referenced above (11Do92, 11Do93, and 11Do94) and three isolated finds were recorded within 1 mile (1.6 kilometers) of the survey area. A recent survey for a gas pipeline identified a single isolated historic whiteware ceramic fragment in the proposed power plant site, but it is not evaluated as an archaeological site (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, 2006b). IHPA concurrence has been received and no further investigations are needed (see Appendix A).

5.10.2.2 Historic Resources

The HAARGIS database shows no historic properties listed in the NRHP within the ROI (FG Alliance, 2006b).

5.10.2.3 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 to the Bureau of Indian Affairs Eastern Region Office, which does have jurisdiction, of the FutureGen Project. A response has not yet been received. To date, no Native American tribes have responded.

5.10.2.4 Other Cultural Resources

Two rural cemeteries, Hammett and Murdock, are within the ROI for Segment 2 of the proposed 345-kV transmission corridor, but well outside of the corridor's boundaries. There are no known paleontological resources within the project ROI.

5.10.3 IMPACTS

5.10.3.1 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 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 (Finney, 2006). 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, or archeological resources are located in the proposed project area (see Appendix A).

Sequestration Site

There are no known cultural resources in areas that would be disturbed by construction at the proposed sequestration site (Finney, 2006). 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).

Utility Corridors

There are no known cultural resources in areas that would be disturbed by construction within the proposed CO₂ corridor, the process water corridor, or Segment 1 of the electrical transmission line corridor (Finney, 2006).

If Segment 2 of the transmission line is upgraded, no impacts to cultural resources would be expected; however, if new construction should take place in a parallel ROW, the potential for impacting undocumented cultural resources would exist. Segment 3 of the electrical transmission line would be in a new ROW that was not surveyed. Corridor construction in a new or previously undisturbed ROW would have a higher potential for impacting undocumented cultural resources.

On January 30, 2007, IHPA concurrence was received stating that no significant historical, architectural, and archaeological resources are located in the proposed project area. However, Segment 3 of the electrical transmission line would be in this new ROW and would require a survey if the Tuscola Site is selected and the proposed electrical transmission line corridor is disturbed for construction of the line.

Transportation Corridors

Potential roadway improvements are unspecified, pending traffic studies that would be conducted if the Tuscola site is selected. Therefore, potential impacts to cultural resources as a result of road improvements are unknown at this time. If road improvements take place in new, undisturbed ROWs, there would be a potential for impact to undocumented cultural resources. The IHPA would need to be consulted regarding the need for cultural resource investigations before construction of improvements.

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

5.10.3.2 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.

5.11 LAND USE

5.11.1 INTRODUCTION

This section identifies land uses that may be affected by the construction and operation of the proposed FutureGen Project at the Tuscola Power Plant Site, 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 Tuscola Sequestration Reservoir.

5.11.1.1 Region of Influence

The ROI for land use includes the area within 1 mile (1.6 kilometers) of the boundaries of the proposed Tuscola Power Plant Site, sequestration site, and all related areas of new construction, including proposed utility corridors.

5.11.1.2 Method of Analysis

In preparing the description of the affected environment for land use and the analysis of potential impacts, DOE reviewed information provided in the Tuscola EIV (FG Alliance, 2006b) and relevant land use data, including the City of Tuscola's Comprehensive Plan (City of Tuscola, 2001) and zoning ordinances (City of Tuscola, 2006), City of Arcola zoning ordinances (City of Arcola, 2006), Federal Aviation Administration (FAA) regulations, and various databases related to contaminated sites. DOE also reviewed aerial photographs and conducted 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 a jurisdictional noise ordinance; or
- Conflict with a local or regional land use plan or policy.

5.11.2 AFFECTED ENVIRONMENT

The proposed Tuscola Power Plant Site consists of a 345-acre (140-hectare) parcel of land located in Tuscola Township, Douglas County, Illinois (FG Alliance, 2006b). It is situated 161 miles (259 kilometers) south of Chicago; 152 miles (245 kilometers) west of Indianapolis, Indiana; and 153 miles (246 kilometers) northwest of St. Louis, Missouri. The entire site is currently used for agricultural row crops.

The proposed Tuscola Sequestration Site is located 11 miles (16 kilometers) south of the Tuscola Power Plant Site on a 10-acre (4-hectare) parcel of land in Arcola Township, Douglas County, Illinois, at 1,087,141.666 North and 984,488.654 East, Illinois State Plane E – NAD 83 (North American Datum of 1983). The site is physically located approximately 0.25 mile (0.4 kilometer) east of CR 750E along CR 000N, the Douglas-Coles County line (FG Alliance, 2006b). This entire site is currently used for agricultural row crops.

5.11.2.1 Local and Regional Land Use Plans

Only one municipality, the City of Tuscola, has a master planning document within the ROI. The City of Tuscola created its Comprehensive Plan to manage development and public infrastructure to promote efficient and desirable patterns for growth and redevelopment within the city limits and in a 1.5-mile (2.4-kilometer) radius beyond the city limits referred to as "extra-territorial" lands (City of Tuscola, 2001). In the extra-territorial lands, the City of Tuscola has the discretion of enforcing its zoning ordinances (City of Tuscola, 2006). The Comprehensive Plan indicates that the proposed Tuscola Power Plant Site lies partially within these extra-territorial lands. The plan also identifies the land use at the plant site as industrial for future use. Figure 5.11-1 depicts the City of Tuscola's current land uses for the extraterritorial lands. Figure 5.11-2 depicts the current Coles County land uses for the proposed sequestration site and the proposed CO₂ corridor. Douglas County does not have county-wide zoning and does not have detailed land use maps that show public and private land ownership or uses.

5.11.2.2 Zoning

As noted above, the City of Tuscola's zoning jurisdiction includes the 1.5-mile (2.4-kilometer) extraterritorial area outside the city limits, and the proposed Tuscola Power Plant Site is partially within the extra-territorial area. The City of Tuscola has the discretion of enforcing its zoning ordinances around the proposed Tuscola Power Plant Site (City of Tuscola, 2006) (see Appendix A).

The City of Arcola is the nearest municipality to the proposed Tuscola Sequestration Site with zoning regulations. The City of Arcola, in accordance with its zoning ordinance 25-2-1, controls zoning 1.5 miles (2.4 kilometers) beyond the municipal boundary. Any new development within 1.5 miles (2.4 kilometers) of the municipal boundary requires a building permit (City of Arcola, 2006) (see Appendix A).

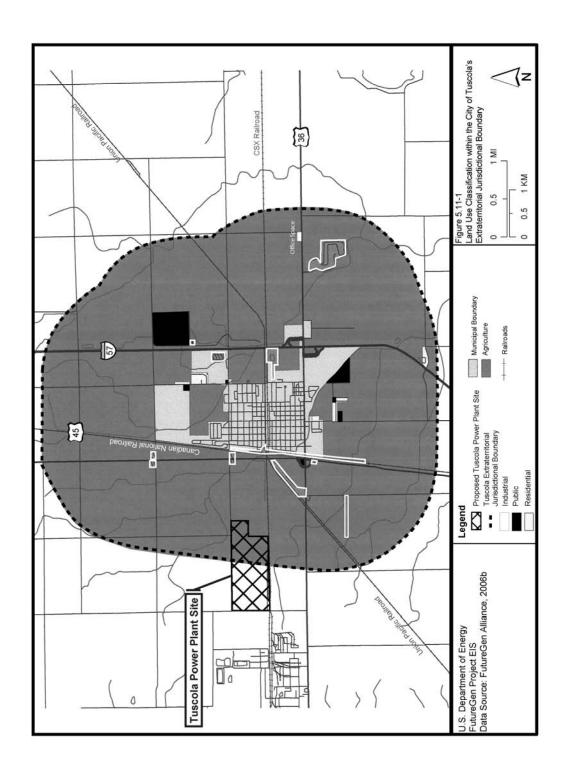
The proposed process water pipeline and sanitary sewer lines would occupy property owned by Lyondell-Equistar Chemicals, and would be located outside of the zoning jurisdiction for the City of Tuscola and its 1.5-mile (2.4-kilometer) extra-territorial zoning area.

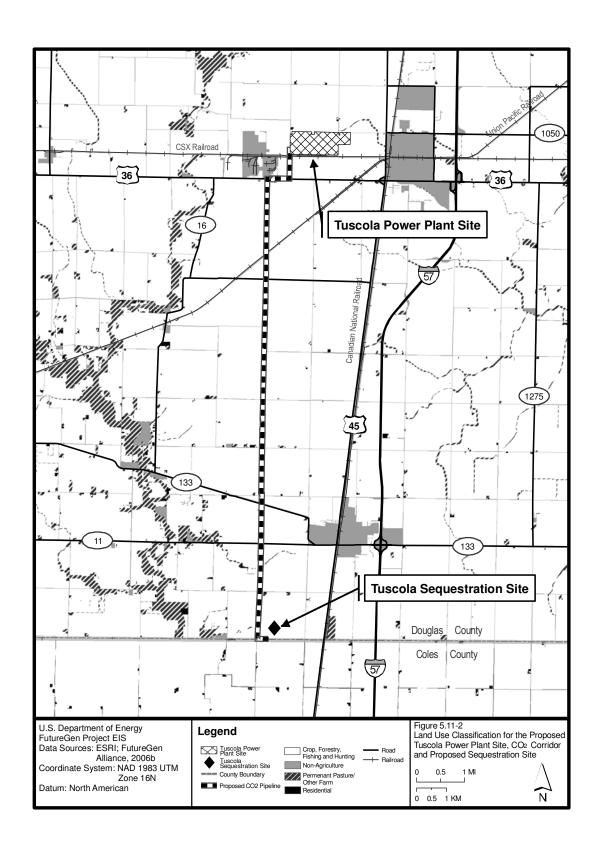
The proposed electrical transmission line would occupy both existing and new ROWs within the municipality of Tuscola and its zoning jurisdiction, as well as the Townships of Camargo and Murdock, which do not have zoning authority.

The proposed CO₂ transmission corridor would occupy both existing roadway ROW and new ROW southwest of Tuscola and west of the City of Arcola. The proposed CO₂ transmission line would be located outside of the zoning jurisdiction for the City of Tuscola and City of Arcola and their 1.5-mile (2.4-kilometer) extra-territorial zoning areas.

5.11.2.3 Airspace

The Tuscola Airport is approximately 1.5 miles (2.4 kilometers) south of the proposed plant site. The Tuscola Airport is a small, low traffic field with a 2,660-foot (811-meter) oil and chip runway (improved surface) with a parallel grass landing strip. 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 the 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).

A majority of the proposed Tuscola Power Plant Site falls within the 10,000-foot (3,048-meter) radius of the Tuscola Airport, and therefore the notification requirements of 14 CFR Part 77 would be applicable.

5.11.2.4 Public Access Areas and Recreation

Walnut Point State Park is the nearest public access area to the proposed Tuscola Power Plant Site at a distance of approximately 15.5 miles (24.9 kilometers). Lake Shelbyville, operated by USACE as a flood control project on the Kaskaskia River, is located approximately 22 miles (35.4 kilometers) southwest of the proposed site. The lake provides camping, hiking trails, boating access, and picnicking facilities.

The City of Tuscola has two parks, Ervin Park and Wimple Park, that provide a range of recreational activities. Ervin Park is located 1 mile (1.6 kilometers) east of the proposed Tuscola Power Plant Site within the northeast section of the city limits. The proposed transmission line corridor follows an existing transmission line corridor that runs along the northern edge of the park. Ervin Park contains 36 acres (14.6 hectares) and includes four baseball diamonds, a baseball batting cage, two basketball courts, five horseshoe pits, three picnic pavilions, three playgrounds, four public restrooms, a 250,000-gallon (946,353-liter) swimming pool, four tennis courts, one volleyball court, and one walking path. Wimple Park, located approximately 2.5 miles (4.0 kilometers) southeast of the proposed Tuscola Power Plant Site and just over 2 miles (3.2 kilometers) south of the proposed transmission line corridor, is a 20-acre (8.1-hectare) park that offers a pond and walking trail. It is adjacent to the South Tuscola Sanitary Treatment Facility (City of Tuscola, 2001).

Iron Horse Golf Course is located approximately 1.3 miles (2.1 kilometers) northeast of the proposed Tuscola Power Plant Site. The proposed transmission line corridor follows an existing transmission line corridor that runs along the southern edge of the golf course. The Iron Horse Golf Course is an 18-hole public course and has a clubhouse that offers a sports bar and a restaurant. There are residences located within the golf course.

5.11.2.5 Contaminated Sites

DOE review of the Illinois Environmental Protection Agency (IEPA) databases (IEPA, 2006) for the proposed Tuscola 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 (RCRA), permitted activities, or solid waste landfills.

DOE review of the CERCLIS Database for Douglas County, Illinois, reveals no environmental issues requiring remediation (*CERCLIS*, 2006) in the vicinity of the proposed Tuscola Power Plant Site.

5.11.2.6 Land Ownership and Uses

Power Plant Site

The proposed Tuscola Power Plant Site land usage is 100 percent agricultural, consisting of row crops. There is a Trunkline Gas Company natural gas pipeline that runs underground through the site, but the surface of the ROW is tilled along with the remainder of the site. The site totals 345 acres (140 hectares) and includes six parcels owned by

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).

three private individuals. All of the property owners have agreed to an exclusive option contract to sell their property if the site is selected for the FutureGen Project.

The surrounding area within 1 mile (1.6 kilometers) has been agricultural farmland with scattered heavy industrial, commercial, and rural residential uses for more than 50 years. Two chemical facilities, Cabot Corporation and Lyondell Equistar Chemicals, occupy large parcels west and southwest of the proposed Tuscola Power Plant Site (see non-agricultural land use designations on Figure 5.11-2). The two chemical facilities contain water intake reservoirs, treatment ponds, four injection wells (drilled to a depth of 5,300 to 5,524 feet [1,615 to 1,684 meters]), holding tanks, fly ash landfill, and a water treatment plant.

There are three small residential parcels that directly abut the proposed Tuscola Power Plant Site on the north, seven residences within 0.5 mile (0.8 kilometer), and several dozen additional residences within 1 mile (1.6 kilometers) of the site, almost all of which are near the 1-mile (1.6-kilometer) boundary of the ROI on the western edge of the City of Tuscola near the Illinois Central Gulf Railroad line. A CSX rail corridor is immediately adjacent to the southern boundary of the proposed site. The majority of the land bordering the site on the north and east is farmland, historically planted in corn and soybean in annual rotation. The plant site is located less than 0.5 mile (0.8 kilometer) from a road construction company, a chemical transport firm, and natural gas pipeline companies. The remaining non-industrial area surrounding the plant site is rural farmland. In addition to the residences and facilities noted above, there are also two township roads, one state highway, a CSX railroad siding, an Ameren Corporation-CIPS substation, and a hog market within 1 mile (1.6 kilometers) of the site (FG Alliance, 2006b). There are no hospitals, schools, or nursing residences within 1 mile (1.6 kilometers) of the proposed plant site.

Sequestration Site

The proposed 10-acre (4-hectare) injection site is part of a larger parcel of 80 acres (32.4 hectares). The area above the proposed Tuscola Sequestration Reservoir is farmland located on Land Trust number L-745, where the trustee is the First National Bank of Arcola and the beneficiaries are four private individuals. The trustee and beneficiaries have agreed to an exclusive binding option contract for a 10-acre (4-hectare) portion of the site, including subsurface/mineral rights, and have also indicated a willingness to offer a smaller amount of acreage at the same price (FG Alliance, 2006b).

Regarding properties with improvements (buildings) on the land, there are 14 private landowners above the target formation for the sequestration reservoir, including 58 parcels of farmland. There are 7.9 miles (12.6 kilometers) of township roads and 0.5 mile (0.8 kilometer) of state highway adjacent to the site. Additionally, there is some aboveground piping for area natural gas pipelines and storage areas in the surrounding ROI (FG Alliance, 2006b).

Complete title searches for subsurface rights at the injection site, proposed Tuscola Sequestration Site, and surrounding area have not been performed for this EIS. Entities with potential property rights include the land surface owners, mineral interest owners, royalty owners, and reversionary interest owners (that is, owners of an interest in a reservoir that becomes effective at a specified time in the future [de Figueiredo et al., 2005]).

Utility Corridors

Potable water from the Illinois American Water Company runs along the southern boundary of the proposed power plant site parallel to the CSX rail line. If an on-site treatment facility is not built, the proposed sanitary wastewater pipeline would be approximately 0.9 mile (1.4 kilometer) long and would be constructed on property owned by Lyondell-Equistar Chemicals and Tuscola Township Road ROW. This wastewater corridor would parallel the proposed process water corridor, where the existing land use in the ROI includes industrial uses, row crops, and a small number of agricultural farmsteads (FG Alliance, 2006b).

The proposed process water supply line would run west approximately 1.5 miles (2.4 kilometers) from the proposed site to an existing 150 million-gallon (568 million-liter) surface water storage facility operated by Equistar Chemical Company. The proposed process water pipeline would occupy property owned by either Lyondell-Equistar Chemicals plus an existing township ROW. The existing land use for this ROI includes industrial uses, row crops, road and utility ROWs, and a small number of agricultural farmsteads (FG Alliance, 2006b).

Under Option 1 of the electrical transmission line options, the plant would tie into an existing 138-kV line located approximately 0.5 mile (0.8 kilometer) north of the site. Connection to this line would require an additional ROW alongside CR 750E. There are several farmsteads within the ROI of this corridor, and the remainder of the ROI is cropland. Option 2 proposes a new 345-kV transmission line that would parallel or replace the existing 138-kV line. This transmission line would run approximately 17 miles (27.4 kilometers) and connect to a substation east of Murdock. The existing transmission line corridors would be used for the first 14 miles (22.5 kilometers) and the last 3 miles (4.8 kilometers) would fall on new ROW. The new ROW required for the last 3 miles (5 kilometers) of the proposed transmission line would affect nine landowners (FG Alliance, 2006b).

The existing land uses in the transmission corridor's ROI include industrial facilities, row crops, agricultural farmsteads, the Iron Horse Golf Course, Ervin Park, the municipality of Tuscola, and the townships of Camargo and Murdock. Within the municipality of Tuscola, the proposed transmission line would come within 1 mile (1.6 kilometers) of Jarman Senior Living Center and North Ward Elementary School (FG Alliance, 2006b). There is one mine located within the 1-mile (1.6-kilometer) ROI of the transmission line in Murdock. This mine is currently closed (FG Alliance, 2006b).

The proposed 11-mile (17.7-kilometer) CO₂ pipeline corridor from the proposed Tuscola Power Plant Site to the proposed Sequestration Site would occupy new ROW parallel to CR 750E and CR 700E. Existing land use in the ROI includes industrial uses, row crops, and agricultural farmsteads. The ROI extends to the westernmost boundary of the City of Arcola (FG Alliance, 2006b).

5.11.2.7 Prime Farmland

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 these acres were 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 to produce the least impact on farmland. The FPPA also

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).

seeks to ensure that federal programs are administered in a manner that, to the extent practicable, will be compatible with state and local government policies, as well as private programs, 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 purpose of the review is a systematic procedure to assist in determining which proposed governmental action would incur the least harm to the agricultural environment. The ILDOA established the Land Evaluation and Site Assessment (LESA) system as a tool to use in making such evaluations. The National Resources Conservation Service (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 345-acre (140-hectare) proposed Tuscola Power Plant Site, NRCS identified all 345 acres (140 hectares) 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 141 points out of a possible 200 points, totaling 239 LESA points out of a possible 300 (FG Alliance, 2006b). 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 these 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.

5.11.3 IMPACTS

5.11.3.1 Construction Impacts

Power Plant Site

The 345-acre (140-hectare) proposed Tuscola Power Plant Site and area within 1 mile (1.6 kilometers) consists of farm crops, heavy industrial use, and seven small rural residential parcels. 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, and research and development center. Project construction would have a major, long-term impact on the current mainly agricultural land use of the 345-acre (140-hectare) parcel. Up to 200 acres (81 hectares) would be disturbed during construction. The remaining 145 acres (59 hectares) could be available for continued farming under a lease agreement if construction is limited to the 200-acre (81-hectare) envelope. The

industrial use would be compatible with the heavy industrial use already occurring in the general vicinity of the site but could have a major impact on the three residential parcels that abut the site on the north side.

The City of Tuscola's Comprehensive Plan identifies the future land use at the proposed plant site as industrial. Therefore, construction of the proposed Tuscola Power Plant would fall within the parameters set by the City of Tuscola for future land use and would be compatible with the local comprehensive plans and zoning ordinances.

Most of the proposed Tuscola Power Plant Site falls within the 10,000-foot (3,048-meter) radius of the airport required for FAA Part 77 Airspace Obstruction Analysis. Patrick Engineering Inc. (2006) conducted an FAA Part 77 Airspace Obstruction Analysis to determine whether airspace obstruction would occur within 10,000 feet (3,048 meters) of Tuscola Airport. All corners of the proposed power plant site that fell within 10,000 feet of the airport, as well as the center of the site, were analyzed (five total locations). Patrick Engineering Inc. estimated the ground elevation of each location using the ISGS 7.5-minute topographic map for the Tuscola, Illinois, Quadrangle, and then added 250 feet (76 meters) to account for the height of the heat recovery steam generator stack for the proposed power plant. They then calculated the slope of the surface from the airport runway to each location and compared this calculation to the minimum guideline from the FAA of 50H:1V (that is, a 50 to 1 ratio of horizontal distance to vertical distance). The five locations ranged from 26H:1V to 37H:1V and all exceeded the FAA Airspace Obstruction guideline of 50H:1V within 10,000 feet (3,048 meters) of the Tuscola Airport (Patrick Engineering, 2006). The analysis shows that a 250-foot (76-meter) stack constructed at nearly any location on the proposed site would extend into the 50:1 surface defining the controlled airspace around the Tuscola Airport. Construction would require advance FAA notification and evaluation, and signal lights would be required atop the heat recovery steam generator and flare stacks. FAA regulations require such lighting for any structure of more than 200 feet (61 meters) high (14 CFR Part 77). The FAA charts show several other existing obstructions in the vicinity of the proposed site, including grain storage facilities, mobile telephone towers, and the stacks at the Lyondell-Equistar Power Plant, which are 193 feet (59 meters) tall. The proposed Tuscola Power Plant Site would be located north of the runway, which is oriented west to east.

As noted above, construction of the Tuscola Power Plant 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) the NRCS reports as lost annually in Illinois. The proposed Tuscola Power Plant Site's LESA score of 239 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 5.11.2.1, the City of Tuscola Comprehensive Plan identifies the site's future land use as industrial (City of Tuscola, 2001).

Sequestration Site

Construction at the proposed Tuscola Sequestration Site would have temporary, minor effects on the agricultural land use during the actual construction period due to trenching for the pipeline corridor, construction of the injection structure, equipment movement, and material laydown. After construction is complete, the areas not used for wells and equipment would be regraded and revegetated in accordance with applicable permits, with no permanent change in the existing agricultural land use.

Utility Corridors

Construction within the proposed wastewater and process water pipeline corridor would have temporary, minor effects on the primarily industrial uses, along their respective 0.85-mile (1.4-kilometer)

and 1.5-mile (2.4-kilometer) corridors during the actual construction period due to trenching, equipment movement, and material laydown. The same is true of the agricultural use of the 11-mile (18-kilometer) CO_2 pipeline corridor. After construction is complete, the areas would be regraded and revegetated if needed, and all original land uses would continue.

Where the proposed transmission line corridor coincides with an existing transmission line corridor, there would be no change in current land use. Construction within the proposed transmission line corridor, if needed to upgrade the existing line, would have temporary, minor effects on land use (agricultural use, industrial use) during the actual construction period. The proposed corridor would either be 0.5 or 17 miles [0.8 to 27.4 kilometers]) in length. After construction is complete, the areas would likely return to their current use.

If the new ROW required for the last 3 miles (4.8 kilometers) of the proposed transmission line were needed, it would affect nine landowners. Construction within the new ROW would make the ROW temporarily unavailable for its current, mostly agricultural, use. After construction is complete, the areas would likely return to their current use.

Construction of the proposed transmission line would come within 1 mile (1.6 kilometers) of the closed mine located in the township of Murdock, but would have no effect on the mine.

Transportation Corridors

The property adjacent to the southern property line of the proposed power plant site belongs to CSX Transportation. This property is used both as a switch yard and as mainline rail facilities. Access to the CSX mainline rail would be gained through the CSX Transportation ROW. A new proposed rail spur corridor would not be needed to gain access to the CSX Transportation rail facilities, and project construction would have no effect on current offsite land use.

5.11.3.2 Operational Impacts

Power Plant Site

As noted in Section 5.11.3.1, construction of the proposed Tuscola Power Plant would permanently remove at least 200 acres (81 hectares) of the site from its current agricultural use. The remainder of the site (145 acres [59 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 three residences adjacent to the north border of the site and the other residences within 1 mile (1.6 kilometers) of the site. As noted in Section 5.11.2.6, most of the several dozen additional residences are near the 1-mile (1.6-kilometer) boundary of the ROI, on the western edge of the City of Tuscola near the Illinois Central Gulf Railroad line. While the facility would be visible from those residences, it would not affect the land use of that area.

Sequestration Site

Over the long term, the presence of the injection wells and equipment would permanently remove up to 10 acres (4 hectares) from agricultural use at the proposed sequestration site. It is likely that the rest of the site would continue in its current agricultural use.

The option contract for the land at the sequestration site includes all subsurface rights, including any oil, gas, water, and mineral rights for the properties. Obtaining mineral rights from the 13 additional landowners located over the expected 30-year sequestration plume (there may be additional landowners if subsurface rights are needed to the 0.25-mile [0.4-kilometer] buffer) may be required and, in Douglas County this historically has not been difficult or uncommon (FG Alliance, 2006b). 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 (Tuscola, Illinois), 2006).

Utility Corridors

Once the utility pipelines were in place, the lands would be returned to their pre-existing land use, such as roadway, cropland, industrial use, or utility corridor, so permanent loss of land would only occur at the pole locations. There would be no permanent change in the existing land use, although the presence of underground utilities would preclude future development of the ROW for incompatible uses.

Over the long term, the presence of the electrical transmission line would permanently eliminate the locations of the 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 the future development of incompatible uses, such as residential construction, within the ROW.

