3. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

3.1 COMPARISON OF IMPACTS OF ALTERNATIVES

3.1.1 INTRODUCTION

This chapter provides a comparison of the potential environmental impacts to physical, natural, cultural, and socioeconomic resources for all four site alternatives for the FutureGen Project. ***The Best and Final Offer (BAFO) information for the Mattoon and Odessa sites, and their potential impacts, have been addressed in Sections S.4.2.4, S.4.3, 2.4.4, 2.4.5, and Tables S-12 and 3-3, and therefore are not reflected in the text of this section.***

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

3.1.2 AIR QUALITY

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

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

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

Table 3-1. Project Features for Alternative Sites

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

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

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

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

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

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

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

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

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

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

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

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

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

3.1.3 CLIMATE AND METEOROLOGY

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

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

Over a 50 year period, within a 850 square mile (2,202 square kilometer) "normalized" area of the sites, there would be statistically (within that large area) the following numbers of F1 or higher tornadoes: 24 for Mattoon, 10 for Tuscola, 7 for Jewett and 6 for Odessa. Because the power plant sites would comprise a small fraction of that land area (less than 0.1 percent), the probability of a tornado impacting any of the sites is low. All four sites could experience severe or extreme drought.

3.1.4 GEOLOGY

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

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

DOE based its evaluation on a review of reports from state geologic surveys and information provided by the Alliance that pertain to the geological features of the proposed sequestration formations. DOE reviewed the numerical reservoir modeling of CO_2 injection, conducted by the Alliance, which showed that each site would be able to achieve the goals of the FutureGen Project. The predicted

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

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

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