Transportation Corridors

There would be no change in land use associated with the rail spur because the rail spur would not require any off-site ROW.

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5.12 AESTHETICS

5.12.1 INTRODUCTION

This section identifies viewsheds and scenic resources that may be affected by the construction and operation of the proposed FutureGen Project at the Tuscola Power Plant Site, 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.

5.12.1.1 Region of Influence

The ROIs for aesthetic resources include areas from which the proposed Tuscola Power Plant 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 site, 1 mile (1.6 kilometers) around the proposed sequestration site and on either side of the proposed electrical transmission line corridor, and immediately adjacent to the proposed underground utility corridors.

5.12.1.2 Method of Analysis

DOE identified land uses and potential sensitive receptors in the ROIs of the proposed power plant site, sequestration site, and utility corridors based on site visits, information in the Tuscola EIV (FG Alliance, 2006b), and 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.

5.12.2 AFFECTED ENVIRONMENT

5.12.2.1 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 Tuscola Power Plant Site, shown in

Figure 5.12-1, 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. Two industrial facilities, Cabot Corporation and Lyondell-Equistar Chemicals, are visible from the site to the west. The tallest visible feature associated with the Lyondell-Equistar and Cabot Corporation facilities is a 193-foot (59-meter) tall stack at the Lyondell-Equistar Power Plant (Ruppenkamp, 2006). A 101-foot (31-meter) tall Cargill grain elevator is visible from the site to the east (Zack, 2007). On its south side, the site is bordered by the CSX Transportation (CSX) Decatur Subdivision rail line and a CSX rail siding.

A few residences are located near the Tuscola Power Plant Site. Three single-family residences are located along the northern boundary of the site on CR 1050N. If the facility were located in the middle of the site, the residences would be about 600 feet (182.9 meters) from the facility. Other residences within 0.5 mile (0.8 kilometer) of the site include two residences to the north located between the site and CR 1150N, and five residences south of the site on or near SR 36. Additionally, there are several dozen residences within 1 mile (1.6 kilometers) of the site, almost all of which are near the 1-mile (1.6-kilometer) boundary of the ROI on the western edge of the City of Tuscola near the Illinois Central Gulf Railroad line.

As noted in Section 5.10, there are three previously recorded archaeological sites and five isolated finds within the ROI of the proposed power plant site. There are no historic sites within the ROI.



Figure 5.12-1. Proposed Tuscola Power Plant Site

The landscape of the proposed Tuscola Sequestration Site is similar to the proposed power plant site in that it has a relatively flat topography and is devoted to corn and soybean production. Figure 5.12-2 is a photograph of the proposed sequestration site. Aerial photography (Douglas County Highway Department, 2006) indicates that fewer than 10 residences are located on the proposed Tuscola Sequestration Site.

The landscape of the proposed underground utility corridors consists of typical Illinois farmland that is used for row crop production, with scattered farmsteads and other residences. Based on a review of

aerial photography (Douglas County Highway Department, 2006), the proposed CO₂ pipeline corridor, which would run from the proposed power plant site south along CR 700E, would pass within 0.25 mile (0.4 kilometer) of approximately 12 residences.

As noted in Section 5.10, there are no recorded archaeological or historic resources within the ROI of the proposed sequestration site.



Figure 5.12-2. Proposed Tuscola Sequestration Site

One transmission line option (Option 1) would require only a 0.5-mile (0.8-kilometer) transmission line from the proposed power plant site to an existing 138-kV transmission line that runs east through farmland areas and periodically crosses slightly rolling, small, constructed drainage swales, bermed ponds, two creeks, and the Embarras River (Figure 5.12-3). The Option 2 transmission line corridor would parallel the existing 138-kV line for approximately 17 miles (27.4 kilometers), and would also include about 3 miles (4.8 kilometers) of new ROW. Residences located within 0.25 mile (0.4 kilometer) of the existing transmission line ROW include residences in the Iron Horse golf course community, along Ascot Way, in Brookstone Estates, and in Lakeview Estates, as well as scattered residences along the north-south roads from CR 750E to CR 2250E. Aerial photography (Douglas County Highway Department, 2006) does not reflect all of the most recent construction in the area, but the photographs and subsequent construction suggest that there are about 120 to 150 residences within 0.25 mile (0.4 kilometer) of the existing 138-kV transmission line. The area within 0.5 mile (0.8 kilometer) of the existing line also includes North Ward Elementary School, two churches, and the community of Murdock.

The ROI for the proposed transmission line also includes two archaeological resource sites and an isolated find, as well as two rural cemeteries, as described in Section 5.10.

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



Figure 5.12-3. Proposed Tuscola Electrical Transmission Line Corridor

5.12.2.2 Light Pollution Regulations

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

5.12.3 IMPACTS

5.12.3.1 Construction Impacts

Power Plant Site

During construction at the proposed Tuscola Power Plant Site, the nearest neighbors, especially the three residences along the northern border of the site boundary on CR 1050N and the other seven residences within 0.5 mile (0.8 kilometer) of the site, would have an 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. The construction site would also be visible from the several dozen residences on the west side of Tuscola, near the outer perimeter of the 1-mile (1.6-kilometer) ROI.

As noted in Section 5.10, construction at the proposed power plant site is not anticipated to have any direct or indirect effects on cultural resources in the ROI (see IHPA concurrence letter in Appendix A).

Sequestration Site

The landscape at the sequestration site is similar to that at the proposed power plant site. During construction at the proposed Tuscola Sequestration Site, fewer than 10 residential properties would have nearly unobstructed and temporary views of construction activities at the 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, including the 12 residences within 0.25 mile (0.4 kilometer) of the proposed CO₂ pipeline corridor and persons driving along CR 700E. This would constitute a direct short-term impact on residences nearest the corridors during the construction period, which is estimated at 3 to 6 weeks each for the process water and CO₂ pipelines (FG Alliance, 2006b).

Construction along the 17-mile (27.3-kilometer) Option 2 electrical transmission line corridor would be visible from within the 1-mile (1.6-kilometer) ROI, particularly to persons living in the 120 to 150 residences estimated to be within 0.25 mile (0.4 kilometer) of the existing 138-kV line in the corridor, which would be a direct short-term impact for the duration of the construction period. Construction along the 0.5-mile (0.8-kilometer) Option 1 corridor would be visible at only a few houses and to motorists on that portion of CR 750E.

Construction along the transmission line corridor is not anticipated to affect the archaeological sites or rural cemeteries within the ROI (see IHPA concurrence letter in Appendix A).

Transportation Corridors

The existing roadways meet the current needs of traffic in the area of the proposed Tuscola Power Plant Site (FG Alliance, 2006b). If the site is selected for the FutureGen Project and a feasibility or traffic study indicates that the access roads need to be reconstructed, construction activity would be visible only to those immediately adjacent to the construction sites.

5.12.3.2 Operational Impacts

Power Plant Site

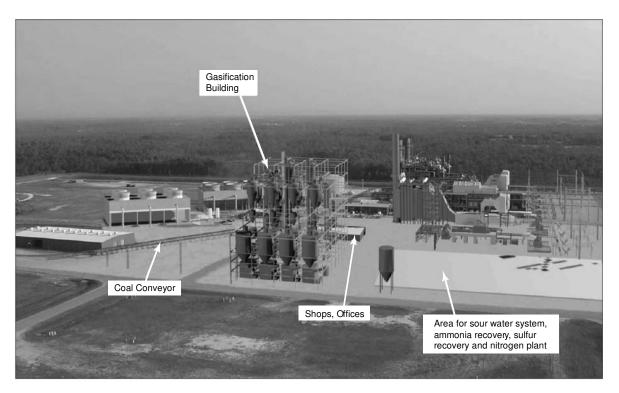
Major equipment for the power plant would include the gasifier and turbines, a 250-foot (76-meter) tall HRSG stack, a 250-foot (76-meter) tall flare stack, synthesis gas cleanup facilities, coal conveyance and storage systems, and particulate filtration systems. Additionally, the project would include 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 Tuscola Power Plant Site would include the main building, stacks, and communication towers. The maximum proposed height of the facility is 250 feet (76 meters). Residences closest to the site, including the three residences on the north edge of the proposed Tuscola Power Plant Site and seven other residences within 0.5 mile (0.8 kilometer) of the site, would have a nearly unobstructed view of the power plant. People at additional scattered residences located farther from the site, as well as people on the western edge of Tuscola and in public places such as Ervin Park, 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 from a distance of 7 to 8 miles (11.3 to 12.9 kilometers). The proposed FutureGen Power Plant would have aesthetic characteristics similar to other existing industrial facilities in the immediate area, such as the Cabot Corporation and Lyondell-Equistar facilities, grain elevators, and cement plants.

With respect to the site layout, the visual impact at the three nearest residences would be reduced if the facility were laid out such that the less intrusive features, such as administrative offices and similar buildings and parking areas, were located nearest the residences (i.e., on the north side of the site) and the more industrial features and coal storage piles were located farthest from the residences, near the rail line on the site's southern border. This configuration would move the more intrusive industrial features nearer the five residences south of the site, but these residences would still be more than 2,000 feet (610 meters) from the plant.

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 5.12-4 and 5.12-5 show two points on a range of conceptual IGCC plant designs. Figure 5.12-4 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 5.12-5 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.



Source: DOE, 2006a

Figure 5.12-4. Artist's Rendering of an IGCC Plant with Minimal Screening and Architectural Design Elements



Source: DOE, 2006b

Figure 5.12-5. Artist's Rendering of an IGCC Plant with Extensive Screening and Architectural Design Elements

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 5.12-4 would create a more industrial appearance. Although still very large in scale, a plant design similar to Figure 5.12-5 would have less of an industrial appearance, and would be visually less intrusive than the plant design shown in Figure 5.12-4. 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.

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. The existing Cabot Corporation and Lyondell-Equistar industrial facilities can be seen from approximately 7 to 8 miles (11.3 to 12.9 kilometers) away at night when the agricultural crops are still in the fields. This distance is increased in late fall, winter, and spring when the fields are barren or the crops have just been planted or harvested. The proposed FutureGen facility, including the vapor plumes, would likely be visible for a comparable distance. Intervening buildings, vegetation, and topography would reduce the visibility of the plant from some vantage points.

The plant is not anticipated to have any effect on the archaeological sites within the ROI (see Section 5.10 and IHPA concurrence letter in Appendix A).

Because there are no BLM visual resource management classifications or designated scenic vistas in the power plant site, 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 the plant lighting.

Sequestration Site

Once construction is complete, the tallest structure associated with the proposed Tuscola Sequestration Site would be about 10 feet (3.0 meters) tall. The facility would be visible to those passing by on the adjacent county roads, but would not be visible from a distance. It is likely that farming would continue on the Tuscola Sequestration Site, which would provide screening for the injection facility during the growing season. Thus, the project would create a direct, minor visual intrusion for those nearest the site primarily in the fall after harvest, during the winter, and in the spring before crops achieve their full growth.

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 nearby residences and those traveling on adjacent roadways.

On the proposed transmission line corridor, the visibility of the line would depend upon whether a new, parallel line or taller towers would be needed. 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, including at the 120 to 150 residences within 0.25 mile (0.4 kilometer) of the existing line and in the areas where the existing line abuts Ervin Park and the Iron Horse Golf Course. Any new substation would be visible to those nearby.

Transportation Corridors

If studies show that any road construction is required, the transportation corridors would appear similar to other transportation facilities. Once construction is complete and the power plant is in operation, the visual impacts would be similar to those for the power plant site, sequestration site, and utility corridors.

5.13 TRANSPORTATION AND TRAFFIC

5.13.1 INTRODUCTION

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

5.13.1.1 Region of Influence

The ROI for the proposed power plant site includes a 50-mile (80.5-kilometer) radius around the site, as shown in Figure 5.13-1. The Tuscola Power Plant Site is located on CR 750E approximately 0.5 miles (0.8 kilometers) north of U.S. Highway (US) 36 and approximately 2.5 miles (4.0 kilometers) from the center of Tuscola. It is approximately 2.5 road miles (4.0 kilometers) from the US 36 interchange with US 45 and 4 road miles (6.4 kilometers) from the US 36 interchange with Interstate 57 (I-57). Because most vehicle trips to the proposed site would use US 36 from the I-57 interchange, this transportation analysis focuses on the area within the 4-mile (6.4-kilometer) corridor on US 36 passing along the south edge of Tuscola. This analysis includes possible alternate routes using CR 1050 North, city streets, and US 45, and thus includes Tuscola's city street network and the area north to CR 1050.

5.13.1.2 Method of Analysis

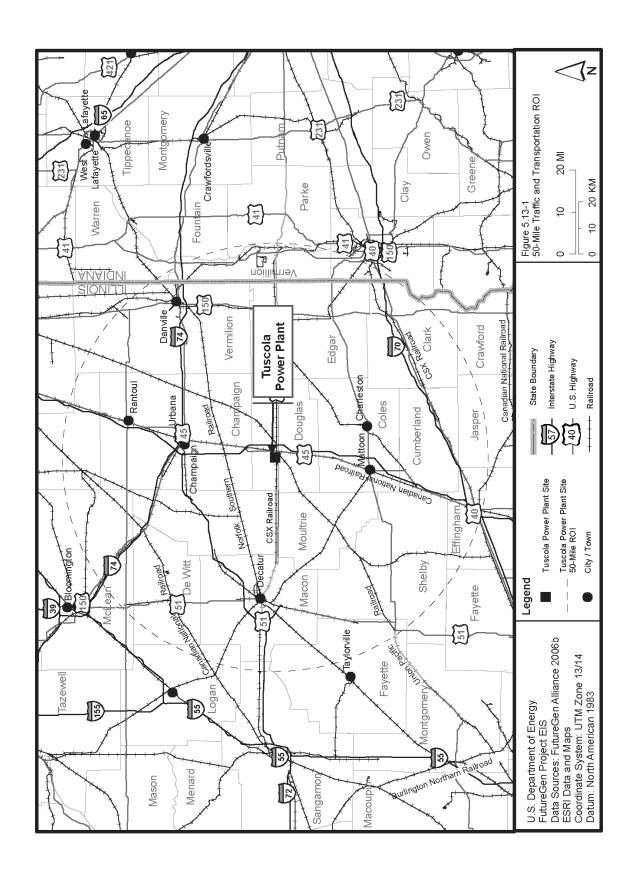
DOE reviewed information provided in the Tuscola EIV (FG Alliance, 2006b), which characterizes elements in the roadway hierarchy within the ROI based on function (e.g., city street and rural arterial), traffic levels, and observed physical condition. The EIV also contains traffic data obtained from the Illinois Department of Transportation (IDOT). The number of vehicle trips generated during construction and operations was based on data provided in the Tuscola EIV (FG Alliance, 2006b).

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 particular traffic facility based on operational conditions within a traffic stream, generally in terms of such 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

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).

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 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 is dependent on the Highway Class (I or II), lane and shoulder widths, accesspoint density, grade and terrain, percent of heavy vehicles, and percent of no-passing zones within the analysis segment. Class I two-lane 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 two-lane highway typically operates at lower speeds and most often serves shorter trips. Class II also includes scenic or recreational routes. Table 5.13-1 defines each LOS category for Class I and II two-lane highways.



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

Table 5.13-1. Level of Service Criteria, Two-Lane Highways

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 kilometer per hour). The LOS depends on the lane width, lateral clearance, median type, number of access points, free-flow speed, and percent of heavy vehicles. Table 5.13-2 defines the LOS criteria for each free-flow speed on a multi-lane highway.

Table 5.13-2. Level of Service Criteria, Multi-Lane Highways

| Free-Flow | | LOS | | | | | | |
|-----------------------|-----------------------|-----|----|----|----|----------------------|--|--|
| Speed (mph [kmph]) | Criterion | Α | В | С | D | E 40 41 43 45 | | |
| 60 (96.6) | | 11 | 18 | 26 | 35 | 40 | | |
| 55 (88.5) | Maximum | 11 | 18 | 26 | 35 | 41 | | |
| 50 (80.5) | density (pc/mi/ln) | 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 5.13-3 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).

| . resmay segments | | | | | | |
|-------------------|----------------------------------|--|--|--|--|--|
| LOS | Passenger Cars Per Mile Per Lane | | | | | |
| Α | 0 – 11 | | | | | |
| В | >11 – 18 | | | | | |
| С | >18 – 26 | | | | | |
| D | >26 – 35 | | | | | |
| E | >35 – 45 | | | | | |
| F | >45 | | | | | |

Table 5.13-3. Level of Service Criteria, Basic Freeway Segments

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 the 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, no methods are 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 site are not available (IDOT, 2005a). DOE reviewed IDOT's Comprehensive Highway Safety Plan (CHSP) (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:

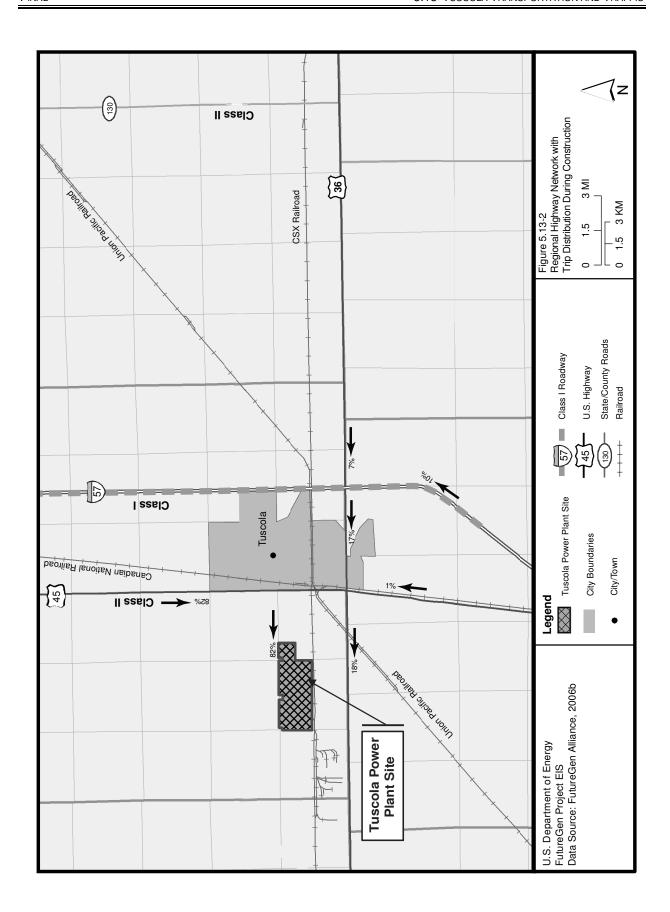
- Increase traffic volumes as to degrade LOS conditions on roadways;
- Alter traffic patterns or circulation movements;
- Alter road and intersection infrastructure:
- Conflict with local or regional transportation plans;
- Increase rail traffic compared to existing conditions on railways within the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

5.13.2 AFFECTED ENVIRONMENT

5.13.2.1 Roads and Highways

Figure 5.13-2 shows the local highway network in relationship to the regional network around the proposed Tuscola Power Plant Site. The proposed site is primarily accessed via I-57, immediately east of Tuscola and 4 road miles (6.4 kilometers) from the proposed Tuscola Power Plant Site. The proposed Tuscola Sequestration Site is located approximately 10 miles (16.1 kilometers) south of Tuscola and 1 mile (1.6 kilometers) west of US 45. Access to the proposed sequestration site would be via US 45 and CR 1700N or CR 1900N.

There are two potential routes to the proposed Tuscola Power Plant Site from I-57. The site could be accessed via US 36 to CR 750E, entering the proposed Tuscola Power Plant Site on its west side or via US 36, US 45, and CR 1050N to enter the proposed Tuscola Power Plant Site on its north side.



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, 2006b), there are no "sharp or hazardous curves" on any of the state-maintained roads.

I-57 is a four-lane divided north-south highway that connects with I-70 approximately 50 miles (80.5 kilometers) to the south and via I-70 to Indianapolis and St. Louis. 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).

In addition to I-57, the principal north-south highway is US 45, a two-lane highway that makes up the western border of Tuscola and runs parallel with I-57. US 45 connects with Arcola and Mattoon to the south and with Pesotum, Tolono, and Champaign to the north. US 45 is classified as a major collector roadway.

US 36 is a two- to four-lane east-west principal arterial highway on the southern edge of the Tuscola street grid, connecting with I-57 in a full interchange. US 36 intersects US 45 and I-57 approximately 2 miles (3.2 kilometers) and 3.5 miles (5.6 kilometers), respectively, to the east of the intersection of CR 750E and US 36. It crosses US 45 on an overpass with connections immediately southwest of the city. US 36 also serves the Lyondell-Equistar facility approximately 1 mile (1.6 kilometers) west of the proposed project site.

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 36 and US 45 are designated as Class II truck routes. The characteristics of each roadway class are shown in Table 5.13-4.

Table 5.13-4. 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

The proposed plant site is bordered by two county roads under the jurisdiction of the Tuscola Township Road Commissioner and the Douglas County Engineer. Either of these roads could serve as an access route to the proposed Tuscola Power Plant Site from US 45 and US 36. CR 750E parallels the western boundary of the proposed Tuscola Power Plant Site and CR 1050N parallels the northern boundary.

CR 750E is a two-lane rural roadway classified as a local roadway that runs north-south. CR 750E intersects US 36 approximately 0.5 mile (0.8 kilometer) to the south of the proposed Tuscola Power Plant Site. Access to the proposed Tuscola Power Plant Site could be made via this road. CR 750E currently has approximately 8 inches (20.3 centimeters) of oil and chip pavement with an oiled-earth base, and is roughly 20 feet (6.1 meters) wide. It has a weight capacity of 36 tons (32.7 metric tons).

CR 1050N (TR 47) is a two-lane minor collector roadway that runs along the north edge of the proposed Tuscola Power Plant Site and is rated at 36 tons (32.7 metric tons). CR 1050N intersects US 45 approximately 1 mile (1.6 kilometers) east of the proposed site and continues east to become Tuscola's North Line Road. I-57 can be accessed from this route by traveling approximately 9 miles (14.4 kilometers) north on US 45 to the I-57/US 45 interchange in Pesotum, Illinois; or by traveling 1 mile (1.6 kilometers) south to the intersection/interchange of US 45/US 36, then 1.5 miles (2.4 kilometers) east to the US 36/I-57 interchange.

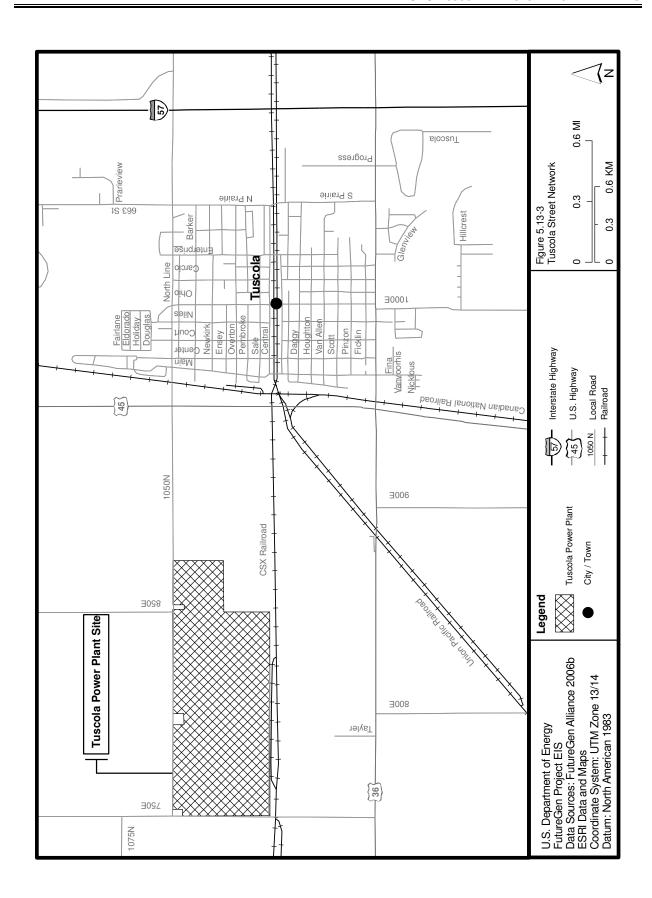
The Douglas County highway system routes range from bituminous treatment on 8 to 12 inches (20.3 to 30.5 centimeters) of compacted aggregate, bituminous overlay of rigid pavement, or concrete (rigid) pavements. Approximately 50 percent of the county's 102 miles (164 kilometers) of pavement is "high quality" pavements and surfaces.

Local Roads

Tuscola's street pattern is a grid of major and minor streets. Figure 5.13-3 shows the street network in Tuscola and key intersections. The township roads in Douglas County include dirt roads, aggregate roads, oiled earth, and bituminous seal coat on 6 to 8 inches (15.2 to 20.3 centimeters) of compacted aggregate. Approximately 85 percent of the township mileage in the county is either oiled earth or bituminous seal coat on compacted aggregate.

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.

- US 36 and I-57 Northbound ramps
- US 36 and I-57 Southbound ramps
- US 36 and South Prairie Street
- US 36 and US 45 ramps
- US 36 and CR 750E
- US 45 and CR 1050N



Programmed Transportation Improvements

IDOT has a Proposed Highway Improvement Program (HIP) for Fiscal Years 2007 to 2012 for each of its nine districts. The area within and adjacent to the 4-mile (6.4-kilometer) focus area is covered in the District 5 plan. The following are programmed improvements in the HIP and the approximate distance from the proposed Tuscola Power Plant Site:

- Bear Creek Bridge replacement, US 36 (3 miles [4.8 kilometers]);
- US 36 resurfacing, Moultrie County line to Washington Street in Tuscola (0.75 mile [1.2 kilometers]);
- Hackett Branch Bridge replacement, US 36, 2.4 miles (3.9 kilometers) east of I-57 (5 miles [8.0 kilometers]); and
- US 45 over Union Pacific Railroad and CSX Railroad, and over US 36 at Tuscola, new construction/bridge replacement (3 miles [4.8 kilometers]).

5.13.2.2 Railroads

There are four Class I railroads located within the ROI: CSX Transportation, Union Pacific, Canadian National, and Norfolk Southern. The proposed Tuscola Power Plant Site is bordered to the south by the CSX Transportation Decatur Subdivision rail line and a CSX rail siding (FG Alliance, 2006b).

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.

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. A CSX rail line borders the full

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

southern boundary of the proposed Tuscola Power Plant Site. The CSX line that serves the proposed Tuscola Power Plant Site is the Decatur Subdivision, which connects Decatur with CSX lines to the east in Chrisman, Illinois, and Hillsdale, Indiana. Currently, between four and six trains operate per day on this line; far below its capacity. The line can handle loads of up to 286,000 pounds (129,727 kilograms). Part of the line is currently restricted from six-axle locomotives. This section would require an upgrade to handle the traffic volume planned for the proposed FutureGen Project.

Union Pacific operates the largest railroad in Illinois, with 2,247 miles (3,616 kilometers) of track and 4,000 employees in Illinois. Tuscola is located on Union Pacific's main line track that connects Chicago and St. Louis. Daily freight train counts on this Union Pacific main line average 22 trains per 24-hour period. This Union Pacific main line has a 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.

Canadian National operates the second largest railroad in Illinois, with 1,519 miles (2,444 kilometers) of track. Through the Chicago gateway, the Canadian National moves freight between Canada and points

in the Mississippi Valley, the Gulf Coast, and Mexico. The Canadian National main line between Effingham and Champaign, Illinois, passes through Tuscola approximately 1.5 miles (2.4 kilometers) east of the proposed Tuscola Power Plant Site and parallels US 45. Canadian National runs 12 freight trains with service six days per week through Tuscola. The track is classified by the Federal Railroad Administration (FRA) as Class IV (maximum freight speed of 60 mph [96.6 kmph]). In addition, four Amtrak passenger trains classified at 79 mph (127.1 kmph) pass through Tuscola each day.

Class IV track, classified by the Federal Railroad Administration (FRA), allows a maximum freight speed of 60 mph (96.6 kmph).

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 Tuscola. This section is a main line with approximately 36 through trains per day. The track along that line can support car loadings of up to 286,000 pounds (129,727 kilograms). The Norfolk Southern Railroad has access to the proposed Tuscola Power Plant Site via an existing rail yard/switch yard located in Decatur, Illinois, approximately 30 miles (48.3 kilometers) west of Tuscola.

5.13.2.3 Local and Regional Traffic Levels and Patterns

Regional Traffic

According to IDOT, in 2005, I-57 carried approximately 19,300 vehicles per day (vpd, also referred to as average daily traffic [ADT]) south of Tuscola and approximately 26,600 vpd north of the city in 2005 (FG Alliance, 2006b). US 45 carried approximately 2,400 vpd in the vicinity of US 36, and US 36 carried approximately 4,450 vpd in the vicinity of CR 750E. Typically, morning and afternoon peak hour volumes range from 8 to 12 percent of the ADT (Table 5.13-5). 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 to calculate the peak hour truck volumes for this analysis.

| Roadway | ADT (vpd) ¹ | Truck ADT (vpd) ¹ | Weekday Peak Hour Volume (vph) ² | Weekday Peak Hour Truck Volume (vph) ² | LOS ³ |
|---------------------------|---------------------------|------------------------------|---|---|------------------|
| I-57, north of Tuscola | 26,600 | 7,750 | 2,660 | 775 | В |
| I-57, south of Tuscola | 19,300 | 6,450 | 1,930 | 645 | В |
| US 45 | 2,400 | 300 | 240 | 30 | Α |
| US 36 | 4,450 | 650 | 445 | 65 | С |
| CR 1050N | 390 | 47 | 39 | 5 | Α |
| CR 750E | 90 | 11 | 9 | 1 | А |

Table 5.13-5. 2005 Average Daily and Peak Hour Traffic Volumes

¹ Source: FG Alliance, 2006b.

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.

ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

IDOT (Region 3-District 5) does not keep records of LOS for the highways under state, county, or municipal control. The only time IDOT uses LOS is during capacity analysis and design of unsignalized and signalized intersections. However, Region 3-District 5 has performed an analysis to determine the LOS for the roadways in the vicinity of the proposed Tuscola Power Plant Site (FG Alliance, 2006b). Based on the existing roadway LOS reported in Table 5.13-5, DOE concluded that the key intersections near the proposed Tuscola Power Plant Site are likely to be operating smoothly as well.

Truck Traffic

Information provided by IDOT indicates that in 2005 there were approximately 7,750 trucks per day, or 29 percent of the ADT, using I-57 north of Tuscola; and approximately 6,450 trucks per day, or 33 percent of the ADT, using I-57 south of Tuscola (FG Alliance, 2006b). US 45 carried approximately 300 trucks per day in the vicinity of US 36, which is 13 percent of the ADT. US 36 carried approximately 650 trucks per day, or 15 percent of the ADT, in the vicinity of CR 750E. CR 1050N carried approximately 47 trucks per day, while CR 750E carried 11 trucks per day, both of which represent 12 percent of their respective ADTs.

There are several truck routes in the vicinity of the proposed Tuscola Power Plant Site. These truck routes use county roads near the proposed power plant site. I-57 is a Class I truck route, and US 36 and US 45 are Class II truck routes in the vicinity of the proposed Power Plant Site. The county roads have weight-bearing capacities of 36 tons (32.7 metric tons).

Rail Traffic

The proposed Tuscola Power Plant Site would be served by the CSX Railroad, which borders the proposed site's southern boundary. This line runs at approximately 25 percent capacity today (FG Alliance, 2006b). Accessing the proposed power plant site would require no new at-grade rail crossing.

5.13.3 IMPACTS

5.13.3.1 Construction Impacts

Power Plant Site

Based on the necessary permitting and design requirements, DOE expects that construction would begin on the proposed Tuscola Power Plant and related infrastructure is 2009 (FG Alliance, 2006b). Table 5.13-6 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 5.13-6. 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 |
|------------------------|---------------------------|------------------------------|---|---|------------------|
| I-57, north of Tuscola | 27,680 | 7,857 | 2,768 | 786 | В |
| I-57, south of Tuscola | 20,084 | 6,712 | 2,008 | 671 | В |
| US 45 | 2,297 | 312 | 250 | 31 | Α |

| Roadway | ADT ¹ (vpd) | Truck ADT ¹ (vpd) | Weekday Peak Hour Volume ¹ (vph) | Weekday Peak Hour Truck Volume ¹ (vph) | LOS ² |
|----------|---------------------------|------------------------------|---|---|------------------|
| US 36 | 4,631 | 676 | 463 | 68 | С |
| CR 1050N | 406 | 49 | 41 | 5 | Α |
| CR 750E | 94 | 11 | 9 | 1 | Α |

Table 5.13-6. 2009 Average Daily and Peak Hour No-Build Traffic Volumes

Based on the 2009 No-Build volumes, DOE estimated the capacity of each roadway (Table 5.13-6). 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 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 workforce for the proposed power plant site is estimated to average 350 workers on a single shift, with a peak period of 700 workers (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 in order to estimate the highest level of potential impact during construction.

Trips would be largely oriented to Tuscola and the I-57/US 36 interchange east of the city, and to Decatur 30 miles (48.3 kilometers) to the west on US 36. Principal routes to the interstate would be via CR 750E and US 36, and via CR 1050E, US 45, and US 36. The balance of trips would come to the proposed site via US 45 from the north and south and US 36 from the west. The expected trip distribution is summarized in Figure 5.13-2. All personal vehicles and trucks would use a single site entrance.

DOE assumed that the construction workforce would work a 10-hour work day, 5 days per week. Construction workforce trips would generally occur before the morning peak hours (7:00 am to 9:00 am) and coincide with the afternoon peak hours (4:00 pm 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 5.13-7). CR 750E and CR 1050N would see the most direct impact during construction with ADT volumes possibly increasing 370 and 1,600 percent, respectively. Though some of the percentage increases are very large, this is partially due to the low existing volumes on each road.

Table 5.13-7. 2009 Average Daily and Peak Hour Construction Traffic Volumes

| Roadway | ADT ^{1,2} (vpd) | Change in ADT ^{1,2} (percent) | Weekday Peak Hour Volume ^{1,3} (vph) | Change in Weekday Peak Hour Volume ² (percent) | LOS⁴ |
|-----------------------|-----------------------------|--|---|--|------|
| I-57 north of Tuscola | 28,832 | 4 | 3,331 | 20 | В |

¹ DOE estimate based on 1 percent growth per year from 2005.

² DOE used HCS+ to perform capacity analysis.

ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

| Roadway | ADT ^{1,2} (vpd) | Change in ADT ^{1,2} (percent) | Weekday Peak Hour Volume ^{1,3} (vph) | Change in Weekday Peak Hour Volume ² (percent) | LOS ⁴ |
|-----------------------|-----------------------------|--|---|--|------------------|
| I-57 south of Tuscola | 20,228 | 1 | 2,079 | 4 | В |
| US 45 | 3,678 | 47 | 827 | 231 | А |
| US 36 | 4,890 | 6 | 590 | 27 | С |
| CR 1050N | 1,587 | 291 | 618 | 1,422 | С |
| CR 750E | 1,534 | 1,538 | 713 | 7,517 | С |

Table 5.13-7. 2009 Average Daily and Peak Hour Construction Traffic Volumes

The I-57 interchange with US 36 would provide the main access route for all truck traffic from the north, south, and east to the proposed Tuscola Power Plant Site, while truck traffic from the west would use US 36 and CR 750E directly to the site entrance. This would not cause a large direct traffic impact on these roads due to the available capacity.

As shown in Table 5.13-7, 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 relatively minor. The capacity analysis of the roadways during the construction period is shown in Table 5.13-7. I-57 would continue to operate at LOS B both north and south of Tuscola, and US 45 and US 36 would continue to operate at LOS A and LOS C, respectively. CR 1050N and CR 750E would operate at LOS C (stable flow), compared to LOS A (free flow) under the 2009 No-Build conditions. Given that the roadways would be operating at LOS C 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, 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 US 36, as well as the ramps from US 45 to US 36, could see some temporary change in LOS due to the traffic volumes generated during construction. Changes to traffic signal timings may be required at the US 36/I-57 ramp intersections to accommodate changes in the turning volumes at those intersections.

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. Tuscola is served by several large construction material supply firms, offering both concrete and asphalt, within 20 miles (32.2 kilometers) of the proposed Tuscola Power Plant Site. DOE did not estimate a specific numbers of trips by trucks from any specific supply location; however, DOE included 40 truck trips per day (20 entering and 20 exiting the 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

¹ DOE estimate based on peak workforce of 700 workers arriving at site in SOVs, plus 40 truck trips per day (20 entering and 20 exiting the site).

² Trip distribution on area roadways is shown in Figure 5.13-2.

³ DOE derived peak hour volumes were derived assuming half of all passenger car trips occur in peak hour and truck trips are evenly distributed over a ten-hour work day.

⁴DOE used HCS+ to perform capacity analysis.

ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

40 per day, it is highly unlikely that it would result in a significant direct impact on roadways surrounding the proposed site.

Sequestration Site

There would be much less construction activity at the proposed Tuscola Sequestration Site and along the CO₂ pipeline connecting the proposed sequestration site to the proposed power plant site, than at the power plant site. Construction traffic to the proposed sequestration site and utility corridor would have a negligible direct impact on roadways and traffic.

Utility Corridors

All underground utilities (potable water, process water, wastewater, natural gas, and CO₂) are proposed to be constructed using open trenching (FG Alliance, 2006b). Though there would be a need for staging areas for this construction, DOE assumes that typical construction practices would be employed and all roadways would maintain one lane of traffic in each direction during construction. Construction of several of the proposed utility lines (process water, wastewater, and CO₂) is expected to last for approximately four to six weeks (FG Alliance, 2006b). During this time there would be minor disruptions to traffic, but they would not create a substantial direct impact to traffic operations.

Construction of the utility lines would require approximately 45 persons for all construction to occur concurrently (FG Alliance, 2006b). In the most conservative case, all construction workers would travel in single-occupant vehicles. Therefore, there would be approximately 90 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, 45 trips would take place before the morning peak hour. The 45 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 within the ROI and are not expected to have any appreciable direct impact on traffic operations.

Transportation Corridors

Based upon the analysis of 2009 construction conditions, no additional transportation infrastructure would be required to accommodate the proposed Tuscola Power Plant Site. DOE recommends that a truck route be implemented during construction to include I-57, US 36, CR 1050N, and CR 750E. Implementation of a truck route would also include signs on the affected roadways to and from the site.

A new private sidetrack from the CSX railroad would be constructed on the proposed Tuscola Power Plant Site and CSX ROW. The property adjacent to the southern boundary of the proposed power plant site belongs to CSX Transportation and is used as a switch yard and mainline rail facility. Access to the CSX mainline rail would be provided through the CSX Transportation ROW. DOE expects that construction of the new track would require approximately 9 to 11 months 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 C or better during construction (see Table 5.13-7), these trips would not be expected to appreciably change traffic operations on the roadway network.

During the connection of the rail loop to the existing CSX railroad, railroad safety flaggers would be required. This construction should have minimal, if any, impact on CSX railroad operations because the CSX ROW in this location contains switching facilities, which would allow approaching trains to be switched away from the track to which the private sidetrack was being connected.

5.13.3.2 Operational Impacts

The proposed FutureGen Project is expected to begin operating in 2012 (FG Alliance, 2006e). Table 5.13-8 shows 2012 No-Build traffic volumes, which DOE projected by applying a background growth rate of one (1) percent per year to 2005 volumes. This growth rate was determined through review of *IDCEO population projections (DCEO, 2005)*. Based on the 2012 No-Build volumes, DOE estimated the capacity of each roadway (Table 5.13-8).

| Roadway | ADT ¹ (vpd) | Truck ADT ¹ (vpd) | Weekday Peak Hour Volume ¹ (vph) | Weekday Peak Hour Truck Volume ¹ (vph) | LOS² | | | |
|-----------------------|---------------------------|------------------------------|---|---|------|--|--|--|
| I-57 north of Tuscola | 27,680 | 7,857 | 2,768 | 786 | В | | | |
| I-57 south of Tuscola | 20,084 | 6,712 | 2,008 | 671 | В | | | |
| US 45 | 2,497 | 312 | 250 | 31 | Α | | | |
| US 36 | 4,631 | 676 | 463 | 68 | O | | | |
| CR 1050N | 406 | 49 | 41 | 5 | Α | | | |
| CR 750E | 94 | 11 | 9 | 1 | Α | | | |

Table 5.13-8. 2012 Average Daily and Peak Hour No-Build Traffic Volumes

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 (FG Alliance, 2006e), 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. The workforce would result in 160 new peak hour trips in both the morning and afternoon peak periods. For this analysis, DOE assumed that these employees would arrive at the proposed plant in single-occupant vehicles and that the trip distribution would be the same as assumed for the construction worker trips, with the majority coming from Tuscola or from I-57 and reaching the proposed plant site via US 36. A portion of the workforce would come from communities to the west via US 36. Depending on the plant orientation, a single access gate could be located on either CR 1050N or CR 750E (FG Alliance, 2006b).

There would be a small number of delivery truck trips to the proposed plant to support personnel and administrative functions, and to deliver spare parts. Coal would be delivered by rail. Other bulk materials used by the plant and byproducts are expected to be delivered or removed from the proposed Tuscola 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. DOE estimated the number of truck trips required based on the estimated quantities of materials and 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,

¹ DOE estimate based on 1 percent growth per year from 2005.

² DOE used HCS+ to perform capacity analysis.

2 entering and 2 exiting, and byproduct removal would result in an additional 28 trips per day, 14 entering and 14 exiting. Delivery truck trips would not appreciably affect traffic on the truck route.

Estimated 2012 Build ADT and peak hour traffic volumes are given in Table 5.13-9. The most direct impact would be seen on CR 1050N and CR 750E, which directly abut the proposed site. It is assumed that every trip to or from the proposed Tuscola Power Plant Site would use either or both of these routes for access. Daily traffic volumes on CR 1050N and CR 750E would increase 103 and 446 percent, respectively. Although these percentages are very high, this is partially due to the low volumes that currently exist on these roads.

| Roadway | ADT ¹ (vpd) | Change in ADT ¹ (percent) | Weekday Peak Hour Volume ² (vph) | Change in Weekday Peak Hour Volume ² (percent) | LOS ³ |
|--------------------------|---------------------------|--------------------------------------|---|--|------------------|
| I-57 north of Tuscola | 28,781 | 1 | 2,983 | 5 | В |
| I-57 south of Tuscola | 20,725 | <1 | 2,086 | 1 | В |
| US 45 | 2,842 | 11 | 392 | 52 | Α |
| US 36 | 5,203 | 9 | 507 | 6 | С |
| CR 1050N | 850 | 103 | 176 | 322 | В |
| CR 750E | 528 | 448 | 174 | 1,700 | В |

Table 5.13-9. 2012 Average Daily and Peak Hour Build Traffic Volumes

ADT = average daily traffic; vpd = vehicles per day; vph = vehicles per hour; LOS = Level of Service.

As shown in Table 5.13-9, each roadway has enough available capacity to absorb these increases. I-57 would continue to operate at LOS B both north and south of Tuscola. US 45 and US 36 would continue to operate at LOS A and C, respectively. CR 1050N and CR 750E would operate at LOS B (reasonably free flow), compared to LOS A (free flow) under the 2012 No-Build conditions. Given that the roadways would be operating at LOS C 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 under the proposed operating conditions, 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 US 36/I-57 ramp intersections to accommodate changes in turning volumes at those intersections.

The primary component of materials transport would be the delivery of coal to the plant by rail, using the spur track. It is anticipated that deliveries would require five 100-unit trains per week or 10 entering or exiting train trips per week (FG Alliance, 2006e). This would equal a 24 to 36 percent increase in the number of trains on the CSX line through Tuscola, which currently accommodates 28 to 42 trains per week (four to six freight trains per day seven days per week) (FG Alliance, 2006b). Coal trains would use this line to and from the east and west. The line can handle loads of up to 286,000 pounds

¹ DOE derived ADT using the maximum operating workforce (200 persons, 400 vpd) passenger car trips (FG Alliance, 2006e) and assuming 32 operations-related truck trips daily (16 entering and 16 exiting the site).

² DOE derived peak hour volumes assuming that administration and 1/3 of shift workers arrive in peak hour, and that 4 truck trips occur in each peak hour.

³ DOE used HCS+ to perform capacity analysis.

(129,727 kilograms). A section of the line is currently restricted from six-axle locomotives, and would require an upgrade to handle the rail traffic volume for the proposed FutureGen Project.

There is one at-grade crossing of the CSX track by CR 750E near the proposed Tuscola Power Plant Site. This at-grade crossing does not have actuated gates and warning lights, as the only warnings of a crossing are the old crossbuck railroad signs on either side. IDOT's Comprehensive Highway Safety Plan specifically targets at-grade rail crossings as locations that should be improved to better highway safety with actuated gates and warning lights. All grade crossings within the Tuscola city limits are gate controlled; therefore, similar crossing protection would be required for any new crossings.

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 the crossing. A unit train car ranges from 48 to 53 feet (14.6 to 16.2 meters) long; therefore, a 100-car unit train is approximately 1 mile (1.6 kilometers) long. Train speed through at-grade crossings varies from 10 to 40 mph (16.1 to 64.4 kmph) (FRA, 2006). DOE assumed trains would pass through the at-grade crossing at approximately 10 mph (16.1 kmph). A 100-unit train traveling at 10 mph (16.1 kmph) would take approximately six to seven minutes to clear the 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 additional trains would not appreciably alter the results of this analysis.

Sequestration Site

There would be very little operational traffic to and from the proposed Tuscola Sequestration Site, and thus negligible direct traffic or roadway impact.

Utility Corridors

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

Transportation Corridors

There are no proposed transportation infrastructure improvements required in order for the existing roadway network to accommodate the proposed power plant and proposed sequestration site.

Operations using the proposed rail spur on the proposed Tuscola Power Plant Site would have little to no direct or indirect impact on the rail operations on the CSX line.

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5.14 NOISE AND VIBRATION

5.14.1 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 analyses completed for both noise and vibration. Specific details of the noise and vibration analyses are provided in sequence under each subsection, with the results of the noise analysis presented first followed by those of the ground-borne vibration analysis.

5.14.1.1 Region of Influence

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

5.14.1.2 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 Tuscola Power Plant Site, sequestration site, and related corridors. In preparing the noise and vibration analysis, DOE evaluated information presented in the Tuscola EIV (FG Alliance, 2006b) and estimated increases in ambient noise and ground-borne vibration levels, and evaluated the 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 vibration decibels (VdB).

Noise Methods

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.

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

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

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 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 5.14-1 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 time 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:

$$SPL_1 = SPL_2 - 20 \log (D_1/D_2) - A_e$$
, where:

- SPL₁ is the noise level at a sensitive receptor due to a single piece of equipment operating throughout the day;
- SPL₂ is the equipment noise level at a reference distance D₂;
- D₁ is the relative distance between the equipment noise source and a sensitive receptor;
- D₂ is the reference distance at which the equipment noise 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. Because the FutureGen Project is in the early pre-design stage, noise specification data for the power plant operating equipment is 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 Tuscola 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 as being sensitive receptors in this analysis.

| Sound Source | dBA | Response Criteria |
|---|-----|---|
| | 150 | |
| Carrier Deck Jet Operation | 140 | |
| | 130 | Painfully Loud Limit Amplified Speech |
| Jet Takeoff (200 feet) | 120 | |
| Discotheque Auto Horn (3 feet) Riveting Machine | 110 | Maximum Vocal Effort |
| Jet Takeoff (2000 feet) Shout (0.5 feet) | 100 | |
| N.Y. Subway Station Heavy Truck (50 feet) | 90 | Very Annoying Hearing Damage (8 hours, continuous exposure) |
| Pneumatic Drill (50 feet) | 80 | Annoying |
| Freight Train (50 feet) Freeway Traffic (50 feet) | 70 | Telephone Use Difficult |
| Air Conditioning Unit (20 feet) | | |
| Light Auto Traffic (50 feet) | 50 | Quiet |
| Living Room Bedroom | 40 | |
| Library Soft Whisper (15 feet) | 30 | Very Quiet |
| Broadcasting Studio | 20 | |
| | | Just Audible |
| | 0 | Threshold of Hearing |

Source: NYSDEC, 2000

Figure 5.14-1. 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 the 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

The concept of vibration is easily 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

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

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.

5.14.2 AFFECTED ENVIRONMENT

5.14.2.1 Power Plant Site

The proposed Tuscola Power Plant Site and the majority of the land area within 1 mile (1.6 kilometers) of its boundary are currently in agricultural use. There are three farmsteads (e.g., farm houses, outbuildings, silos, and pasture land) and single-family residences adjacent to the site, and several dozen additional residences within 1 mile (1.6 kilometers) of the site, almost all of which are near the 1-mile (1.6-kilometer) boundary of the ROI on the western edge of the City of Tuscola near the Illinois Central Gulf Railroad line.

Several existing noise sources contribute to the ambient sound levels in the vicinity of the proposed Tuscola Power Plant Site. These sources include existing United States (US) 36 and US 45; CSX, Union Pacific, and Canadian National rail lines; chemical/industrial facilities; County Road (CR) 750E, CR 850E, and CR 1050N; and farmsteads. The Tuscola EIV presents existing ambient noise levels based on daytime and nighttime measurements collected on August 30, 2006, at various locations along and within 1 mile (1.6 kilometers) of the proposed site boundary, as shown in Figure 5.14-2 (FG Alliance, 2006b). In addition, DOE took supplemental measurements on October 12 and 13, 2006, to record ambient noise levels at the nearest sensitive receptor location relative to the CSX rail line that is proposed

to be used for project-related coal deliveries. Table 5.14-1 describes geographic information and identifiers used for each noise measurement location.

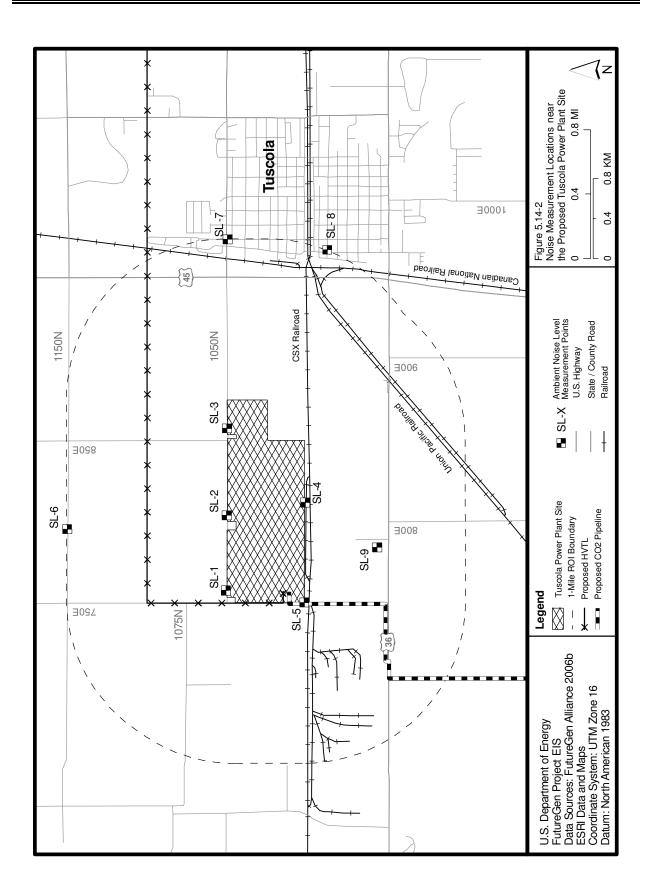
Table 5.14-1. Noise Measurement Locations Near the Proposed Tuscola Power Plant

| Site ID | Location | Proximity to Proposed Tuscola Power Plant Site |
|---------|---|--|
| SL-1 | Intersection of CR 750E and CR 1050N | Northwest corner of proposed site near existing farmstead |
| SL-2 | CR 1050N between CR 750E and CR 850E | Along northern boundary of proposed site near existing farmstead |
| SL-3 | Intersection of CR 850E and CR 1050N | Northeast corner of proposed site near existing farmstead |
| SL-4 | Access Road adjacent to CSXT railroad tracks | Along southern boundary of proposed site |
| SL-5 | CR 750E at CSXT railroad crossing | Southwest corner of proposed site |
| SL-6 | CR 1150N between CR 750E and CR 850E | Approximately 1 mile (1.6 kilometers) north of proposed site boundary between two farmsteads |
| SL-7 | Near Jarman Senior Center on Main Street | Approximately 1 mile (1.6 kilometers) east of proposed site boundary |
| SL-8 | Intersection of Wilson and Washington Streets | Along Wilson Street near single-family residences |

Source: FG Alliance, 2006b - SL-1 through SL-7; SL-8 measured by DOE.

Daytime noise measurements were collected at all locations shown on Figure 5.14-2, and nighttime measurements were collected at four locations: SL-1, SL-6, SL-7, and SL-8. These locations were chosen because they represent ambient noise levels along the property boundary and at sensitive receptors (residences and Jarman Senior Center) that are proximate to the proposed Tuscola Power Plant Site (FG Alliance, 2006b). 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 the hours between 10:00 PM and 7:00 AM. Existing noise levels were collected using a Reed Model 322 and Quest Model 2900 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 (FG Alliance, 2006b). The Type II sound level meter was equipped with a windscreen and mounted on a tripod approximately 4 feet (1.2 meters) above ground level, away from any reflective surface. Broadband noise levels were collected and recorded in dBA at each receptor location over sampling periods ranging from 6 to 10 minutes.

As described in the Tuscola EIV (FG Alliance, 2006b), no octave band measurements were taken. The sound level meter was field calibrated and weather conditions (e.g., temperature, wind) were noted before each sampling period. The ambient noise environment at SL-1 through SL-8 ranged from 39.2 to 66.1 dBA, which is generally typical of a quiet, rural setting. Intermittent increases in the ambient noise due to road and rail traffic fluctuations were recorded, which is indicated by the recorded peak maximum levels of 78.9 and 75.7 dBA during the day- and nighttime measurement periods, respectively, at SL-8 and SL-7. During the 4:00 PM to 5:00 PM measurement period at the SL-8 location (corner of Wilson and Washington streets), ambient noise was influenced by three heavy trucks traveling on the adjacent roadway and a 100-unit freight train passing by. The maximum SPL values recorded during this 6-minute measurement period was 78.9 dBA. Table 5.14-2 lists the recorded Leq noise levels as well as the maximum and minimum SPL values.



| | Daytim | e Noise Lo dBA | evels in | Nighttime Noise Levels in dBA | | | Time Collected | |
|----------|------------------|-------------------|----------|-------------------------------|------------------|----------|----------------|---------|
| Location | L _{max} | L _{min} | L_{eq} | L _{max} | L _{min} | L_{eq} | Day | Night |
| SL-1 | 74.5 | 45.5 | 49.2 | 73.9 | 49.2 | 52.4 | 10:24 AM | 6:02 AM |
| SL-2 | 61.3 | 40.6 | 50.9 | - | - | - | 9:08 AM | - |
| SL-3 | 69.3 | 42.8 | 47.8 | - | - | - | 7:55 AM | - |
| SL-4 | 53.8 | 43.8 | 47.3 | - | - | - | 7:30 AM | - |
| SL-5 | 67.2 | 44.1 | 47.9 | - | - | - | 7:12 AM | - |
| SL-6 | 46.3 | 41.8 | 43.9 | 67.4 | 41.2 | 46.1 | 8:46 AM | 6:45 AM |
| SL-7 | 76 | 40.7 | 47.5 | 75.7 | 42.2 | 51.6 | 9:30 AM | 6:20 AM |
| SL-8 | 65.6 | 32.1 | 48.0 | 52.9 | 31.6 | 39.2 | 8:00 AM | 6:25 AM |
| SL-8 | 78.9 | 37.8 | 66.1 | - | - | - | 4:23 PM | - |

Table 5.14-2. Measured Ambient Noise Levels and Maximum and Minimum Sound
Pressure Level Values

 $dBA = A\text{-weighted decibels}; \ L_{\text{max}} = \text{highest sound pressure level}; \ L_{\text{min}} = \text{lowest sound pressure level};$

 L_{eq} = continuous equivalent sound level.

Source: SL-1 to SL-7, FG Alliance, 2006b; SL-8 measured by DOE.

5.14.2.2 Sequestration Site

The Tuscola Sequestration Site is primarily agricultural farmland (e.g., corn fields) with a few single-family residences along the outskirts of the 1.1-mile (1.8-kilometer) plume radius. Farther beyond the 1.1-mile (1.8-kilometer) CO_2 plume radius boundary, there is a cluster of residences in the rural community of Arcola.

An ambient noise measurement was taken on October 13, 2006, in the area adjacent to where the CO_2 injection well is proposed to be installed. At the intersection of CR 000N and 700E, a L_{eq} value of 34.4 dBA was recorded during the early morning, with the minimum and maximum SPLs ranging from 26.8 to 53.4 dBA. This location is primarily influenced by the surrounding background noise levels; there are minimal vehicular traffic noise contributions in this area. The same noise measurement procedures were followed as described above.

5.14.2.3 Utility Corridors

The proposed transmission line corridor originates from the northwest corner of the proposed Tuscola Power Plant Site, as shown in Figure 5.14-2, heads north, and then follows a path due east along the right-of-way (ROW) for an existing 138-kV transmission line. The proposed corridor would occupy between 0.5 mile (0.8 kilometer) and 3 miles (4.8 kilometers) of new ROW, depending upon the option chosen. The existing land use along the ROW for the proposed transmission line is primarily agricultural farmland for crops such as corn and soybeans; however, there are a few sensitive receptors including farm houses and North Ward Elementary School in the vicinity of the corridor. The proposed transmission line corridor, which includes both the 138-kV and 345-kV options, traverses three townships, including Tuscola, Camargo, and Murdock, spanning approximately 17 miles (27 kilometers). No noise measurements were taken along this corridor, but the noise environment is likely to be similar to that of the rural setting described in Section 5.14.2.1. However, slightly elevated noise levels are expected in the area where the transmission line corridor crosses US 57, a major highway thoroughfare.

CO₂ Pipeline Corridor

The proposed CO_2 pipeline would occupy new ROW in an area where existing land use in the ROI is primarily agricultural farmland with a few industrial facilities and residences. DOE took an ambient noise measurement on October 13, 2006, at a representative location along the CO_2 pipeline corridor. At the intersection of CR 750N and 700E, the recorded L_{eq} value was 37.0 dBA during the daytime, with the minimum and maximum SPLs ranging from 31.6 to 55.6 dBA. This location is primarily influenced by the surrounding background noise levels; there are minimal vehicular traffic noise contributions in this area. DOE followed the same noise measurement procedures as described above.

Process Water/Wastewater Pipeline Corridors

The proposed process water pipeline and sanitary sewer lines would occupy existing property owned by Lyondell-Equistar Chemicals. The existing land use for this region of influence is industrial, row crops, and a small number of agricultural farmsteads. No noise measurements were taken along this corridor, but existing ambient levels are likely to be the same as that of the proposed Tuscola Power Plant Site.

Potable Water Pipeline Corridor

The proposed potable water pipeline extends to the west of the proposed power plant site in the same general area as the process water/wastewater pipelines. No noise measurements were taken along this corridor, but existing ambient levels are likely to be the same as cited above.

5.14.2.4 Transportation Corridors

The existing ambient noise level along US 36 (SL-9) is estimated to range from 57 to 67 dBA, a range that is typical of a busy highway.

5.14.2.5 Regulatory Setting

There are no federal, state, or local government noise standards applicable to proposed construction activities, and neither the City of Tuscola nor Douglas County has noise ordinances or codes that would apply to activities proposed for this project. For plant operation, the State of Illinois has established maximum noise level threshold standards. Additionally, the FTA establishes guidelines and threshold standards for noise and vibration related to projects affecting transit facilities (FTA, 2006).

State of Illinois Noise Code

Operational activities at the proposed Tuscola Power Plant Site and its related constructed corridors, including the electrical transmission line, CO₂, process water, wastewater, and potable water corridors, would be governed by the 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, and agricultural). The proposed Tuscola Power Plant 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, and 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 5.14-3 and 5.14-4 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 5.14-3. 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: Illinois Administrative Code Title 35, Part 901(35 IAC Part 901) - Sound Emission Standards and Limitations for Property Line-Noise-Sources During Daytime Hours

Table 5.14-4. 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: Illinois Administrative Code Title 35, Part 901(35 IAC Part 901) - Sound Emission Standards and Limitations for Property Line-Noise-Sources During Nighttime Hours

5.14.2.6 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 5.14.1.2 to identify receptors that the project could potentially affect and to estimate noise contributions from project related mobile and stationary sources. To determine if the 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, which 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 consideration 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.

5.14.3 IMPACTS

5.14.3.1 Construction Impacts

Construction of the proposed Tuscola 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 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 Tuscola 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's 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., crane) generally would be transient in nature or would not generate much noise.

Table 5.14-5 provides standard noise levels for construction equipment measured at a reference distance of 50 feet (15 meters).

Table 5.14-5. 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 |
| Concrete Mixer | 85 |
| Crane | 83 |
| Pump | 76 |
| Compressor | 81 |
| Jackhammer | 88 |
| Pile Driver | 101 |

dBA = A-weighted decibels.

Source: Bolt, Beranek, and Newman, 1971.

Due to the proximity of the receptors located along the perimeter of the proposed site (SL-1, SL-2, and SL-3), mitigation would be necessary to reduce impacts resulting from the construction of the power plant. To evaluate the potential maximum effects of the anticipated noise level increases on the sensitive receptors located to the north, south, and east of the site boundary, DOE predicted equipment source noise levels using the logarithmic equation described in Section 5.14.1.2.

First, the combined noise level expected from the three noisiest pieces of equipment (excavator, grader, and dump truck) used during the initial phase of construction was attenuated over the relative distances from the site boundary to the following seven directional noise-sensitive receptors:

- SL- 1: Northwest corner of proposed site near existing farmstead
- SL- 2: Along northern boundary of proposed site near existing farmstead
- SL- 3: Northeast corner of proposed site near existing farmstead
- SL-6: North of proposed site boundary between two farmsteads
- SL-7: East of proposed site boundary
- SL-8: Along Wilson Street near single family residences
- SL-9: Along US 36, south of the proposed site boundary

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 5.14-6. This represents a maximum noise prediction estimate because sound waves generated by the noisiest pieces of equipment are assumed to start at 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.

| Residential Receptor | Relative Distance in miles (kilometers) | 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 | 0 | 47.8 | 93 | 93.0 | 93.0 | +45.2 |
| SL-2 | 0 | 47.3 | 93 | 93.0 | 93.0 | +45.7 |
| SL-3 | 0 | 47.5 | 93 | 93.0 | 93.0 | +45.5 |
| SL-6 | 1 (1.6) | 43.9 | 93 | 52.5 | 53.1 | +9.2 |
| SL-7 | 0.9 (1.4) | 47.5 | 93 | 53.0 | 54.1 | +6.6 |
| SL-8 | 1.1 (1.8) | 48.0 | 93 | 51.5 | 53.1 | +5.1 |
| SL-9 ² | 0.5 (0.8) | 62 ² | 93 | 59.4 | 63.9 | +1.9 |

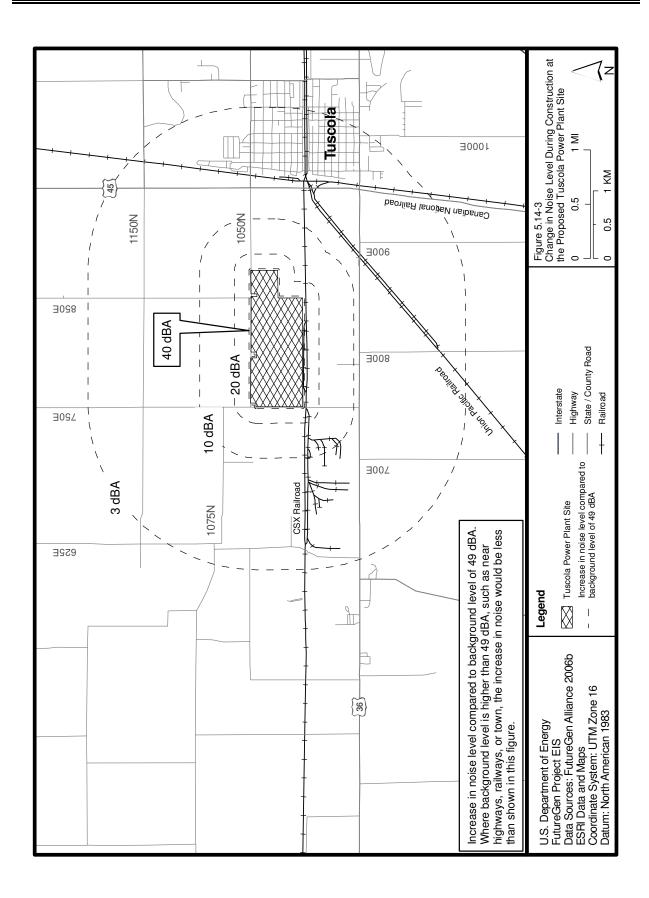
Table 5.14-6. Estimated Noise Level at Selected Residential Receptor Locations

A comparison of the predicted noise levels with the measured daytime ambient noise levels at SL-1, SL-2, SL-3, SL-6, SL-7, and SL-8 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 Tuscola Power Plant would be noticeable to these receptors because the incremental change from the existing condition would be 45.2, 45.7, 45.5, 9.2, 6.6, and 5.1 dBA, respectively. Noise level changes of 45 to 46 dBA would be very significant, as expected with heavy equipment operating right at the boundary of three properties (SL-1, SL-2, and SL-3). The 9.2 dBA noise increase at SL-6 would be perceived as nearly a doubling in the noise level. The 5 to 6 dBA increases at SL-7 and SL-8 would be readily perceptible to the human ear. Mitigation measures would need to be considered to reduce the effects of construction, particularly at the three residences adjacent to the site boundary (SL-1, SL-2, and SL-3). At SL-9, even with the noisiest equipment operating, construction noise from the proposed plant site would not be noticeable because the incremental change resulting from construction activity would be less than 2 dBA.

To evaluate the potential maximum impacts for the nighttime period when the existing background noise levels would probably be the quietest, DOE performed a supplemental noise study on June 28, 2007, during the early morning hours. The results of the supplemental noise study showed that the ambient environment within an approximate 2-mile radius of the power plant would be quietest during the night between 12 AM and 4AM, with an averaged background noise level of 49 dBA. During the early morning hours, DOE personnel observed that the ambient noise environment was influenced by the 24-hour operation at neighboring industries and intermittent spikes generated by train horns, whistles, and track noises that can be heard when rail cars traveling on the CSX, Union Pacific, or Canadian rail lines pass by the City of Tuscola. Based on the averaged 49 dBA background level, Figure 5.14-3 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 1.5 miles (2.4 kilometers) from the boundary of the power plant site, an area that would encompass much of downtown Tuscola. However, at any point where the background noise level was actually higher, such as on downtown streets, near all three rail lines mentioned above, and near US 36 or US 45, Figure 5.14-3 overstates the increase in noise level.

¹ Combined equipment noise level at 50 feet (15 meters) from source.

² No noise measurements were taken at SL-9 located on US 36; however, ambient noise is estimated to range from 57 to 67 dBA because receptor is near major roadway and is influenced by heavy traffic noise (FHWA, 1998). dBA = A-weighted decibels.



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 72 dBA at the property boundary, which would affect the three closest residences (SL-1, SL-2, and SL-3). Noise levels at these three receptors would increase by as much as 25 dBA compared to the measured background levels shown in Table 5.14-2. At residential receptors located beyond the perimeter of the site (SL-6, SL-7, SL-8, and SL-9), the ambient noise generated by the steam blows could range from 58 to 66 dBA, which is up to 15 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 commencing plant blowdown activity. Blowdown activities generally would last no more than 2 weeks.

DOE anticipates little or no vibration impacts at 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 (2006).

Sequestration Site

Construction at the sequestration site would be limited to the installation of CO₂ injection wells. No noise and vibration impacts on sensitive land uses are anticipated at the injection well locations. Noise level increases during construction would be less than 3 dBA at the nearest residences.

Utility Corridors

Transmission Corridor

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, although a temporary increase in noise due to construction would 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 even if the 17-mile (27-kilometer), 345-kV transmission line were built. Temporary construction activities would include activities 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 an excavator and a dump truck. At roadway and rail crossings, a boring machine would be used to complete excavation under the roadway or rail line.

Transportation Corridors

The truck routes connecting Interstate 57 (I-57) to the proposed Tuscola Power Plant Site are US 36, US 45, CR 750E, and CR 1050N. Existing vehicle traffic count data along the transportation routes leading into the proposed site are provided in Table 5.14-7. It is anticipated that additional traffic resulting from 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 5.14-7 show that, in the absence of mitigation, construction-related vehicles (e.g., passenger cars and trucks) traveling on CR 750E and CR 1050N to and from the proposed power plant would appreciably increase the noise level (that is, cause a change greater than 3 dBA) at nearby noise-sensitive receptors. Conversely, the impacts on noise-sensitive receptors adjacent to US 36 would not be noticeable.

To obtain more specific information on the potential impacts that construction traffic may have on receptors adjacent to CR 750E and CR 1050N, DOE took a PM peak hour ambient noise measurement and conducted a detailed TNM analysis along both roadways following issuance of the DEIS. Measurements were taken in front of SL-1 on CR 750E and SL-3 on CR 1050N on June 27, 2007, using the same methods described in Section 5.14.1.2. 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 65.1 dBA and 64.8 dBA with the TNM predicted L_{eq} values of 55.5 dBA and 56.8 dBA to calibrate the modeling program for the CR 750E and CR 1050N roadway segments; respectively. The results of this comparative analysis showed that ambient noise in both noise study areas are influenced by other noise sources in addition to those generated by roadway traffic.

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 CR 750E and CR 1050N. The TNM output file predicted an incremental change of 14.1 dBA and 7.2 dBA along CR 750E and CR 1050N; respectively, which is slightly more than the preliminary results shown in table 5.14-7. Consistent with the results presented in the draft EIS, 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 to reduce noise impacts on CR 750E and CR 1050 could include diverting most of the construction-related truck traffic traveling along CR 750E to the CSX access roadway on the south side of the proposed site and adjusting construction worker shifts to lower the total vehicle trips during the morning and evening peak hours.

| 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 |
|-------------------------|---------------------------------|--|--|--|---|
| US 36, east of CR 750E | 445/65 | 463/68 | 127/1 | 590/69 | 0.3 dBA |
| CR 750E, north of US 36 | 9/1 | 9/1 | 704/4 | 713/5 | 13.7 dBA |
| CR 1050N, west of US 45 | 39/5 | 41/5 | 577/3 | 618/8 | 6.8 dBA |

Table 5.14-7. Projected Noise Level Increase during Construction

Peak hour traffic data are provided as total/truck volumes.

Build/No-Build Year: 2009.

AM peak and PM peak hour volumes are the same.

Project New Total/Truck Trips were obtained from Table 5.13-9.

dBA = A-weighted decibels.

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

5.14.3.2 Operational Impacts

Projected noise levels that were calculated using the noise screening and analysis methods described in Section 5.14.1.2 show that there would be significant permanent ambient noise level increases resulting from operation of the proposed power plant facility at receptors located to the north along 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 be noticeable to noise-sensitive receptors identified near assigned transportation routes, except for the one residence adjacent to US 36. DOE expects no operational impacts at the constructed CO₂, natural gas, potable water, and wastewater pipeline corridors because the pipelines would be buried underground. The 345-kV transmission line, as well as the pumps and compressors that are used to convey liquid and gaseous flow through the pipelines, may generate some additional noise to the existing ambient environment; however, the results of the impacts analysis show that any noise impacts would be minimal.

Power Plant Site

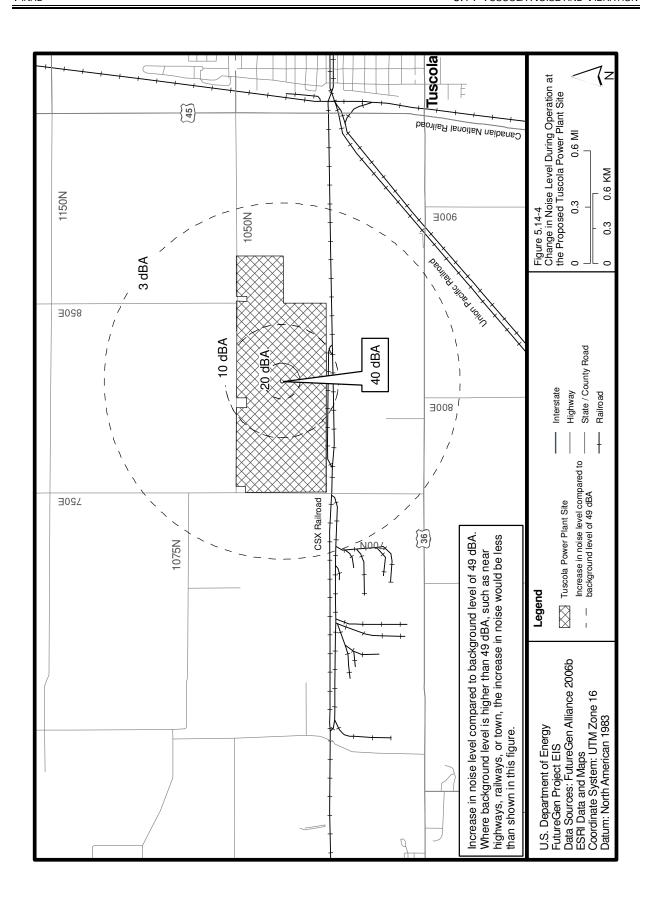
The principal equipment noise sources during plant operation include the gas combustion turbine/generator, steam turbine/generator, heat recovery systems, turbine air inlets, exhaust stack, six-cell mechanical-draft cooling tower, coal crusher, coal mill, pumps (e.g., feed, circulating), fans, and compressors, as well as noise from piping flow and flared gas. For the most part, these noise sources would be enclosed inside 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 by equipment installed without full enclosures and exposed to the outside environment 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 is 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 Tuscola Power Plant Site. Using the predicted noise level of 53 dBA at 0.6 mile (1.0 kilometer) that was 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 Tuscola Power Plant.

DOE applied the source noise level to the proposed 345-acre (140-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 0.3 mile (0.5 kilometer) from the center of the property to the site's perimeter, DOE predicted a noise level of 59 dBA at the property boundary. A comparison of the predicted versus the existing noise level shows that the proposed power plant would cause an increase of up to 12 dBA at the property boundary, which would increase the noise levels at the three closest residences (SL-1, SL-2, and SL-3). Correspondingly, the predicted noise level at the closest residential receptor to the south (e.g., SL-9, approximately 0.8 mile [1.3 kilometers] from the center of the property) would be 51 dBA. Adding the predicted noise contribution from the proposed power plant site to the lowest anticipated ambient noise level of 57 dBA at SL-9 resulted in an estimated combined noise level of 58 dBA, a 1 dBA increase that would be imperceptible to the human ear. The closest directional receptors that are approximately 1.3 miles (2.1 kilometers) to the north and 1.25 miles (2.0 kilometers) to the east of the site would experience an incremental change of 4.3 and 2.6 dBA in the ambient noise level, respectively. Based on this analysis, DOE anticipates little or no noticeable impact at sensitive receptors located to the south and east of the proposed power plant. However, in the absence of mitigation, significant permanent ambient noise level increases would be expected for the receptors located to the north and along the perimeter of the site (e.g., SL-1, SL-2, SL-3, and SL-6).

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 in the vicinity of the power plant had a background noise level of 49 dBA as described in Section 5.14.3.1. Based on the averaged 49 dBA background level, Figure 5.14-4 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 1 mile (1.6 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 only a few residences. At any point where the background noise level was actually higher than 49 dBA, such as near the existing three rail lines, US 36, or US 45, the figure overstates the increase in noise level that would actually occur at those sites. As noted above, the actual predicted change at SL-9, which is within the 3-dBA contour shown on Figure 5.14-4, would be just 1 dBA because of the higher ambient noise level associated with that location near US 36.



During coal deliveries, noise would be generated by unloading/loading activities such as the movement of containers, placement of coal feedstock on conveyors 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 predicted 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 site during unloading/loading activity. However, noise levels for the Tuscola Site during coal unloading would increase be less than 3 dBA at the three closest residential receptors (Sl-1, SL-2, and Sl-3), because the coal delivery area would likely be located near the southern boundary of the site near the existing railroad, which is more then 0.5 mile (0.8 kilometer) from SL-1, Sl-2, and SL-3, and noise levels would be less than 3 dBA at four other residences within 1 mile (1.6 kilometers) of the site boundary. 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 electrical 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.

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 away 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 resulting 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 Tuscola 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 Illinois noise spectrum limitations.

Sequestration Site

Operations at the sequestration site would entail pumping CO₂ underground. Only minimal noise impacts are anticipated during operation and maintenance at the injection well point. 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 major impacts are 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

The CO₂ pipeline would be buried except where it is necessary to come to the surface for valves and metering. Although valve spacing has not been determined at this time, a typical distance between metering stations is 5 miles (8 kilometers). Typically, these features are installed on concrete pads and surrounded by fencing. Alternatively, these features can be enclosed in metal buildings. These features do not have to be above ground; it is not uncommon for valves and meters to be located below grade in concrete vaults. Limited noise impacts from equipment above ground would be anticipated along the proposed CO₂ pipeline corridor during plant operation.

No noise or vibration impacts would be anticipated at the other 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 sensitive receptors near 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 5.14.1.2. *As presented in the DEIS*, *results* showed vehicle trips on roadways leading to the proposed Tuscola Power Plant Site would have minimal effects on noise-sensitive receptors near US 36 during normal plant operations because the predicted change in the ambient noise level is much less than 3 dBA. However, in the absence of mitigation, sensitive receptors near CR 750E and CR 1050N *were expected to* experience permanent ambient noise level increases of up to 9.2 and 3.5 dBA, respectively. Table 5.14-8 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 CR 750E and CR 1050N using the 2012 Build and No Build traffic data. The TNM results predicted incremental changes of 9.4 and 4.1 dBA

on those two road segments, respectively, slightly higher than those shown in Table 5.14-8. 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. Adhering to the recommended truck routes and limiting trips to the daytime hours would help reduce noise impacts at residences along transportation routes.

| Table 5.14-8. | Projected Noise Lev | vel 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 |
|-------------------------|---------------------------------|--|--|--|---|
| US 36, east of CR 750E | 445/65 | 477/70 | 30/1 | 507/71 | 0.1 dBA |
| CR 750E, north of US 36 | 9/1 | 10/1 | 164/4 | 174/5 | 9.2 dBA |
| CR 1050N, west of US 45 | 39/5 | 42/5 | 164/3 | 176/8 | 3.5 dBA |

Peak hour traffic data are provided as total/truck volumes.

Build/No-Build Year: 2012.

AM peak and PM peak hour volumes are the same.

Project New Total/Truck Trips were obtained from Table 5.13-9.

dBA = A-weighted decibels.

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

Five 100-unit trains per week for coal deliveries would use the CSX 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 train passes through the City of Tuscola. 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 four to six rail trips per day on the CSX rail line, DOE estimates that the number of trains on the line would increase about 24 to 36 percent (five trains coming and going [10 trips] added to an average 35 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. No vibration impacts are anticipated at sensitive receptors near the Tuscola Power Plant Site because the closest vibration-sensitive receptors, including humans, buildings, and sensitive equipment, are not located within the 200-foot (61-meter) perimeter defined by FTA's distance screening threshold guidance. The closest residential receptor (SL-8) that could possibly be affected by ground-borne vibrations generated by project-related rail deliveries is approximately 320 feet (97.5 meters) from the CSX rail line.

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 250 feet (76.2 meters) at the proposed Tuscola Power Plant Site, ground-borne vibrations are not expected to propagate over extended distances (FG Alliance, 2006e).

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5.15 UTILITY SYSTEMS

5.15.1 INTRODUCTION

This section identifies utility systems that may be affected by the construction and operation of the proposed FutureGen Project at the proposed Tuscola Power Plant Site, 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.

5.15.1.1 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 site, sequestration site, or utility corridors.

5.15.1.2 Method of Analysis

Based on data provided in the Tuscola EIV (FG Alliance, 2006b), 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, 2006b) 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 offsite construction for connection with a public wastewater system; and
- Affect the capacity and distribution of local and regional energy and fuel suppliers.

5.15.2 AFFECTED ENVIRONMENT

5.15.2.1 Potable Water Supply

Several options exist near the proposed Tuscola Power Plant Site for potable water service. An existing water line operated by the Arcola-Tuscola Joint Water Agency runs parallel to the CSX rail line on the north side of the rail line. This 8-inch (20.3-centimeter) line would be available to provide potable water to the proposed Tuscola Power Plant Site. Less than 1 mile (1.6 kilometers) of pipeline along new ROW would be required to connect to the existing pipeline.

Illinois American Water Company was unable to provide specific information regarding demand versus capacity of the 8-inch line (20.3-centimeter) adjacent to the plant site. However, it provided information concerning the 14-inch (35.6-centimeter) transmission line located approximately 0.75 mile (1.2 kilometers) east of the proposed plant site. At this location, the 14-inch (35.6-centimeter) main connects into two separate 8-inch (20.3-centimeter) mains, with one serving the City of Tuscola and the other serving the City of Arcola. The 14-inch (36-centimeter) main currently supplies up to 2.0 MGD (7.6 MLD) for both cities. This amount is dictated by an existing agreement between the Cities of Arcola, Tuscola, and Illinois American Water. The actual daily use of water by both cities from this line is roughly 1.0 MGD (3.8 MLD).

The ultimate design capacity of the 14-inch (35.6-centimeter) line is between 3.0 and 3.5 MGD (11.4 and 13.3 MLD), which results in an "in main water velocity" of 4 to 4.5 feet (1.2 to 1.4 meters) per second. The pumps and impellers of the upstream pump station would need to be re-configured in order to reach the ultimate design capacity of the 14-inch (35.6-centimeter) line. Thus, the current demand on the 14-inch (35.6-centimeter) line is about 28.6 percent of the ultimate design capacity. It is not known whether the same demand versus capacity ratio could be applied to the existing 8-inch (20.3-centimeter) main that is located along the south property line of the proposed Tuscola Power Plant Site.

5.15.2.2 Process Water Supply

The proposed Tuscola Power Plant Site would receive its required 4.3 MGD (16.3 MLD) non-potable water supply from a 150-million-gallon (568-million-liter) holding pond at Lyondell-Equistar Chemical Company, located west of the site and operated by Duke Energy Generation Services. Lyondell-Equistar Chemical Company currently supplies its holding pond with raw water pumped from the adjacent Kaskaskia River. Table 5.15-1 provides a summary of raw water usage by the Lyondell-Equistar plant for 2003 through 2005.

Table 5.15-1. Consumption/Discharge Data at Lyondell-Equistar Chemical Company Water Intake

| | 2003 | | 20 | 2004 | | 2005 | |
|---------|------------------|------------|-------------|-------|------|-------|--|
| | MGD | MLD | MGD | MLD | MGD | MLD | |
| | | River Flow | Near Intake | | | | |
| Maximum | 345 | 1,308 | 477 | 1,808 | 487 | 1,846 | |
| Minimum | 4.0 | 15.2 | 5.0 | 18.9 | 3 | 11.4 | |
| Average | 19 | 72 | 36.59 | 138.7 | 8.85 | 33.5 | |
| | | Return D | ischarge | | | | |
| Maximum | 5.81 | 22 | 5.62 | 21.3 | 8.54 | 32.4 | |
| Minimum | 0.39 | 1.5 | 0.44 | 1.7 | 0.3 | 1.14 | |
| Average | 1.56 | 5.9 | 1.73 | 6.6 | 1.34 | 5.1 | |
| | Consumption Rate | | | | | | |
| Maximum | 3.0 | 11.4 | 3.01 | 11.4 | 2.6 | 9.9 | |
| Minimum | 1.83 | 6.9 | 1.69 | 6.4 | 1.71 | 6.5 | |
| Average | 2.19 | 8.3 | 2.01 | 7.6 | 1.96 | 7.4 | |

MGD = million gallons per day; MLD = million liters per day. Source: Behl, 2006.

Based on the information provided in Table 5.15-1, Lyondell-Equistar Chemical Company's average consumption rate from 2003 to 2005 is 2.05 MGD (7.8 MLD), and the average return discharge to the river is 1.54 MGD (5.8 MLD). These are far below the maximum capacity of the system. During normal flow periods in the Kaskaskia River, the plant regularly pumps water from the Kaskaskia River to maintain the water level in the holding pond. During low-flow periods, however, the plant typically does not pump from the river to maintain the holding pond level, but instead continues to draw water from the pond. Lyondell-Equistar Chemical Company estimates that the pond can supply its plant without pumping from the river for 30 to 45 days. During low flow periods, the company has access to groundwater that can be pumped into the Kaskaskia River from the Mahomet aquifer, upstream of the facility near Bondville, Illinois, to augment the river flow.

Lyondell-Equistar Chemical Company has the future potential to become a "zero discharge" plant (Behl, 2006). This would mean that the plant would discontinue discharge of its treated effluents, and would reuse the effluent for plant processes. If that occurs, less water would need to be pumped from the Kaskaskia River for Lyondell-Equistar Chemical Company's processing needs, and the company would be able to provide water to the proposed Tuscola Power Plant Site at a flow rate of 3,000 gallons (11,356 liters) per minute or 4.3 MGD (16.3 MLD).

Fire protection at the proposed Tuscola Power Plant Site would be provided by use of the proposed force main from Lyondell-Equistar Chemical Company. Construction of an on-site reservoir to hold water for fire protection as well as other purposes is also an option.

5.15.2.3 Sanitary Wastewater System

Two options exist for sanitary wastewater treatment at the Tuscola Power Plant Site. Wastewater from the power plant could be treated by Duke Energy Generation Services, the same facility that would provide non-potable makeup water. The wastewater treatment plant operated by Duke Energy is located less than 1 mile (1.6 kilometers) from the proposed Tuscola Power Plant Site, and is operating at less than 25 percent of its rated capacity. An existing line, formerly used as a potable water line, dead ends directly across the road to the west of the proposed Tuscola Power Plant Site. This line could be used as a force main to run wastewater from the power plant site to Duke Energy's wastewater treatment facility. This would allow for wastewater treatment without the installation of a new wastewater line.

The other option for sanitary wastewater systems would be to construct an on-site wastewater treatment facility that would be capable of meeting the future needs of the proposed power plant.

5.15.2.4 Electricity Grid, Voltage, and Demand

The proposed Tuscola Power Plant 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.

Peak demand in the SERC region occurs during the summer months. As of 2006, the total internal demand was 188,763 MW, which is forecast to increase to 226,921 MW by 2015 (North American Electric Reliability Council [NERC], 2006), representing a growth rate of

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.

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.

The proposed power plant could tie into a 138-kilovolt (kV) line 0.5 mile (0.8 kilometer) north of the site. This line is owned and operated by Ameren Corporation, and runs east/west. It connects with a 345-kV line about 17 miles (27.4 kilometers) to the east (the Sidney-Kansas 345-kV line, near Murdock, Illinois). Another option would be for the plant to connect to a new 345-kV line that would parallel or replace the 138-kV line and connect to the 345-kV Sidney-Kansas line.

A preliminary interconnection (PowerWorld Corporation, 2006) estimates the capacities of the existing transmission network to deliver power from the proposed facility (Table 5.15-2). The system interconnection was modeled with both 138- and 345-kV system connections.

| · | | | | | | |
|----------|------------|--------------|-----------------------|---------|--|--|
| Scenario | ATC (Therm | al Capacity) | PV (Voltage Capacity) | | | |
| Scenario | Summer | Winter | Summer | Winter | | |
| 138-kV | 187 MW | 244 MW | 375 MW | 385 MW | | |
| 345-kV | 631 MW | 464 MW | 1038 MW | 1085 MW | | |

Table 5.15-2. Capacities of Existing Transmission Network

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

Directly south of the proposed Tuscola Power Plant Site, immediately on the south side of the CSX rail line, is a 69-kV substation operated by Ameren Corporation. A 69-kV line runs parallel to the south border of the plant site from this substation.

5.15.2.5 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 Tuscola Power Plant Site would be serviced by a natural gas transmission line operated by Trunkline Gas Company, a subsidiary of Southern Union Company. The gas pipeline that would serve the proposed power plant site is a high pressure line. The pipelines on the discharge side of the station are 26 and 30 inches (66 and 76 centimeters) in diameter. The discharge of the nearest compressor station has a pressure range of 650 to 850 psig (pounds per square inch gauge) (4.5 to 5.9 megapascals). The flow

rate for the station is typically more than 1 billion cubic feet (28 million cubic meters) per day, or 42 million cubic feet (1.2 million cubic meters) per hour. This is more than sufficient to supply the demands of the proposed FutureGen Project, which could require 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.

5.15.2.6 CO₂ Pipeline

No CO₂ pipelines exist in the vicinity of the proposed power plant or sequestration sites.

5.15.3 IMPACTS

5.15.3.1 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 5.15-3.

Table 5.15-3. Utility System Construction Requirements

| Infrastructure Element | Equipment | Duration | Manpower |
|---|---|------------------|-----------------------------|
| Potable water pipeline | n/a | n/a | n/a |
| Using existing line – no construction except to access and tap existing line (<1 mile [1.6 kilometer] pipeline) | | | |
| Process water pipeline | Track hoe/backhoe, trench safety | 3 weeks | 8 to 10 workers |
| From Lyondell-Equistar Chemical Company for 1.5 miles (2.4 kilometers) | equipment, dump trucks, forklifts, water tankers for hydrostatic testing of the pipeline, compaction equipment, dozers, and graders for finish grading and site cleanup | | |
| Sanitary wastewater pipeline | Track hoe/backhoe, trench safety equipment, dump trucks, forklifts, | 4 weeks | 8 to 10 workers |
| Option for Lyondell-Equistar Chemical Company for 0.9 mile (1.4 kilometers), or use existing line | water tankers for hydrostatic testing of the pipeline, compaction equipment, dozers, and graders for finish grading and site cleanup | | |
| Transmission line | Crane for setting poles, bulldozer | Not estimated | 15, in 3 crews of 5 each |
| Several options along existing and new ROWs (up to 17 miles [27.4 kilometers]) | for earth moving and path leveling, and several bucket trucks | | |
| Natural gas pipeline | n/a | n/a | n/a |
| Using existing line – no construction except to access and tap the existing line | | | |

| Table 5.15-3. | Utility System | Construction | Requirements |
|---------------|----------------|--------------|--------------|
|---------------|----------------|--------------|--------------|

| Infrastructure Element | Equipment | Duration | Manpower |
|--|--|--------------|--------------------|
| CO₂ pipeline 11 miles (17.7 kilometers) to sequestration site | Track hoe/backhoe, trench safety equipment, dump trucks, forklifts, welder rig, gang truck with tools, water tankers for hydrostatic testing of the pipeline, compaction | 4 to 6 weeks | 8 to 10 workers |
| | equipment, dozers, and graders for finish grading and site cleanup | | |

n/a = not applicable. Source: FG Alliance, 2006b.

Power Plant Site

The 200-acre (81-hectare) envelope, which includes the power plant footprint and railroad loop, could ultimately be located anywhere within the proposed 345-acre (140-hectare) Tuscola Power Plant Site. There are two known natural gas lines that traverse the proposed plant site. Other unknown utilities may occur at the site. To prevent damage to any utilities that might occur at the site, the existing utility locations would be confirmed before construction. Existing utility lines would either be avoided or relocated during siting and construction of the power plant causing the potential for temporary service outages.

Sequestration Site

Construction at the proposed Tuscola Sequestration Site would not affect existing utilities or utility systems because the site is currently undeveloped, and there are no known utilities at the site. 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 5.15-1.

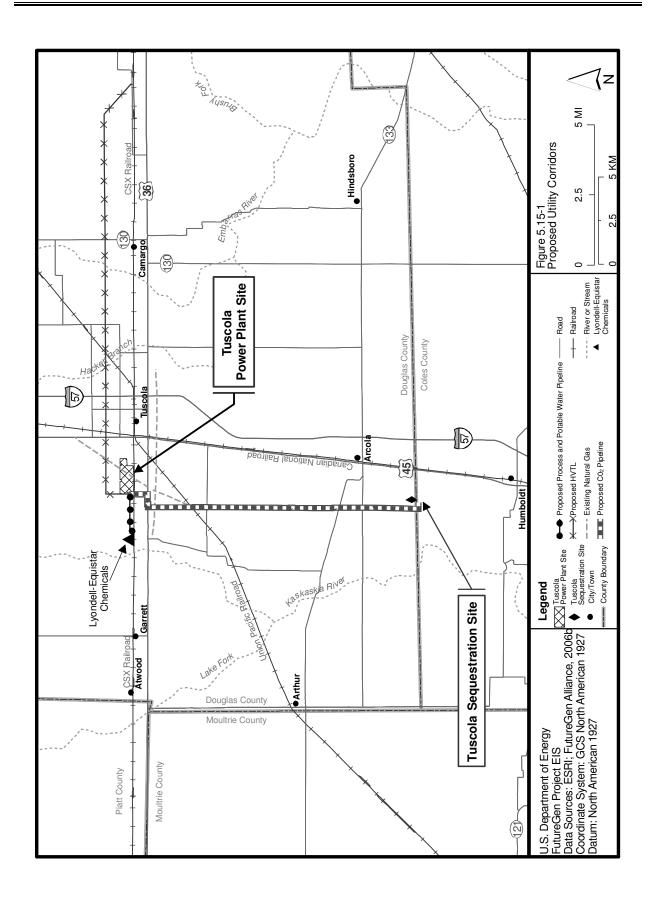
Potable Water Supply

The proposed Tuscola Power Plant Site has an existing 8-inch (20.3-centimeter) water transmission line that abuts the site's southern boundary. A new potable water corridor would not be needed, although a service tap would need to be installed.

Process Water Supply

The proposed process water pipeline would be approximately 1.5 miles (2.4 kilometers) long and would be constructed on property owned by Lyondell-Equistar Chemical Company and on Tuscola Township road ROW. This line would be connected to the existing water works plant on the west side of the Lyondell-Equistar Chemical Company facility.

In addition, an abandoned 8-inch (20.3-centimeter) water transmission line could potentially be used as a redundant process water line. The line was originally constructed to serve as a potable water transmission line from the Lyondell-Equistar water treatment plant to the city of Tuscola. This line would need to be hydraulically tested before it could be put into service.



Sanitary Wastewater System

An on-site WWTP could be constructed at the power plant site to treat sanitary wastewater that could then be used as process water. Alternatively, a proposed sanitary wastewater pipeline could be constructed that would be approximately 0.9 mile (1.4 kilometers) long and would be constructed on property owned by Lyondell-Equistar Chemical Company and on Tuscola Township road ROW. This wastewater corridor would parallel the proposed process water corridor. This line would be connected to an existing sanitary lift station located in the center of the Lyondell-Equistar Chemical Company facility. Tuscola Township has control of the proposed sanitary wastewater pipeline ROW and has committed to allow the pipeline to be placed on the ROW. An existing abandoned 8-inch (20.3-centimeter) water transmission line could potentially be used as a sanitary force main.

Transmission Line Corridors

Two options for the electric transmission lines are being considered. The first option would be for a proposed 138-kV interconnection to primarily use existing utility corridors, except for a new 0.5-mile (0.8-kilometer) long segment required to connect the plant site with the 138-kV line.

A second option would connect the power plant to a proposed 345-kV transmission corridor that could be separated into three segments. The need to upgrade/construct these individual segments of the proposed transmission line corridor would be determined from the results of a MISO feasibility study that is currently underway. MISO has not provided a schedule for completion of this study. The 345-kV connection would consist of the following three segments totaling 17 miles (27.4 kilometers) in length:

- Segment #1 would run from the proposed power plant site north along CR 750E along an existing 69-kV transmission line for approximately 0.5 mile (0.8 kilometer).
- Segment #2 would run east along an existing 138-kV transmission line approximately 13.5 miles (21.7 kilometers) through Tuscola, Camargo, and Murdock townships, ending at a point approximately 0.75 mile (1.2 kilometers) north of Murdock, Illinois. The existing 69-kV and 138-kV transmission lines are owned by Ameren Corporation.
- Segment #3 would continue due east approximately 3 miles (4.8 kilometers) to an existing 345-kV transmission line that is owned and operated by Ameren Corporation. The third segment of the proposed transmission line would occupy new ROW.

Natural Gas Pipeline

An existing natural gas mainline runs through the proposed Tuscola Power Plant Site, so no new corridor would be required. The gas pipeline is a high-pressure line. A new tap and delivery station would be required.

CO₂ Pipeline

The proposed CO₂ pipeline corridor would be approximately 11 miles (17.7 kilometers) long. The pipeline would occupy new ROW parallel to CRs 750E and 700E to the proposed CO₂ sequestration site. Table 5.15-3 contains information on estimated construction requirements, staffing, and timing for the proposed utility corridors.

5.15.3.2 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 Tuscola Power Plant Site would be limited to the sanitary needs of a workforce of 200 employees (FG Alliance, 2006b). For 200 employees using 30 gallons (113.6 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 2 MGD (7.6 billion liters per day) in the 14-inch (35.6-centimeter) line that would be tapped to provide potable water. 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

The proposed Tuscola Power Plant Site would receive its process water supply from a 150-million-gallon (568-million-liter) holding pond at Lyondell-Equistar Chemical Company, located west of the site and operated by Duke Energy Generation Services. The proposed Tuscola Power Plant Site would require construction of a force main from the holding pond to the site. The proposed force main would be approximately 1.5 miles (2.4 kilometers) long. This water source would also be used for fire protection. A small reservoir could be constructed on the power plant site to store additional fire protection water.

Lyondell-Equistar Chemical Company has the future potential of becoming a "zero discharge" plant. This would mean that the plant would discontinue discharge of its treated effluents, and would reuse the effluent for plant processes. If that occurs, they would be able to provide water directly to the proposed power plant site at a flow rate of 3,000 gallons (11,356 liters) per minute or 4.3 MGD (16.3 MLD).

Sanitary Wastewater System

Because the FutureGen Project would use a ZLD system, there would be no process-related wastewater discharge 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 (113.6 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 proposed power plant wastewater force main would connect to an existing wastewater treatment facility with a 0.9-mile (1.4-kilometer) pipeline that is operating at 25 percent capacity. An alternative may include construction of an on-site wastewater treatment facility. The operational requirements of the project would have no adverse effect on the existing community wastewater treatment plant's ability to meet current and future 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, which would result in an average of 2,047,650 MWh of energy per year.

The results of the MISO study will determine the extent to which the proposed transmission corridor would need to be upgraded to transport the electricity generated at the proposed power plant site to the existing power grid. If the MISO study determines that there is not enough available capacity to connect at the existing 138-kV line or substation, then the longer, new 345-kV transmission line would be needed. One option to upgrade the corridor to a 345-kV line is to construct a separate line next to the existing line, requiring an additional 100-foot (30.5-meter) easement. Another option would be a completely new double-circuit line, with new towers and conductors, in place of the existing 138-kV structures.

As noted above, the electrical system interconnection was evaluated with both 138-kV and 345-kV connection options (PowerWorld Corporation, 2006). To satisfy stability margins, it is likely that the 138-kV interconnection may require more supplemental voltage support than the 345-kV interconnection. If the MISO study determines that there is not enough available capacity in the existing 138-kV line and a new 345-kV transmission line is needed, all three transmission line segments would need to be constructed or upgraded. This would include the construction of two new interconnect substations. The first interconnection would be located approximately 0.5 mile (0.8 kilometer) north of the proposed Tuscola Power Plant Site, where the new 345-kV line would interconnect with the existing 138-kV transmission line. The second interconnection would be constructed at the point where the proposed new 345-kV transmission line would tie into the existing 345-kV transmission line.

If the MISO study determines that the existing 138-kV transmission line would be adequate or that the line needed to be upgraded with a new conductor, only Segments #1 and #2 (previously described) would be required. Segment #1 would need to be upgraded-reconstructed to a 138-kV transmission line, and Segment #2 would be restrung to meet the anticipated projected capacity. This scenario would require the construction of one new interconnection facility approximately 0.5 mile (0.8 kilometer) north of the proposed Tuscola Power Plant Site. The existing 138-kV transmission line passes through the existing interconnect substation located east of Murdock, Illinois.

The third scenario under analysis in the MISO study assumes that the existing 138-kV transmission line is adequate for the projected output of the proposed Tuscola Power Plant. This scenario would require construction of a new 138-kV transmission line along the existing 69-kV corridor to the existing 138-kV transmission line. A new interconnect substation would be needed for the proposed new 138-kV line at the point of connection with the existing 138-kV transmission line.

Based on the conclusions of PowerWorld's report (2006), both the 138-kV and 345-kV interconnections would be capable of supporting the rated output of the proposed power plant. However, 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 notifies 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. The MISO feasibility study that has been requested would provide further clarification on the ultimate line requirements.

Natural Gas Pipeline

The proposed Tuscola Power Plant Site has an existing natural gas transmission line, operated by Trunkline Gas Company, that passes through the proposed plant site with a capacity of almost 700,000 cubic feet (19,822 cubic meters) per minute, which is more than sufficient to supply the demands of the proposed FutureGen Project (startup: 500 standard cubic feet per minute at 450 psi [15 cubic meters at 3.1 megapascals] to 30,000 standard cubic feet [900 cubic meters] per minute). 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.

CO₂ Pipeline

Upon completion of construction of the new pipeline, there would be sufficient capacity to accommodate the CO_2 expected from the proposed Tuscola Power Plant.

Sequestration Site

Once construction was completed, operation of the injection wells at the sequestration site would have no effect on the operation of other utilities present in the area.

Utility Corridors

Once construction was completed, the operation of project-related utilities would have no effect on the operation of other utilities sharing the corridor.

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5.16 MATERIALS AND WASTE MANAGEMENT

5.16.1 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 CO₂ and dispose of any waste that is generated. This section discusses the capabilities of the proposed Tuscola 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.

5.16.1.1 Region of Influence

The ROI includes waste management facilities; industries that could use the FutureGen by-products; and the suppliers of construction materials, coal, and process chemicals used in the construction and operation of the proposed FutureGen Project (power plant, sequestration site, CO₂ 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 Tuscola 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.

5.16.1.2 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 Tuscola Site EIV (FG Alliance, 2006b) and proposal (FG Site Proposal [Tuscola, 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.

5.16.2 AFFECTED ENVIRONMENT

The Tuscola Power Plant Site is 345 acres (140 hectares), which is entirely in agricultural row crops, and would be located less than 0.5 mile (0.8 kilometer) east of an existing heavy industrial area housing multiple chemical manufacturing companies, a road construction company, a large grain elevator, a chemical transport firm, and natural gas pipeline companies. The remaining non-industrial area surrounding the power plant site is rural farmland planted in row crops. The sequestration site is also rural, primarily consisting of agricultural land with row crops. There are no existing waste management operations associated with the plant site or sequestration site.

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, 2006b).

5.16.2.1 Construction Materials

Concrete, asphalt, and aggregate producers within a 50-mile (80-kilometer) radius of the Tuscola 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

The following summarizes the concrete production capacity in the vicinity of the Tuscola Site. Stationary production facilities could provide concrete at a total rate of 330 cubic yards (252 cubic meters) per hour. Two area suppliers have the capability to provide a mobile batch plant (FG Alliance, 2006b).

- A.J. Walker Construction Company, located in Mattoon, is capable of producing 90 cubic yards (69 cubic meters) per hour.
- Charleston Farrier, located in Charleston, is capable of producing 100 cubic yards (76 cubic meters) per hour.
- Tuscola Builders, located in Tuscola, has the capability to provide a mobile batch plant.
- Mid-Illinois Concrete, located in Toledo, is capable of producing 140 cubic yards (107 cubic meters) per hour.
- Prairie Central, with multiple locations throughout Illinois, has the capability to provide a mobile batch plant.

Asphalt

The asphalt producers in the area are capable of providing approximately 1,900 tons (1,724 metric tons) of asphalt per hour.

- Apcon Corporation, located in Urbana, is capable of producing 440 tons (399 metric tons) per hour.
- Ne-Co Asphalt, located in Charleston, is capable of producing 130 tons (118 metric tons) per hour.
- Cross Construction, located in Urbana, is capable of producing 225 tons (204 metric tons) per hour
- Howell Asphalt Company, with multiple locations throughout Illinois, is capable of producing 920 tons (825 metric tons) per hour.
- Dunn Company, located in Decatur, is capable of producing 190 tons (172 metric tons) per hour (FG Alliance, 2006b).

Aggregate and Fill Material

There are multiple quarries in the vicinity of the Tuscola Site with a combined capacity of approximately 4.4 million tons (4.0 MMT) of aggregate per year (FG Alliance, 2006b). The Tuscola Stone Company, located approximately 3 miles (5 kilometers) east of the proposed power plant site, has production capacity of 750 tons (680 metric tons) per hour. Material Service Corporation operates four quarries in central Illinois. Their Nokomis and Fairmont operations provide a combined capacity of 2.5 million tons (2.3 MMT) per year. Charleston Stone Company owns two quarries with an annual production totaling 750,000 tons (680,000 metric tons) of aggregate (FG Alliance, 2006b).

- Mid-Illinois Quarry, located in Casey, has an aggregate capacity of 125,000 tons (113,000 metric tons) per year, with no fill availability.
- Material Service Corporation, with multiple locations throughout Illinois, has an aggregate capacity of 2.4 million tons (2.2 MMT) per year, with no fill availability.
- Lawrence Gravel, Inc., located in West Union, has fill availability.
- Brush Creek Quarry, located in Mode, has an aggregate capacity of 300 tons (272 metric tons) per hour, with no fill availability.
- Charles Heuerman Trucking Company, located in Charleston, has an aggregate capacity of 200,000 tons (180,000 metric tons) per year, with no fill availability.
- Prairie Materials, located in Mahomet, has an aggregate capacity of 300,000 tons (272,000 metric tons) per year, with no fill availability.
- Tuscola Stone Company, located in Tuscola, has an aggregate capacity of 750 tons (680 metric tons) per hour, and a fill availability of 4 million cubic yards (3 million cubic meters).
- Charleston Stone Company, located in Charleston, has an aggregate capacity of 750,000 tons (680,000 metric tons) per year, with fill availability.
- Whitesville Mill, located in Crawfordsville, Indiana, has an aggregate capacity of 91,000 tons (83,000 metric tons) per year, with no fill availability.
- Mid-American Sand and Gravel, located in Mahomet, has an aggregate capacity of 500,000 tons (450,000 metric tons) per year, and a fill availability of 100,000 cubic yards (76,000 cubic meters).
- Parke County Aggregates, LLC, located in Montezuma, Indiana, has fill availability.
- Vulcan Materials Company, located in Kankakee, has fill availability.

There is a little more than 4 million cubic yards (3 million cubic meters) of fill material available in the area, with the majority available from Tuscola Stone Company. In addition, the Tuscola Site consists of 345 acres (140 hectares) and would require some excavation for detention ponds; thus, some fill would be available at the site (FG Alliance, 2006b).

5.16.2.2 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 (FutureGen Alliance, 2006b). Because Pittsburgh coal is not generally utilized by Illinois power plants, delivered pricing is not available.

The best-price quotes shown in Tables 5.16-1 and 5.16-2 indicate coal and transportation bids for the Tuscola Site. Illinois Basin coal could be transported via truck or rail. There would be no truck-delivered option for PRB coal to the Tuscola Site due to distance. The quotes reflect 2006 costs.

 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
 6.5 (7.15)
 19 (20.90)

 Delivered price
 36.5 (40.15)
 47 (51.70)

Table 5.16-1. Illinois Basin Bituminous Coal

Source: FG Site Proposal (Tuscola, Illinois), 2006.

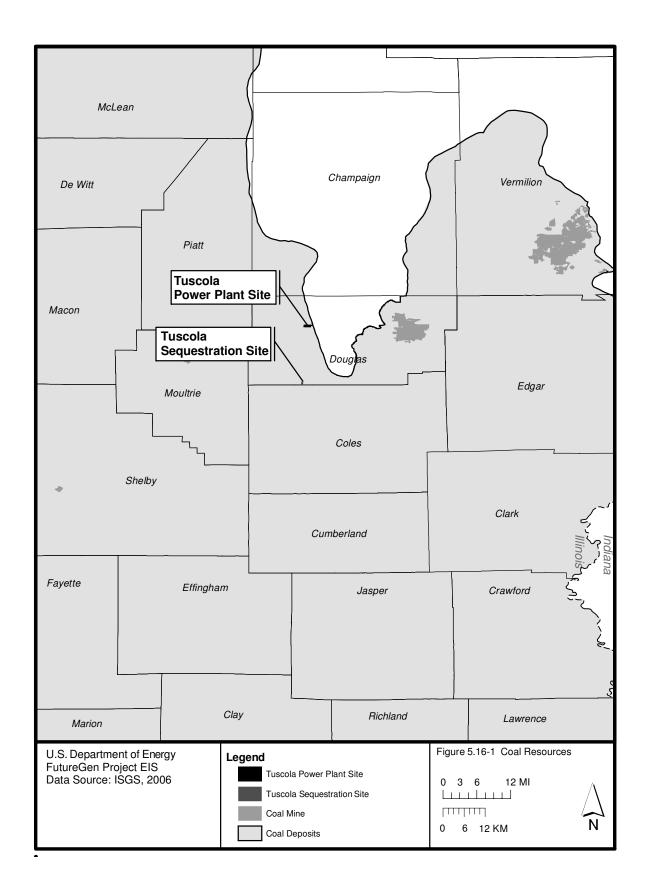
Table 5.16-2. Western-PRB Sub-Bituminous Coal

| | 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 (Tuscola, Illinois), 2006.

Figure 5.16-1 shows the locations of coal mines and probable locations of coal deposits in relation to the proposed Tuscola Power Plant 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 impact 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 State. The Springfield and Herrin coals, where available for mining, average approximately 3.5 to 5.5 feet (1.0 to 1.7 meters) thick in this area, with the areas of available Herrin containing some coal thicker than 5.5 feet (1.7 meters) in the northern part of Douglas County.

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) and are eroded outside of the areas classified as available for mining. The Herrin and Springfield coals average 800 to 900 feet (244 to 274 meters) deep near the Tuscola Site (FG Alliance, 2006b).



The nearest active coal mining area is approximately 35 miles (56 kilometers) to the east-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 (80 meters) and seam thickness of 5 to 6 feet (1.5 to 1.8 meters). Production for each mine was approximately 1 million tons (900,000 metric tons) in 2004 (FG Alliance, 2006b). The Murdock Mine, shown on Figure 5.16-1, in Eastern Douglas County is closed.

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 of water and waste treatment chemicals in the area include Ciba, Kemira, Nalco, Stockhausen, and the SNF Group.

5.16.2.3 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 manufacture 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 MMT] 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).

5.16.2.4 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 would be due to federal and State transportation departments promoting the use of coal combustion products for road construction (ACAA, 2006).

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 5.16-3 lists the sanitary waste landfills in the region and their remaining disposal capacity. Regional landfill availability in the Tuscola area would be up to 116 years (based on closure of the Illinois Landfill in 2122). Space on the 345-acre (140-hectare) proposed Tuscola Power Plant Site would be available for a landfill if needed. Figure 5.16-2 shows the location of these facilities in relation to the Tuscola Site.

| Landfill | City | State | State Remaining Disposal Capacity in Place ¹ (yd ³ [m ³]) | | Approximate Distance from Site (miles [km]) |
|--|------------|-------|---|-------------------|---|
| ERC Coles County Landfill | Charleston | IL | 799,000 (610,897) | 2008 ² | 30 (50) |
| Onyx Valley View Landfill | Decatur | IL | 3,831,000 (2,929,000) | 2010 | 45 (72) |
| Landfill 33 Ltd. | Effingham | IL | 3,280,000 (2 507 739) | 2017 | 55 (89) |
| Clinton Landfill #2 | Clinton | IL | 3,518,000 (2,689,704) | 2030 | 56 (90) |
| Brickyard Disposal and Recycling, Inc. | Danville | IL | 18,837,000 (14,401,920) | 2022 | 64 (102) |
| Illinois Landfill | Hoopeston | IL | 21,503,000 (16,440,223) | 2122 | 74 (118) |

Table 5.16-3. Nearby Sanitary Waste Landfills

Source: IEPA, 2005 and FG Alliance, 2006b.

The IEPA concluded that the East Central Illinois region (a 19-county region that includes the Tuscola 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).

5.16.2.6 Hazardous Waste Treatment, Storage, or Disposal Facilities

Table 5.16-4 provides the locations of hazardous waste landfills closest to the Tuscola Site that have historically received hazardous waste from Illinois sources (FG Alliance, 2006b):

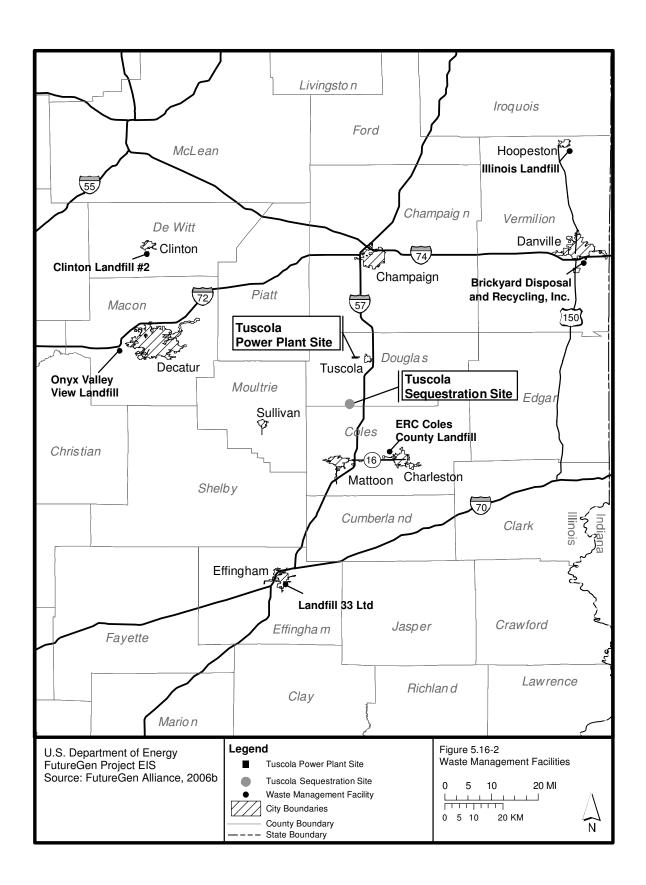
In Illinois, pollution control waste is a special waste, which must be managed in accordance with State of Illinois regulations (Title 35 of the Illinois Administrative Code [IAC] Part 808). Numerous Illinois municipal landfills are approved to accept special waste. A special waste can also be certified 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

Special waste includes hazardous waste, potentially infectious medical waste, pollution control waste, and industrial process waste.

composition. The bottom slag produced from the coal gasification process is expected to be highly marketable.

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. yd³ = cubic yards; m³ = cubic meters; km = kilometers.



| 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) | 90 (145) |
| PDC | Peoria | IL | 660,944 (505,328) | 120 (190) |
| CID Recycling & Disposal Facility #4 | Calumet City | IL | 88,269 (67,486) | 150 (240) |
| Envirosafe of Ohio, Inc. | Oregon | ОН | 822,000 (628,464) | 370 (595) |
| Wayne Disposal | Belleville | MI | 2,134,101 (1,631,637) | 385 (620) |

Table 5.16-4. Hazardous Waste Landfills

yd³ = cubic yards; m³ = cubic meters; km = kilometers.

Source: FG Alliance, 2006b.

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, 2006b). The information contained in this certification would 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.

5.16.3 **IMPACTS**

5.16.3.1 **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,

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Capacity as of January 2004.

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.

The proposed Tuscola 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 envelop, 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. Debris would be disposed on site or transported to an off-site landfill for disposal. In Illinois, on-site non-hazardous landfills do not require a permit. Regulations for on-site landfills are found in Illinois Administrative Code Title 35, Subtitle G – Waste Disposal, Part 815, Procedural Requirements for All Landfills Exempt from Permits (FG Alliance, 2006b).

The Tuscola Site would have adequate acreage for placement of an on-site solid waste landfill, if one should be required at the site.

The large amount of solid waste disposal capacity in the region is detailed in Table 5.16-3. Because the quantity of waste from construction of the Tuscola Power Plant 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 approximately 10 miles (16 kilometers) south of the proposed power plant site. The only components to be constructed at the sequestration site would be the injection well, backup well, associated piping from the plant to the wells, and access road. The materials needed for well components are 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. There would be no impact to waste collection services or disposal capacity. Solid and hazardous waste disposal capacity in the region is detailed in Tables 5.16-3 and 5.16-4. There would be no impact to waste collection services or disposal capacity.

Utility Corridors

The following utility and CO₂ corridors and pipelines would be constructed to support the proposed FutureGen facility:

- 11-mile (17.7-kilometer) long CO₂ pipeline to the proposed sequestration injection location using a combination of existing and new ROWs.
- 17 miles (27.4 kilometers) of transmission line using 14 miles (22.5 kilometers) of existing corridor that may require upgrading and 3 miles (4.8 kilometers) of new ROW (option involving 0.5 mile (0.8 kilometer) of transmission line in new ROW is also being evaluated).
- 1.5 miles (2.4 kilometers) of process water pipeline on Lyondell-Equistar Chemicals property and new ROW.
- Less than 1 mile (1.6 kilometers) of potable water pipeline in new ROW.
- 0.9-mile (1.4-kilometer) long sanitary wastewater force main from the power plant site to an existing lift station located on Lyondell-Equistar Chemicals property using new ROW (construction of an on-site wastewater treatment facility is also being evaluated).

The proposed power plant site is crossed by an existing natural gas pipeline and a potable water line; therefore, the power plant would tap into these existing sources (FG Alliance, 2006b).

The existing corridors would require clearing of vegetation and grading, creating land clearing debris that may require removal from the site. The new ROWs may require more extensive land clearing and grading. However, adequate construction debris disposal capacity is available at area landfills.

The construction of the pipelines 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 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 5.16-3 and 5.16-4. There would be no impact to waste collection services or disposal capacity.

Transportation Corridors

Roads

The materials needed for road construction include concrete, aggregate, and asphalt. Road construction results 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 5.16-3 and 5.16-4. 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 miles [3.2 kilometers] of track [FG Alliance, 2006b]) 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 quantities, 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 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 5.16-3 and 5.16-4. There would be no impact to waste collection services or disposal capacity.

5.16.3.2 Operational Impacts

Power Plant Site

The FutureGen Power Plant would be capable of using various coals. For the 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 5.16-5 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 Tuscola 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 (1.71 MMT) per year based on 85 percent availability (FG Alliance, 2006e). This represents 3.5 percent of the 53.8 million tons (48.8 MMT) of coal of all types consumed by electric utilities within the state 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.

Type of Coal (pounds [kilograms] per hour) Coal Gasification Technology **Powder River** Illinois Basin **Pittsburgh** Basin 248,370 (112,659) Case 1 224,745 (101,943) 281,167 (127,535) Case 2 213,287 (96,745) 244,153(110,746) 353,809 (160,485) Case 3A 208,425 (94,540) 342,790 (155,487) 238,577 (108,217) Case 3B (optional)1 97,625 (44,282) 111,791 (50,708) 154,349 (70,012)

Table 5.16-5. Coal Consumption

The estimated consumption of process chemicals by the proposed power plant is presented in Table 5.16-6. 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 5.17. 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 5.16-6. Process Chemicals Consumption and Storage

| Chemical | Annual Consumption (tons [metric tons]) | Estimated Storage On Site (gallons [liters]) | | | | | |
|---------------------------------|--|--|--|--|--|--|--|
| Selective Cat | 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 | t Demineralizers | | | | | |
| Sodium Bisulfite | 12 (10.9) | 155 (587) | | | | | |
| Sulfuric Acid | 106 (95.8) | 1,150 (4,353) | | | | | |
| Liquid Antiscalant & Stabilizer | 27 (24.5) | 443 (1,677) | | | | | |
| | Clarifier Water Treatment | | | | | | |
| Lime | 1,237 (1,122) | 7,380 (27,936) | | | | | |
| Polymer | 295 (268) | 5,020 (19,000) | | | | | |
| | 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 8,790 tons (7,974 metric tons) of sulfuric acid, 1,680 tons (1,524 metric tons) of sodium hypochlorite, and 1,240 tons (1,125 metric tons)

¹ Case 3B is an optional add-on to the other technology cases (1, 2, 3A) but is considered unlikely to be implemented. Source: FG Alliance, 2007.

of lime. As discussed in Section 5.16.2.3, 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 (37,405 metric tons) assuming 85 percent availability. The U.S. production of sulfur in 2002 was 13.6 million tons (12.4 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 5.16-7). Further characterization would be necessary to determine whether the quality of the slag produced by the 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 5.16-7). 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.

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. They 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.

| 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.

Source: FG Alliance, 2007, except as noted.

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.

The FutureGen facility would have the option of disposing of some of its non-hazardous 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 nonhazardous 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])

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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).

• 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 (SF₆) (as much as 66 lb [30 kg]]
- Helium-3 (³He) (as much as 0.033 lb [15 g])
- Krypton-78 (⁷⁸Kr) (as much as 0.44 lb [200 g])
- Xenon-124 (¹²⁴Xe) (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 CO₂, water, and minerals, 2) limit the problem of interference from naturally occurring CO₂ 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 and CO₂ pipeline and corridor 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.

5.17 HUMAN HEALTH, SAFETY, AND ACCIDENTS

5.17.1 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.

5.17.1.1 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 site, sequestration site, and CO₂ pipeline. At the proposed Tuscola 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 CO₂ plume radius of 1.1 miles (1.8 kilometers) (FG Alliance, 2006b). 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.

5.17.1.2 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 5.17.2.

The calculated cancer risks and hazard quotients for air emissions under normal operating conditions are summarized in Section 5.17.3.1. 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 5.17.3.2.

Potential health effects were evaluated for workers and the general public who may be exposed to releases of captured gases (CO₂ and H₂S) 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 5.17.4.

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 CO₂ pipeline(s) and at injection wells. The results of this analysis are provided in Section 5.17.5.

5.17.2 OCCUPATIONAL HEALTH AND SAFETY

5.17.2.1 Typical Power Plant Health and Safety Factors and Statistics

Power Plant Construction

Table 5.17-1 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 5.17-1). These rates are presented for TRCs, LWDs, and fatality rates.

| Table 5 17-1 | Occupational Injury/Illnes | e and Fatality Data fo | r Project Related I | dustries in 2005 |
|----------------|----------------------------|------------------------|-----------------------|-------------------|
| 1 able 5.17-1. | Occupational injury/limes | S and Falanty Data to | ir Project Related II | laustries in 2005 |

| Industry | 2005 Average Annual Employment (thousands) ¹ | Total Recordable Case Rate (per 100 workers) ¹ | Lost Work Day Cases (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.

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,

² Source: USBLS, 2006b.

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.

CO₂ and Natural Gas Pipeline Safety

More than 1,500 miles (2,414 kilometers) of high-pressure long distance CO₂ pipelines exist in the U.S (Gale and Davison, 2004). In addition, numerous parallels exist between CO₂ and natural gas transport. Most rules and regulations written for natural gas transport by pipeline include CO₂. These regulations are administered and enforced by DOT's Office of Pipeline Safety. States also may regulate pipelines under partnership agreements with the 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 CO₂ 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 by volume (ppmv) of H₂S in the pipeline on a routine basis, and should any of the captured gases escape to the environment, risks from exposure to H₂S would have to be estimated, as well as risks from CO₂ exposure.

Table 5.17-1 shows the occupational injury/illness 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 CO₂. Because natural gas is highly flammable, these rates are determined to be conservative in relation to CO₂ pipelines.

5.17.2.2 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. Material Safety Data Sheets 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 produced 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 NH₃ 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 5.17-2 would be expected. As shown in Table 5.17-2, based on the estimated number of workers during construction, no fatalities would be expected (calculated number of fatalities is less than one).

Table 5.17-2. Calculated Annual Occupational Injury and Fatality Cases for Power Plant Construction

| Construction Phase | Number of Employees | Total Recordable Cases | Lost Workday 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) would be instituted, covering all facets of drilling site 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, on the CO₂ pipeline, at the CO₂ sequestration site, or in the project vicinity; risk of fire or explosion either from general facility operations or specifically from a proposed gas release (e.g., syngas, hydrogen, natural gas, H₂S, or CO₂); 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 517.3.2 and 5.17.4.

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 5.17-3, the number of calculated fatalities for operation of this facility would be less than one.

Table 5.17-3. 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 5.17.3.2.

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 5.17-4 describes chemical occupational 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 5.17-5. Potential public exposures to accidental releases of these chemicals are described in Section 5.17.3.2.

While some of the chemicals listed in Table 5.17-4 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 5.17-4. 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 (HCI) | 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 |

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| Chemical | Exposure Limits | Exposure Routes | Target Organs | Symptoms |
|------------------|--|----------------------------------|--|--|
| H ₂ S | 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 |
| 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.

| Hazard Endpoint | Description | | |
|-----------------|--|--|--|
| NIOSH REL C | NIOSH recommended exposure limit (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. Time-weighted average (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 5.17-6 and Table 5.17-7.

Leakage of 400 pounds (180 kilograms) of aqueous NH₃ solution (19 percent NH₃) 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 97°F (36.1°C), based on the maximum daily air temperature in Tuscola for the past three years. Downwind atmospheric concentrations of volatilized (vapor-phase) NH₃ 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 2,687 feet (819 meters) of the pool would exceed AEGL Level 1 criteria for temporary health effects (30 ppmv – 1 hour) (see Table 5.17-8). Individuals exposed within a distance of 1,210 feet (369 meters) of the pool would be expected to experience NH₃ 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 505 feet (154 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 NH₃. 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 5.17-6. 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 |
| 1 Hour | | Irreversible adverse effects | 160 | AEGL 2 |
| | | Life Threatening | 1,100 | AEGL 3 |

¹See Table 5.17-7 for descriptions of the AEGL endpoints.

AEGL = Acute Exposure Guideline Level.

Table 5.17-7. 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.

For the tanker truck spill scenario, it was assumed that all 46,200 pounds (20,956 kilograms) of the 19 percent NH₃ 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 97°F (36.1°C), based on the maximum daily air temperature in Tuscola for the past three years. Downwind atmospheric concentrations of volatilized (vapor-phase) NH₃ 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 14,107 feet (4,300 meters) of the pool would exceed AEGL Level 1 criteria for temporary health effects (30 ppmv – 1 hour) (see Table 5.17-8). Individuals within a distance of 5,249 feet (1,600 meters) of the pool would be expected to experience NH₃ 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 1,752 feet (534 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 NH₃. 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 NH₃ 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 97°F (36.1 °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 NH₃ concentrations. Concentrations within 7,545 feet (2,300 meters) of the pool would exceed AEGL Level 1 criteria for temporary health effects (30 ppmv – 1 hour) (see Table 5.17-8). Individuals within a distance of 2,739 feet (835 meters) of the pool would be expected to experience NH₃ 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 948 feet (289 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 NH₃. 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 Tuscola, this stability class occurs about 5 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 2 percent of the time. Since NH₃ 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.

| Release Scenario | Gas | Effect ¹ | Distance (feet [meters]) |
|---------------------------------------|-----------------|------------------------------|--------------------------|
| NH₃ leaky valve | NH ₃ | Adverse Effects | 2,687 (819) |
| (400 pounds, 19 percent solution) | | Irreversible adverse effects | 1,210 (369) |
| | | Life threatening effects | 505 (154) |
| NH₃ tanker truck spill | NH ₃ | Adverse Effects | 14,107 (4,300) |
| (46,200 pounds, 19 percent solution) | | Irreversible adverse effects | 5,249 (1,600) |
| | | Life threatening effects | 1,752 (534) |
| NH₃ tank rupture | NH ₃ | Adverse Effects | 7,545 (2,300) |
| (104,355 pounds, 19 percent solution) | | Irreversible adverse effects | 2,739 (835) |
| | | Life threatening effects | 948 (289) |

Table 5.17-8. Effects of an Ammonia Spill at the Proposed Power Plant

Sections 5.17.3.2 and 5.17.4 discuss scenarios involving equipment failure or rupture at the proposed power plant site, along utility corridors, and at the injection site.

¹ See Table 5.17-6 and Table 5.17-7 for an explanation of the effects.

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 examined (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 5.17-9 would be expected. As shown in Table 5.17-9, the number of calculated fatalities for operation of this facility would be less than one.

Table 5.17-9. Calculated Annual Occupational Injury and Fatality Cases for Sequestration Site Operation

| Number of Employees | | Total Recordable Cases | Lost Work Day Cases Fatali | |
|---------------------|----|------------------------|----------------------------|--------|
| | 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 5.17-10 would be expected. As shown in Table 5.17-10, the number of calculated fatalities for operation of this facility would be less than one.

Table 5.17-10. 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.

5.17.3 AIR EMISSIONS

5.17.3.1 Air Quality – Normal Operations

Air quality impacts on human health were evaluated for HAPs potentially released during normal operation of the proposed Tuscola Power Plant and proposed 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 detail in Section 5.2.3 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 5.2.3 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 5.17-11 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 5.17-11, 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 (SO₂, CO, O₃, NO₂, lead, and respirable particulate matter) emissions of any coal-fueled power plant technologies (DOE, 2002). Tables 5.2-1 and 5.2-2 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 5.2), 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.

| Chemical | CT/HRSG Emissions ¹ | | Inhalation Unit Risk Factor ² (µg/m³) ⁻¹ | Reference Concentration ² (µg/m ³) ⁻¹ | Cancer Risk ³ | Hazard Coefficient⁴ |
|-----------------------|-----------------------------------|---------------------|---|--|-----------------------------|------------------------|
| Compound | (lb/hr) | (g/s) | Factor (μg/m ⁻) | Concentration (µg/m) | HISK* | Coefficient |
| 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 | 7.20E-13 | 3.63E-08 |
| Antimony | 5.59E-03 | 7.04E-04 | n/a | n/a 2.00E-01 n/ | | 9.16E-06 |
| Arsenic | 2.94E-03 | 3.70E-04 | 4.30E-03 | 3.00E-02 | 4.14E-09 | 3.21E-05 |
| 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 | 6.89E-12 | 2.94E-08 |
| Benzo(a)anthracene | 1.28E-06 | 1.61E-07 | 1.10E-04 | n/a | 4.60E-14 | n/a |
| Benzo(e)pyrene | 3.05E-06 | 3.84E-07 | 8.86E-04 | n/a | 8.84E-13 | n/a |
| Benzo(g,h,i)perylene | 5.26E-06 | 26E-06 6.63E-07 n/a | n/a | n/a | n/a | n/a |
| Beryllium | 1.26E-04 | 1.59E-05 | 2.40E-03 | 2.00E-02 | 9.89E-11 | 2.06E-06 |
| Cadmium | 4.06E-03 | 5.12E-04 | 1.80E-03 | 2.00E-02 | 2.39E-09 | 6.65E-05 |
| Carbon Disulfide | 2.49E-02 | 3.14E-03 | n/a | 7.00E+02 | n/a | 1.17E-08 |
| Chromium ⁵ | 3.78E-03 | 4.76E-04 | 1.20E-02 | 1.00E-01 | 1.49E-08 | 1.24E-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 | 3.33E-14 | n/a |
| Lead (Pb) | 4.06E-03 | 5.12E-04 | n/a | 1.50E+00 | n/a | 8.88E-07 |
| Manganese | 4.34E-03 | 5.47E-04 | n/a | 5.00E-02 | n/a | 2.84E-05 |
| Mercury (Hg) | 1.27E-03 | 1.60E-04 | n/a | 3.00E-01 | n/a | 1.39E-06 |
| Naphthalene | 2.95E-04 | 3.72E-05 | 3.40E-05 | 3.00E+00 | n/a | 3.22E-08 |
| Nickel | 5.45E-03 | 6.87E-04 | 2.40E-04 | 9.00E-02 | 4.29E-10 | 1.99E-05 |
| Selenium | 4.06E-03 | 5.12E-04 | n/a | 2.00E+01 | n/a | 6.65E-08 |
| Toluene | 4.12E-04 | 5.19E-05 | n/a | 4.00E+02 | n/a | 3.37E-10 |
| TOTAL | | | | | 2.19E-08 | 1.73E-04 |
| Risk Indicators | | | | | 1.00E-06 | 1.00E+00 |
| Percent of Indicator | | | | | 2.2 percent | 0.02 percent |

Table 5.17-11. Summary Analysis Results — Hazardous Air Pollutants

Compounds that are considered to be particulate matter in **bold** text.

5.17.3.2 Hazard Analysis

The "Consequence-Based Risk Ranking Study for the Proposed FutureGen Project Configurations" (referred to 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.

¹ Emission rates scaled by the ratio of VOC or particulate emissions from Orlando EIS to FutureGen.

² Provided by EPA IRIS.

³ Unit risk factor multiplied by maximum annual average impact of 0.0026 µg/m³ determined by AERMOD at a 1 g/s emission rate.

⁴ Maximum AERMOD annual average impact divided by reference concentration:

 $[\]label{eq:ct_def} \mbox{CT/HRSG} = \mbox{combustion turbine/heat recovery steam generator; lb/hr = pounds per hour; g/s = grams per second per hour; g/s = grams per second per hour; g/s = grams per hour; g/s = grams per second per hour; g/s = grams per hour; g/s = grams per second per hour; g/s = grams per hour; g/s = grams per second per hour; g/s = grams per hour; g/s = g/s = g/s = g/s = g/s = g/s = g/$

 $[\]mu$ g/m³ = micrograms per cubic meter; n/a = not available.

⁵ Conservatively assumed all chromium to be hexavalent.

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 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) (Ouest, 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 0.2 to 1.4 miles (0.3 to 2.3 kilometers) from the point of release. There are at least 17 family residences, farm home sites, or commercial properties within the 1.4-mile (2.3-kilometer) plume release radius.

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 at least three farm home sites within the 0.6-mile (1.0-kilometer) plume radius.

The potential health risks to these receptors are discussed in more detail in Section 5.17.5.

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 proposed 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 H₂S and SO₂ 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,

5.17.4 RISK ASSESSMENT FOR CO₂ 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.

5.17.4.1 CO₂ 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 5.17.4.2.

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 Tuscola 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 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 CO₂ 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. Failures 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).

Post-Injection Risk Assessment

The post-injection risk assessment describes the analysis of potential impacts from the release of CO₂ and H₂S after the injection into the subsurface CO₂ 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 CO₂ storage locations and from sites with natural CO₂ 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. CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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.

Risk Screening Results for Pre-Sequestration Conditions (CO₂ 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).

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

Accident Categories and Frequency Ranges

Likely: Accidents estimated to occur one or more times in 100 years of facility operations (frequency $\ge 1 \times 10^{-2} / \text{yr}$).

Unlikely: Accidents estimated to occur between once in 100 years and once in 10,000 years of facility operations (frequency from 1 x 10⁻²/yr to 1 x 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 x 10⁻⁴/yr to 1 x 10⁻⁶/yr).

Incredible: Accidents estimated to occur less than one time in 1 million years of facility operations (frequency < 1 x 10⁻⁶/yr).

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 O_2), toxic effects, or frostbite from the rapid expansion of CO_2 (2,200 psi to 15 psi). Workers near a release could also be exposed at a distance of up to a distance of 446 feet (136 meters) to very high concentrations of CO_2 (e.g., 170,000 ppm) for short durations of one minute, which could be life-threatening.

For this evaluation, risks to workers were evaluated at two distances: workers at a distance of 66 feet (20.1 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 CO₂ and H₂S, consisting, respectively, of a short-term exposure limit (averaged over 15 minutes) for CO₂ and a ceiling concentration for H₂S that should not be exceeded at any time during a workday (NIOSH, 2007). Each of these criteria is listed in Table 5.17-4. Table 5.17-12 summarizes locations where pipeline and wellhead accidents create gas concentrations exceeding allowable levels for facility workers. Workers would be expected to be affected by CO₂ concentrations equal to or greater than 30,000 ppm from a pipeline rupture out to a distance of 459 feet (140 meters) and out to a distance of 504 feet (.153.5 meters) for a pipeline puncture. H₂S concentrations would exceed worker criteria at least out to a distance from the

proposed plant boundary 1,384 feet (422 meters) from a pipeline rupture and 551 feet (168 meters) for a pipeline puncture.

| Release Scenario | Frequency Category ² | Exposure Time | Gas | Area of Exceedance |
|--------------------------------|------------------------------------|-----------------------|------------------|--------------------------------------|
| Pipeline Rupture | U | Minutes | CO ₂ | Near pipeline only ³ |
| | | | H ₂ S | Within plant boundaries ⁴ |
| Pipeline Puncture ⁵ | U | Approximately 4 hours | CO ₂ | Near pipeline only ³ |
| | | | H ₂ S | Near pipeline only ³ |
| Wellhead Rupture | EU | Minutes | CO ₂ | None |
| | | | H₂S | Near wellhead only ³ |

Table 5.17-12. Exceedance of Occupational Health Criteria for Workers

There is also interest in whether ruptures or punctures may affect non-involved workers. Noninvolved 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 to extend to 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 5.17-12, no effects were estimated for non-involved worker exposures to CO₂ from any of the evaluated accidental releases. Alternatively, H₂S could possibly affect noninvolved workers exposed to releases from a pipeline rupture, but not a pipeline puncture 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 the potential impacts to the public, the CO₂ sequestration risk assessment (Tetra Tech, 2007) evaluated potential effects to the public for accidental releases of gases from the pipelines and wellheads. The CO₂ pipeline failure frequency was calculated based on data contained in the on-line

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.

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Occupational health criteria used were the NIOSH REL ST and NIOSH REL C for CO₂ and H₂S, respectively. See Table 5.17-4.

U (unlikely)=frequency of 1x 10⁻²/yr to 1x 10⁻⁴/yr; EU (extremely unlikely)=frequency of 1x10⁻⁴/yr to 1x 10⁻⁶/yr.

³ Distances for CO₂ are 459 feet (140 meters) for a pipeline rupture; 504 feet (153.5 meters) for a pipeline puncture; and at least 230 feet (70 meters) for a wellhead rupture.

⁴ Within 820 feet (250 m) of release.

⁵ 3-inch by 1-inch rectangular opening in pipe wall.

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, five miles 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 5.17-12 and Table 5.17-15.

The predicted releases, whether by rupture or puncture are classified as unlikely: the frequencies for ruptures is 1.1×10^{-3} , and the frequency for punctures is 2.1×10^{-3} . The predicted releases from wellhead failures are classified as extremely unlikely; the frequency for a wellhead rupture 1×10^{-6} to 2×10^{-5} /year. The criteria used to examine potential health effects, including mild and temporary as well as permanent effects are defined in Tables 5.17-7 and 5.17-13. The CO₂ and H₂S exposure durations that could potentially occur for the three types of release scenarios are noted in Table 5.17-14.

Table 5.17-13. 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.

Concentration **Exposure Time** Gas **Effect Category** Hazard Endpoint¹ (ppmv) Minutes (Pipelines) CO2 Adverse effects 30.000 TEEL 1 Irreversible adverse effects 30,000 TEEL 2 40,000 Life threatening TEEL 3 TEEL 1 Adverse effects H₂S 0.51 TEEL 2 Irreversible adverse effects 27 Life threatening 50 TEEL 3 Minutes (Explosions²) H₂S Irreversible adverse effects 41 AEGL 2 (10 minute) 76 Life threatening AEGL 3 (10 minute) SO₂ Irreversible adverse effects 0.75 AEGL 2 (10 minute) 42 AEGL 3 (10 minute)³ Life threatening Headache, etc.4,5 Adverse effects 20,000 Hours/Days CO_2 Headache, etc.^{4,5,6} Life threatening 70,000 H₂S Adverse effects 0.33 AEGL 1 (8 hour) Irreversible adverse effects 17 AEGL 2 (8 hour) AEGL 3 (8 hour) Life threatening 31 Headache, etc.4,7 Years CO₂ Adverse effects 40.000 Headache, etc. 4,6,7 Life threatening 70,000 H₂S Irreversible adverse effects 0.0014 RfC

Table 5.17-14. Hazard Endpoints for Public Receptors

Simulation models were used to estimate the emission of CO₂ 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 CO₂ at 95 percent and H₂S 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 CO₂ under pressure would likely cause rapid expansion and then reduction in temperature and pressure, which can result in formation of solid-phase CO₂, 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 CO₂ and H₂S. 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 CO₂. The

See Tables 5.17-7 and 5.17-13 for descriptions of the TEEL and AEGL endpoints.

²Used by Quest (2006) to evaluate releases from explosions.

³ Quest, 2006.

⁴EPA, 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 Limit.

AEGL = Acute Exposure Guideline Level.

RfC = Inhalation Reference Concentration.

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 5.4.2 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, the postulated accident that would result in the largest number of people with adverse health effects (including mild and temporary effects) is a pipeline rupture from about 7.4 miles (12 kilometers) to the injection site (see Table 5.17-15). If this type of accident occurred, it is estimated that up to 7 members of the general public might experience adverse effects, primarily from H_2S exposure (mild and temporary effects, such as headaches or exhaustion). Since the pipeline would extend approximately 11 miles from the proposed power plant to the injection wellhead, the public could be affected by releases along the pipeline, while workers are more likely to be exposed at the proposed power plant. None of the postulated accidents would cause irreversible health effects to the general public. No fatalities were projected for the same group.

As shown in Table 5.17-15, the number of individuals in the general public potentially with adverse effects from other types of accidents would be less, with 1 individual adversely affected by a pipeline puncture and less than one from a wellhead rupture. No fatalities were projected for a pipeline puncture or a 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); use of newer continuous pipeline monitors and computer models to rapidly interpret changes in fluid densities, pressures, etc.; use of safety check valves at more frequent intervals (e.g., 1 to 3 miles [1.6 to 4.8 kilometers] instead of 5 miles [8 kilometers] in populated areas) 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 high consequence areas such as high population densities, the pipeline could be buried at a deeper depth, valves could be buried in underground vaults, and the pipeline and wellhead locations could be marked and protected with chain link fences and posts. The pipeline could be routed to maximize the distance to sensitive receptors and to allow a buffer between the pipeline and nearest residence or business. In some cases it may be possible to further reduce the concentrations of effect-causing substances being transported (e.g., H₂S). These measures would be implemented, as appropriate.

Table 5.17-15. Effects to the Public from Pre-Sequestration Releases

| Release Scenario | Frequency Category ² | Gas | Effect ³ | Distance ft (m) | Number Affected |
|--|---------------------------------|------------------|----------------------|-----------------|-----------------|
| Pipeline Rupture ¹ | U | CO ₂ | Adverse Effects | 459 (140) | 0 |
| (release duration = minutes) | | | Irreversible Adverse | 459 (140) | 0 |
| | | | Life Threatening | 315 (96) | 0 |
| | | H ₂ S | Adverse Effects | 16,312 (4,972) | 7 |
| | | | Irreversible Adverse | 1,384 (422) | <1 |
| | | | Life Threatening | 873 (266) | <1 |
| Pipeline Puncture ¹ | U | CO ₂ | Adverse Effects | 623 (190) | 0 |
| (release duration = approximately 4 hours) | | | Life Threatening | 118 (36) | 0 |
| | | H ₂ S | Adverse Effects | 5,692 (1,735) | 1 |
| | | | Irreversible Adverse | 551 (168) | 0 |
| | | | Life Threatening | 381 (116) | 0 |
| Wellhead Equipment Rupture (Main) | EU | CO ₂ | Adverse Effects | 16 (4.9) | 0 |
| (release duration = minutes) | | | Irreversible Adverse | 16 (4.9) | 0 |
| | | | Life Threatening | 10 (3.0) | 0 |
| | | H ₂ S | Adverse Effects | 2,034 (620) | <1 |
| | | | Irreversible Adverse | 230 (70) | 0 |
| | | | Life Threatening | 164 (50) | 0 |

 $^{^1}$ Rupture/puncture assumed to occur about 7.4 miles from the injection site. 2 U (unlikely) = frequency of 1x10 4 /yr /y to1x10 2 /yr r; EU (extremely unlikely) = frequency of 1x10 4 /yr to 1x10 6 /yr. 3 See Section 5.17.4.2 for an explanation of the effects categories.

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 CO₂ injection wells would be properly sealed before initiation of CO₂ sequestration, and since the proposed CO₂ 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 5.17-16). However, if this type of release occurred at the proposed sequestration site, it is estimated that up to six members of the public might experience irreversible adverse effects from H₂S exposures (i.e., nasal lesions). This estimate is based on the assumption that the future population would be the same as current conditions, with the town of Arcola located along the periphery of the sequestration plume footprint. 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 H₂S is an extremely low concentration: 0.0014 ppm.

Table 5.17-16. Number of Individuals with Adverse Effects from Potential Exposure to Post-Sequestration H₂S Gas Releases

| Release Scenario | Frequency Category ¹ | Number Affected ² |
|--|---------------------------------|------------------------------|
| Upward slow leakage through CO ₂ injection well | EU | 6 |
| Upward slow leakage through deep oil and gas wells | n/a | n/a |
| Upward slow leakage through other existing wells | EU ³ | 6 |

¹ EU (extremely unlikely)=frequency of 1x10⁻⁴/yr to 1x10⁻⁶/yr.

 $n/\bar{a} = not applicable.$

Since CO₂ 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 Tuscola Sequestration Site and surrounding areas that would occur before and during sequestration activities (FG Alliance, 2006b). 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 CO₂.

5.17.5 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.

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 town of Arcola on the periphery of the sequestration plume footprint.

³ Assumes that the other wells potentially within the sequestration plume footprint have been properly sealed before sequestration begins.

Although risks of sabotage or terrorism 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 sabotage/terrorism, 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 5.17-15 provides effects levels for individuals of the public that could potentially be exposed to releases. Of these release scenarios at the proposed Tuscola Site, a pipeline rupture would result in impacts to the public over the largest distance. For a release of the CO_2 gas from a pipeline rupture, no impacts from CO_2 would occur beyond 459 feet (140 meters) of the release, while irreversible adverse impacts from the H_2S in the gas stream could occur within 0.3 mile (0.4 kilometer) of the release, tapering to no impact at a distance of 3.1 miles (5.0 kilometers). Under upperbound conditions, such a release could cause adverse health effects to about 7 people within the general populace.

For short-term CO₂ and H₂S 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 H₂S 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 H₂S 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 CO₂ pipeline accidents occurred between 1994 and 2006. None of these reported accidents were fatal nor caused injuries (OPS, 2006). Should a CO₂ 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.

- 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 at least 17 family residences, farm home sites, or commercial properties within the maximum distance potentially impacted by releases from the Claus unit (i.e., 1.4 miles [2.3 kilometers] from the site) under current conditions. Examination of population density estimates (see Section 5.17.4.2) suggests that such releases could potentially cause irreversible adverse effects in 115 individuals exposed to SO₂, with 3 exposed to potentially life threatening concentrations, and 15 people exposed to irreversible adverse effects and 8 exposed to potentially life threatening concentrations from H₂S (Table 5.17-17).
- 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 at least four family residences, farm homes or commercial properties within this release footprint. Examination of the population density estimates suggests that such a release could potentially cause irreversible adverse effects in 21 individuals exposed to CO, with three 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.

| Release Scenario | Gas | Effect ¹ | Distance ² (miles [kilometers]) | Number Affected |
|------------------------------|------------------|------------------------------|--|-----------------|
| Claus Unit failure | H ₂ S | Irreversible adverse effects | 0.5 (0.8) | 15 |
| (release duration = minutes) | | Life threatening | 0.4 (0.6) | 8 |
| | SO ₂ | Irreversible adverse effects | 1.4 (2.3) | 115 |
| | | Life threatening | 0.2 (0.3) | 3 |
| Gasifier release | CO | Irreversible adverse effects | 0.6 (1.0) | 21 |
| (release duration = minutes) | | Life threatening | 0.2 (0.3) | 3 |

Table 5.17-17. Effects to the Public from Explosions at the FutureGen Plant

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.

¹ See Table 5.17-6 and Table 5.17-7 for an explanation of the effects.

² Distances taken from Quest, 2006.

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5.18 COMMUNITY SERVICES

5.18.1 INTRODUCTION

This section identifies the community services most likely to be affected by the construction and operation of the proposed FutureGen Project at the Tuscola Power Plant Site in Douglas 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 proposed FutureGen Project could have on those services, as well as any proposed mitigation measures that could reduce any adverse effects, are discussed.

5.18.1.1 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 site and sequestration site. The proposed sequestration site is located approximately 11 miles (17.7 kilometers) south of the proposed plant site. As shown in Figure 5.18-1, the 50-mile (80.5-kilometer) radius for the sequestration site and the 50-mile (80.5-kilometer) radius for the power plant site largely overlap. The ROI for the proposed Tuscola Power Plant Site and sequestration site includes all land areas within the counties of Douglas, Champaign, Coles, Cumberland, Edgar, Macon, Moultrie and Piatt in Illinois; and some land area within the counties of Christian, Clark, Crawford, DeWitt, Effingham, Fayette, Ford, Jasper, Logan, McLean, Sangamon, Shelby and Vermilion in Illinois, and Vermillion 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 Iroquois and Montgomery in Illinois, and Fountain, Parke, Sullivan and Warren in Indiana. Excluding these counties from the ROI makes the remaining data more meaningful for determining project effects.

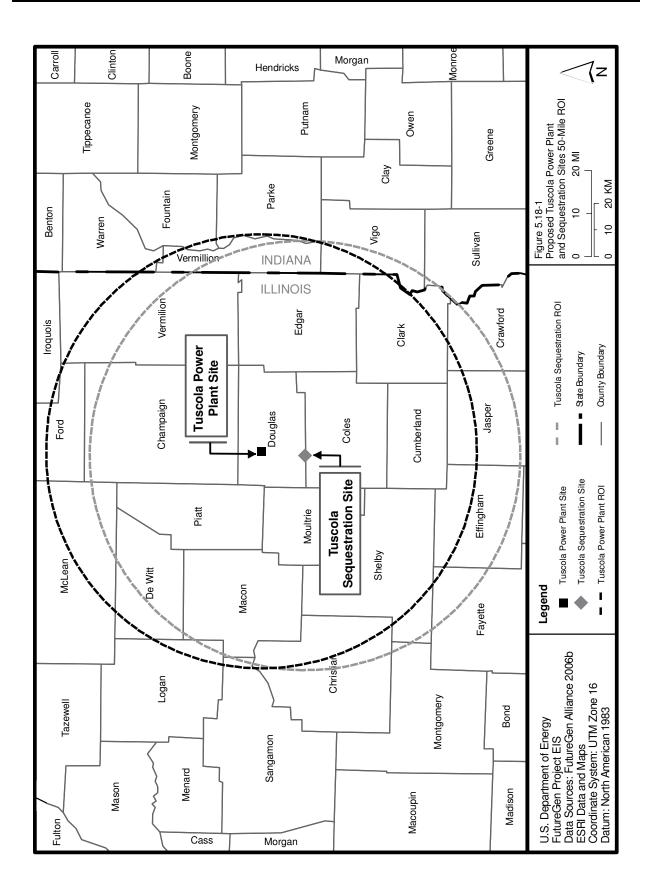
Although the analysis in this section addresses the entire ROI, the affected environment and environmental consequences focus on the proposed power plant site in Douglas County.

5.18.1.2 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 Tuscola EIV (FG Alliance, 2006b). 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;
- 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.

5.18.2 AFFECTED ENVIRONMENT

5.18.2.1 Law Enforcement

Douglas County is served by six municipal police departments located in Arcola, Arthur, Atwood, Newman, Tuscola, and Vila Grove, and all operate under a mutual aid agreement (UC, 2005a and FG Alliance, 2006b). Table 5.18-1 presents the staffing levels of these police departments. Thirty-four full-time and 29 part-time law enforcement officers work out of these six departments in Douglas County (FG Alliance, 2006b). Douglas County is also served by the Douglas County Sheriff's Office and District 10 of the Illinois State Police (UC, 2005a and ILSP, 2004).

Table 5.18-1. Staffing Levels of Police Departments in Douglas County

| Community | Full-Time Officers | Part-Time Officers |
|---------------------|--------------------|--------------------|
| Tuscola | 7 | 1 |
| Atwood | 3 | 6 |
| Arthur | 4 | 4 |
| Arcola | 5 | 3 |
| Villa Grove | 4 | 1 |
| Newman | 1 | 4 |
| Douglas Co. Sheriff | 10 | 10 |
| Total | 34 | 29 |

Source: FG Alliance, 2006b and CD, 2002.

Champaign, Coles, Cumberland, Edgar, Macon, Moultrie, and Piatt counties in Illinois are served by a total of 29 municipal police departments and each county has its own Sheriff's Office (USACOPS, 2005a). Each of these counties is served by District 10 of the Illinois State Police, except Cumberland County, which is served by District 12 (ILSP, 2004). The other Illinois counties located in the ROI are served by a total of 69 municipal police departments, their own County Sheriff's Office, and the Illinois State Police (UC, 2005a and ILSP, 2004). Vermillion and Vigo counties in Indiana are served by a total of three 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 Douglas County, the ratio is approximately 2.4 officers per thousand residents based on the 2005 projected population and the equivalent of 49 full-time law enforcement officers. Douglas County's crime rate is also 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 3,742 index offenses per 100,000 residents in 2003,

whereas Douglas County reported 331 per 100,000 residents for the same year (The Disaster Center, 2005).

5.18.2.2 Emergency and Disaster Response

The Douglas County Sheriff's Office operates the county's 911 center and dispatches fire and rescue, ambulances, and emergency medical personnel. Douglas County and the entire ROI are served by 56 ambulance services, one air ambulance service, and the Illinois State Police. The Tuscola fire department, the Cabot Corporation and Lyondell-Equistar Chemicals provide hazardous materials emergency response in Douglas County (FG Alliance, 2006b; ILSP, 2004; and YYP, 2006a). Through the established Mutual Aid Box Alarm System, up to 120 ambulances from throughout Illinois could be made available within an hour of notification (FG Alliance, 2006b).

5.18.2.3 Fire Protection

Douglas County has nine fire departments with trained fire services personnel (ISFM, 2006). Both the Cabot Corporation and Lyondell-Equistar Chemicals, located less than 1 mile (1.6 kilometers) from the proposed Tuscola Power Plant Site, are members of the region's mutual aid association and would respond to a fire emergency (FG Alliance, 2006b). The ROI is served by a total of 213 fire departments in Illinois and at least 20 fire departments in Vermillion and Vigo counties 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 Tuscola, Decatur, Charleston, Mattoon, Oakland, Urbana and Champaign fire departments have the capability to provide a high angle, vertical or confined space rescue (FG Alliance, 2006b).

5.18.2.4 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). Douglas County is also served by both the Cabot Corporation and Lyondell-Equistar Chemicals who respond outside of their own plant locations for hazardous materials emergencies. In addition, the Tuscola fire department has HazMat capability to include personnel and equipment support. HazMat units respond and perform functions to handle and control actual or potential leaks or spills of hazardous substances (OSHA, 1994).

5.18.2.5 Health Care Service

A total of 28 hospitals and medical centers serve the ROI, with 23 in Illinois counties and five in Vermillion and Vigo counties in Indiana (IHA, 2006; IDOH, 2006a; and IDOH, 2006b). Douglas County and its residents are served by seven large hospitals in the region, which include Provena-Covenant Hospital in Champaign, Sara Bush Lincoln Health Center in Mattoon, Carle Foundation Physicians in Mattoon, Decatur Memorial Hospital in Decatur, Paris Community Hospital in Paris, Kirby Hospital in Monticello, and Memorial Medical Center in Springfield.

There are approximately 3,931 beds in the 28 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 3.2 beds per thousand people within the ROI.

5.18.2.6 Local School System

Douglas County has four elementary schools, three junior high schools, four high schools, and as many as seven private schools (Swager, 2006; CD, 2002). Table 5.18-2 shows the expenditure per pupil per school year and the student-teacher ratios for Douglas County, the State of Illinois and the U.S.

Table 5.18-2. School Statistics for Douglas County, Illinois and the U.S. in 2005

| | Expenditure per Pupil per School Year (\$) | Pupils per Teacher (Elementary/Secondary) |
|----------------|--|--|
| Douglas County | 12,080 | 15.7/12.3 |
| Illinois | 14,000 | 18.9/18.4 |
| Nationwide | 8,287 | 15.4/15.4 |

Source: FG Alliance, 2006b; USCB, 2006; and NCES, 2005.

5.18.3 IMPACTS

5.18.3.1 Construction Impacts

As discussed in Section 5.19, 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 5.19, temporary construction workers would likely reside in short-term housing. Douglas County does not have enough hotel rooms, when occupancy rates are taken into account, to accommodate all of the temporary workers (FG Alliance, 2006b). 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 35,977 people, by 2010 (FG Alliance, 2006b). Additional police and other law enforcement services would be required to accommodate the growing population. The current number of law enforcement officers is above the U.S. average and county crime rates are extremely low, which is an indication that law enforcement is appropriately staffed (FG Alliance, 2006b; 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.

With companies such as the Cabot Corporation and Lyondell-Equistar Chemicals present in Douglas County, local law enforcement agencies have a history of maintaining order in an area with industrial occupancies. Within the ROI, the proposed project is not expected to increase the demand on these services substantially beyond the available capacities. In addition, construction activities would not impede effective law enforcement or conflict with regional plans.

Fire Protection

As discussed in Section 5.17, 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 site. Currently, 213 fire departments within both the ROI and the State of Illinois 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 5.17, it is anticipated that construction of the proposed facilities would result in an average of 19.6 total recordable injury cases per year with a peak maximum of 39.2 total recordable injury cases per year. Based on the number of emergency response organizations, the proposed power plant site would be adequately served in an emergency. Douglas County and the entire ROI are served by 56 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. The ROI currently has 3.2 hospital beds per thousand residents, whereas the U.S. average is 2.9 hospital beds per thousand residents. However, 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 3.2 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.

5.18.3.2 Operational Impacts

As discussed in Section 5.19, 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 490 people, representing a 0.04 percent increase in population within the ROI.

Law Enforcement

Law enforcement in the ROI would be sufficient to handle the 0.04 percent increase in population during facility operations. A 0.04 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 Douglas 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 5.17, 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 213 fire departments within both the ROI and the State of Illinois 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 5.17, 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 site would be adequately served in an emergency. Douglas County and the entire ROI are served by 56 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 0.04 percent, representing approximately 490 new residents. Currently, health care capacity in the ROI is greater than the national average, with 3.2 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 3.0 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 116 new school-aged children could relocate within the ROI (FG Alliance, 2006b). The projected 2007 public school enrollment for the Illinois counties within the ROI is 156,731 for kindergarten through 12th grade (ISBE, 2005). An additional 116 new school-aged children would represent a 0.07 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.

5.19 SOCIOECONOMICS

5.19.1 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.

5.19.1.1 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 site, sequestration site, and utility and transportation corridors. The proposed sequestration site is located approximately 11 miles (17.7 kilometers) south of the proposed power plant site. As shown in Figure 5.18-1, the ROI for the proposed FutureGen Project includes all land area in the following counties: Douglas, Champaign, Coles, Cumberland, Edgar, Macon, Moultrie, and Piatt in Illinois. The ROI also includes some land area in the following counties: Christian, Clark, Crawford, DeWitt, Effingham, Fayette, Ford, Jasper, Logan, McLean, Sangamon, Shelby, and Vermillion in Illinois and Vermillion and Vigo in Indiana. Therefore, this section focuses on the socioeconomic environment at the county level rather than by the proposed power plant site, 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. Iroquois and Montgomery counties in Illinois and Fountain, Parke, Sullivan, and Warren 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 site located in Douglas County.

5.19.1.2 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.

5.19.2 AFFECTED ENVIRONMENT

5.19.2.1 Regional Demographics and Projected Growth

The regional demographics for the ROI are provided in Table 5.19-1. In 2000, the total population for the counties within the ROI was 1,199,171 (USCB, 2000a). The total population for the ROI is anticipated to increase by approximately 3 percent by 2010 to 1,235,148 (FG Alliance, 2006b).

Table 5.19-1. Population Distribution and Projected Change for Counties
Containing Land Area Within the ROI

| | Containing Land Area Within the ROI | | | | | | |
|------------------------|-------------------------------------|-------------|-----------|-------------|---------------------------|----------------------------------|-------------------------------------|
| | | | Year 2000 |) | | 2010 | Projected |
| County | Total | Under 18 | 18-64 | 65 and over | Average Family Size | Projected Total Population | Change 2000 to 2010 (percent) |
| | (| Counties I | Located C | ompletely | Within the F | ROI | |
| Douglas | 19,922 | 5,388 | 11,354 | 3,180 | 2.6 | 21,032 | 1,110 (5) |
| Champaign | 179,669 | 37,819 | 124,380 | 17,470 | 2.3 | 186,883 | 7,214 (4) |
| Coles | 53,196 | 10,477 | 35,652 | 7,067 | 2.3 | 54,178 | 982 (2) |
| Cumberland | 11,253 | 2,976 | 6,495 | 1,782 | 2.6 | 11,511 | 258 (2) |
| Edgar | 19,704 | 4,701 | 11,509 | 3,494 | 2.4 | 19,901 | 197 (0.1) |
| Macon | 114,706 | 28,171 | 69,054 | 17,481 | 2.4 | 115,199 | 493 (0.4) |
| Moultrie | 14,287 | 3,670 | 8,093 | 2,524 | 2.6 | 14,928 | 641 (4) |
| Piatt | 16,365 | 4,115 | 9,721 | 2,529 | 2.5 | 16,815 | 450 (3.0) |
| Subtotal | 429,102 | 97,317 | 276,258 | 55,527 | 2.5 | 440,447 | 11,345 (2.6) |
| | | Counties | s Located | Partially W | ithin the RC |)I | |
| Christian | 35,372 | 8,521 | 20,757 | 6,094 | 2.4 | 37,212 | 1,840 (5.0) |
| Clark | 17,008 | 4,233 | 9,714 | 3,061 | 2.4 | 17,734 | 726 (4.0) |
| 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) |
| Effingham | 34,264 | 9,784 | 19,713 | 4,767 | 2.6 | 36,558 | 2,294 (7.0) |
| Fayette | 21,802 | 5,188 | 13,150 | 3,464 | 2.5 | 21,860 | 58 (0.2) |
| Ford | 14,241 | 3,671 | 7,806 | 2,764 | 2.5 | 14,607 | 366 (3.0) |
| Jasper | 10,117 | 2,620 | 5,830 | 1,667 | 2.6 | 10,174 | 57 (0.5) |
| Logan | 31,183 | 6,824 | 19,668 | 4,691 | 2.4 | 31,310 | 127 (0.4) |
| McLean | 150,433 | 35,292 | 100,520 | 14,621 | 2.5 | 159,339 | 8,906 (6.0) |
| Sangamon | 188,951 | 47,147 | 116,280 | 25,524 | 2.4 | 190,721 | 1,770 (0.9) |
| Shelby | 22,893 | 5,728 | 13,088 | 4,077 | 2.5 | 23,087 | 194 (0.8) |
| Vermilion, IL | 83,919 | 20,972 | 49,522 | 13,425 | 2.4 | 84,471 | 552 (3.0) |
| Vermillion, IN | 16,788 | 4,447 | 8,939 | 3,402 | 2.4 | 17,125 | 337 (2.0) |
| Vigo, IN | 105,848 | 24,216 | 66,584 | 15,048 | 2.4 | 110,441 | 4,593 (4.0) |
| Subtotal or Average | 770,069 | 187,433 | 473,968 | 108,668 | 2.5 | 794,701 | 24,632 (3.2) |
| Total | 1,199,171 | 284,750 | 750,226 | 164,195 | 2.5 | 1,235,148 | 35,977 (3.0) |
| Illinois | 12,419,293 | _ | | | | 12,916,894 | 497,601 (1.0) |
| U.S. | 282,125,000 | | | | | 308,936,000 | 2,681,100 (9.5) |

Source: FG Alliance, 2006b and USCB, 2000a.

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 308,936,000 and approximately 19 percent by 2020 to 335,805,000 (USCB, 2000b). Thus, the ROI population is anticipated to grow at a slower rate than the U.S. and Illinois (FG Alliance, 2006b). Douglas County had a total population of 19,922 in 2000 (FG Alliance, 2006b) and has the tenth smallest population within the ROI and a projected growth rate larger than the ROI's average growth rate. The median age of residents in 2000 was 35.3 years for the nation, 34.7 years for Illinois, and 37.4 years for Douglas County, indicating an older local population (USCB, 2000c and USCB, 2000d).

An Amish community is present in Douglas, Coles, and Moultrie counties, with the largest population located in Southwest Douglas County and Northwest Coles County.

5.19.2.2 Regional Economy

Income and Unemployment

Table 5.19-2 provides information about the workforce, and per capita and median household incomes for the counties located within the ROI. In July 2006, the average unemployment rate for the ROI was 6.2 percent and approximately 36,000 were unemployed (USBLS, 2006a). The average unemployment rate in July 2006 was 4.8 percent in the U.S. and 4.7 percent in Illinois (USBLS, 2004 and 2006b). Thus, the unemployment rate within the ROI is higher than that for either Illinois or the U.S.

In 1999, the average median household income for the ROI was \$37,543 and the average per capita income was \$18,502 in 1999 (FG Alliance, 2006b and USCB, 2000e). Respectively, the median household income for the U.S. was \$41,994 and the per capita income was \$21,587 (USCB, 2000f and USCB, 2000g). The State of Illinois had a median household income of \$46,590 and a per capita income of \$23,104 (USCB, 2000e). Douglas County had a median household income of \$39,439 and a per capita income of \$18,414 (FG Alliance, 2006b). Based on 2000 Census data, both Douglas County and the ROI have median household and per capita incomes less than both Illinois and U.S. averages.

Douglas County collected \$21.2 million in property taxes in 2003 and \$2.8 million in sales taxes in 2004 (FG Alliance, 2006b). The counties located within the ROI each collected an average of *approximately* \$9 million in sales taxes (FG Alliance, 2006b).

Table 5.19-2. Employment and Income for Counties Within the ROI

Employment Income

| | Em | oloyment | Incom | come | |
|------------|---------------------|--|---------------------------|-----------------------------|--|
| County | 2004 Labor Force | July 2006 Unemployment Rate ¹ | 1999 Per Capita Income | 1999 Median Household | |
| | Counties Locate | ed Completely Within | n the ROI | | |
| Douglas | 10,796 | n/a | \$18,414 | \$39,439 | |
| Champaign | 102,196 | n/a | \$19,708 | \$37,780 | |
| Coles | 27,110 | n/a | \$17,370 | \$32,286 | |
| Cumberland | 5,685 | n/a | \$16,953 | \$36,149 | |
| Edgar | 10,411 | n/a | \$17,857 | \$35,203 | |
| Macon | 18,239 | n/a | \$20,067 | \$37,859 | |
| Moultrie | 8,218 | n/a | \$18,562 | \$40,084 | |

Table 5.19-2. Employment and Income for Counties Within the ROI

| | Em | ployment | Incom | е |
|----------------------|---------------------|--|---------------------------|-----------------------------|
| County | 2004 Labor Force | July 2006 Unemployment Rate ¹ | 1999 Per Capita Income | 1999 Median Household |
| Piatt | 9,161 | n/a | \$21,075 | \$45,752 |
| Subtotal or Average | 191,816 | n/a | \$18,751 | \$38,069 |
| | Counties Loca | ated Partially Within | the ROI | |
| Christian | 17,334 | n/a | \$17,937 | \$36,561 |
| Clark | 8,840 | n/a | \$17,655 | \$35,967 |
| Crawford | 9,446 | n/a | \$16,869 | \$32,531 |
| De Witt | 49,909 | n/a | \$20,488 | \$41,256 |
| Effingham | 18,182 | n/a | \$18,301 | \$39,379 |
| Fayette | 10,399 | n/a | \$15,357 | \$31,873 |
| Ford | 7,431 | n/a | \$18,860 | \$38,073 |
| Jasper | 5,373 | n/a | \$16,649 | \$34,721 |
| Logan | 13,703 | n/a | \$17,953 | \$39,389 |
| McLean | 13,733 | n/a | \$22,227 | \$47,021 |
| Montgomery | 13,607 | n/a | \$16,272 | \$33,123 |
| Sangamon | 4,466 | n/a | \$23,173 | \$42,957 |
| Shelby | 122,780 | n/a | \$17,313 | \$37,313 |
| Vermilion, IL | 38,406 | n/a | \$16,787 | \$34,071 |
| Vermillion, IN | 8,094 | n/a | \$18,579 | \$34,837 |
| Vigo, IN | 50,176 | n/a | \$17,620 | \$33,184 |
| Subtotal or Average | 391,881 | n/a | \$18,253 | \$37,016 |
| ROI Total or Average | 583,697 | 6.2 percent | \$18,502 | \$37,543 |
| 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 was not available for Illinois counties for July 2006.

Table 5.19-3 provides minimum and maximum hourly wages for Douglas 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 Douglas County adjusted for inflation.

Table 5.19-3. Minimum and Maximum Hourly Wages by Trade in Douglas 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 |

n/a = not available.

Source: FG Alliance, 2006b; USCB, 2000e; and USCB, 2000h.

Table 5.19-3. Minimum and Maximum Hourly Wages by Trade in Douglas County, Illinois, in November 2005

| Trade | Minimum and Maximum Wages |
|--------------------------|---------------------------|
| Electric Power Groundman | \$19.79 - \$34.10 |
| Electric Power Lineman | \$32.04 - \$34.10 |
| Electrician | \$32.10 - \$34.01 |
| Iron Worker | \$26.42 - \$28.17 |
| Laborer | \$22.92 - \$23.92 |

Source: IDOL, 2006.

Housing

Table 5.19-4 provides total housing and vacant units by county within the ROI. As of 2006, there were 510,883 existing housing units within the ROI, with Douglas County accounting for 8,005 of those units (FG Alliance, 2006b). Of the existing housing units within the ROI, 6.9 percent, or 35,015, were vacant (FG Alliance, 2006b). Of the total vacant units, there were 14,821 units for rent and 6,777 units for sale (FG Alliance, 2006b). In addition, there were at least 5,580 short-term hotel and motel rooms within the ROI (FG Alliance, 2006b).

There are three residences located adjacent to, seven residences located within 0.5 mile (0.8 kilometer) of, and several dozen additional residences within 1 mile (1.6 kilometer) of the 345-acre (140-hectare) proposed power plant site.

5.19.2.3 Workforce Availability

Construction

In 2004, there were approximately 583,697 people within the ROI workforce (FG Alliance, 2006b). Because construction workers represented 6.3 percent of the workforce in Illinois, there were approximately 37,000 construction workers within the ROI (USCB, 2005b and FG Alliance, 2006b). This indicates that there could be a large local workforce from which some or all of the construction workers could be drawn.

Operations

Utility workers made up 0.7 percent of the workforce in Illinois in 2004, resulting in approximately 4,300 utility workers within the ROI (USCB, 2005b). Operations workers could be drawn from this workforce.

Table 5.19-4. Total Housing Units Within the ROI in 2006

| County | Total | Vacant Units | | | | | |
|--|------------------|--------------|----------|-----------------|-----------------|--|--|
| | Housing Units | For Rent | For Sale | Seasonal Use | Other Vacant | | |
| Counties Located Completely Within the ROI | | | | | | | |
| Douglas | 8,005 | 115 | 87 | 32 | 137 | | |
| Champaign | 75,280 | 2,306 | 653 | 214 | 1,189 | | |

Table 5.19-4. Total Housing Units Within the ROI in 2006

| | Total Housing Units | Vacant Units | | | | | | |
|---|---------------------------|--------------|-----------|-----------------|-----------------|--|--|--|
| County | | For Rent | For Sale | Seasonal Use | Other Vacant | | | |
| Coles | 22,768 | 714 | 249 | 215 | 364 | | | |
| Cumberland | 4,876 | 79 | 92 | 134 | 140 | | | |
| Edgar | 8,611 | 175 | 140 | 57 | 314 | | | |
| Macon | 50,241 | 1,628 | 554 | 139 | 981 | | | |
| Moultrie | 5,743 | 56 | 81 | 31 | 132 | | | |
| Piatt | 6,798 | 57 | 62 | 24 | 129 | | | |
| Subtotal | Subtotal 182,322 | | 1,918 | 846 | 3,386 | | | |
| Counties Located Partially Within the ROI | | | | | | | | |
| Christian | 14,992 | 341 | 202 | 63 | 348 | | | |
| Clark | 7,816 | 255 | 117 | 113 | 286 | | | |
| Crawford | 8,785 | 362 | 214 | 56 | 243 | | | |
| De Witt | 7,282 | 184 | 97 | 51 | 114 | | | |
| Effingham | 13,959 | 282 | 156 | 201 | 231 | | | |
| Fayette | 9,053 | 158 | 129 | 207 | 311 | | | |
| Ford | 6,060 | 81 | 106 | 24 | 162 | | | |
| Jasper | 4,294 | 87 | 53 | 30 | 143 | | | |
| Logan | 11,872 | 203 | 153 | 28 | 211 | | | |
| McLean | 59,972 | 1348 | 707 | 230 | 511 | | | |
| Sangamon | 85,459 | 2,715 | 1,131 | 240 | 2,137 | | | |
| Shelby | 10,060 | 132 | 170 | 166 | 445 | | | |
| Vermilion, IL | 36,349 | 1,077 | 1,077 533 | | 911 | | | |
| Vermillion, IN | 7,405 | 714 | 249 | 215 | 364 | | | |
| Vigo, IN | 45,203 | 1,752 | 842 | 302 | 701 | | | |
| Subtotal | 328,561 | 9,691 | 4,859 | 2,067 | 7,118 | | | |
| Total | 510,883 | 14,821 | 6,777 | 2,913 | 10,504 | | | |

Source: FG Alliance, 2006b.

5.19.3 IMPACTS

5.19.3.1 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 site would average 350 workers

during construction, with a peak of 700 workers (FG Alliance, 2006e). Approximately 37,000 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 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. Although it is not known how many workers would relocate, the required number of construction workers represents less than 0.1 percent of population within the ROI. Therefore, impacts on population growth within the ROI would be small.

The Tuscola-Douglas County FutureGen Task Force sent letters to the approximately 30 Amish Bishops associated with this community to provide information on the proposed project and solicit their input (see Appendix A). As a result, an Amish Bishop with the community in Arcola, Illinois, responded and requested additional information. Communication with the bishop indicates that he did not expect that the proposed FutureGen Project would affect the Amish community (see Appendix A). Based on the distance from the proposed power plant site to the Amish residences, it is not anticipated that construction nor operations of the proposed power plant would have an adverse effect on the Amish communities that reside in Douglas, Coles, and Moultrie counties.

Employment, Income, and Economy

Construction of the proposed facilities could result in 350 to 700 new jobs in Douglas County. These new jobs would represent a 0.06 to 0.1 percent increase in the number of workers employed in Douglas County (FG Alliance, 2006b). 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 5.19-3, 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 Douglas County could benefit from temporarily increased sales tax revenues 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 could 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: Douglas County, Arcola Fire District, Parkland College 505, Arcola Library District, Arcola Township, Arcola Township Road District, Arcola Unit 306, Parkland College 505, Tuscola Township, Tuscola Township Road District, and Tuscola Unit 301. The total loss of revenue would be \$6,695 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 10 acres (4 hectares) for the proposed sequestration site. Similar impacts could also occur on the additional 145 acres (60 hectares) of the proposed sites 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 14,821 vacant housing units for rent with Douglas County accounting for approximately 115 of these units. There are at least 5,580 hotel rooms within the ROI, with Douglas County accounting for approximately 291 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 18.2 percent. This increase would result in a hotel occupancy rate of 80 percent and a positive, direct impact for the hotel industry within the ROI.

Power Plant Site

There are three residences located adjacent to, seven residences located within 0.5 mile (0.8 kilometer) of, and several dozen additional residences located within 1 mile (1.6 kilometer) of the 345-acre (140-hectare) proposed plant site. Though construction activities could adversely impact these properties (e.g., increased traffic), construction would not cause the displacement of residents or demolition of their houses. Potential impacts to property values are discussed in Section 5.19.3.2.

Sequestration Site

There are no existing residences or buildings on the proposed sequestration site; therefore, no existing population would be displaced.

5.19.3.2 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 490 people. This increase would represent a 0.04 percent increase in population within the ROI and a 2.4 percent increase in Douglas 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 Douglas County. These new jobs could represent a 0.03 percent increase in the total number of workers employed in Douglas County (FG Alliance, 2006b).

Each new operations job created by the proposed FutureGen Project would 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 could result (IVCA, 2006). Using this job multiplier, the 200 permanent operations jobs would create approximately 240 indirect or induced jobs for a total of 440 new jobs in and around Douglas County. 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 Douglas County.

The proposed FutureGen Project would also have annual operation and maintenance needs that could benefit Douglas 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 FutureGen Project 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 Douglas 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 power plant site would result in a 3.0 percent decrease in residences for sale and a 1.3 percent decrease in residences for rent within the ROI.

Power Plant Site

There are three residences located adjacent to, seven residences located within 0.5 mile (0.8 kilometer) of, and several dozen additional residences located within 1 mile (1.6 kilometers) of the 345-acre (140-hectare) proposed plant site that may have an unobstructed view of the facility. Direct and adverse long-term impacts on property value in relation to comparable property values in Tuscola 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

There are no existing residences or buildings on the proposed sequestration site and, therefore, no existing population that would be displaced by the proposed sequestration site.

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5.20 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 of 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 Tuscola Power Plant Site, 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).

5.20.1 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.

5.20.1.1 Region of Influence

The ROI includes the land area within 50 miles (80.5 kilometers) of the boundaries of the proposed power plant site, sequestration site, reservoir, and utility and transportation corridors. The proposed sequestration site and reservoir are located approximately 10 miles (16 kilometers) south of the proposed plant site. The 50-mile (80.5-kilometer) radius for the sequestration site and the 50-mile (80.5-kilometer) radius for the plant site largely overlap. The ROI includes the counties of Douglas, Champaign, Coles, Cumberland, Edgar, Macon, Moultrie and Piatt in Illinois; some land area in the counties of Christian, Clark, Crawford, DeWitt, Effingham, Fayette, Ford, Jasper, Logan, McLean, Sangamon, Shelby and Vermilion in Illinois; and Vermillion and Vigo counties in Indiana. Section 5.19.1.1 describes the rationale for including these counties in the ROI.

5.20.1.2 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 Tuscola Power Plant Site 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 the 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 5.20-1 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, 2006b) 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 5.20-1. 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 Wholly Located Within the ROI | | | | | | | | |
| Champaign | 179,669 | 78.8 | 11.2 | 0.2 | 6.5 | <0.1 | 2.9 | 16.1 | |
| Coles | 53,196 | 95.4 | 2.3 | 0.2 | 0.8 | <0.1 | 1.4 | 17.5 | |
| 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 | |
| Edgar | 19,704 | 97.1 | 1.8 | 0.2 | 0.2 | <0.1 | 0.8 | 10.5 | |
| Macon | 114,706 | 83.5 | 14.1 | 0.2 | 0.6 | <0.1 | 1.0 | 12.9 | |
| Moultrie | 14,287 | 98.9 | 0.2 | 0.2 | 0.1 | <0.1 | 0.5 | 7.8 | |
| Piatt | 16,365 | 98.8 | 0.2 | 0.1 | 0.1 | <0.1 | 0.6 | 5.0 | |
| Counties Partially Located Within the ROI | | | | | | | | | |
| Christian | 35,372 | 96.3 | 2.1 | 0.2 | 0.4 | <0.1 | 1.0 | 9.5 | |
| Clark | 17,008 | 98.8 | 0.2 | 0.2 | 0.1 | <0.1 | 0.3 | 9.2 | |
| 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 | |
| Effingham | 34,264 | 98.7 | 0.2 | 0.2 | 0.3 | <0.1 | 0.7 | 8.1 | |

Table 5.20-1. County, Regional and National Population and Low-Income Distributions (2000)¹

3.6

0.1

12.5

12.4

0.9

Source: USCB, 2006.

U.S.

5.20.2 AFFECTED ENVIRONMENT

75.1

12.3

5.20.2.1 Minority Populations

281,421,906

Table 5.20-1 compares the minority percentage and low-income percentage of county populations within the ROI with those of Illinois and the nation. 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 (94.2 percent) compared to the state (73.5 percent) and U.S. (75.1 percent) percentages.

The higher minority percentages (above 10 percent) within the ROI are in counties with more urbanized areas including the communities of Decatur (22.4 percent non-white) and Urbana-Champaign (33 percent, 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.

¹ Some of the minority population counted themselves as more than one ethic background, thus the counts do not add up to 100 percent.

5.20.2.2 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 5.20-1). The majority of 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), Vermilion (13.3 percent), and Vigo (14.1 percent) counties.

The proposed power plant site is located within Douglas County, with a portion near the Coles County border. Other areas of low-income populations are located beyond 25 miles (40 kilometers) from the proposed power plant site and sequestration site, and include the communities of Decatur (21.0 percent), Urbana (27.3 percent), and West Terre Haute, Indiana (20.7 percent).

5.20.3 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 5.20.1, 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 5.20.1, 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 5.20.1, was determined.

Using the impacts analyzed in Section 5.17, 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 5.17, 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.

5.20.3.1 Construction Impacts

As discussed in Section 5.20.2.1, no areas of minority population, 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 and sequestration sites would be located in Douglas and Coles counties. Coles County 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 5.2, 5.7, 5.13, and 5.14). Short-term beneficial impacts may include an increase in employment opportunities and potentially higher wages or supplemental income through jobs created during facility construction.

5.20.3.2 Operational Impacts

No areas of minority populations are located within the ROI for the proposed power plant site, 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 5.12, 5.13, 5.14, and 5.19) resulting from operations were determined not to have a disproportionately high and adverse effect on the low-income population. The potential risks to health were determined to be from the unlikely event of pipeline rupture or puncture, the extremely unlikely event of a slow, upward leakage of H₂S from an injection or existing well, or a catastrophic accident, terrorism, or sabotage, which cannot be predicted (see Section 5.17). 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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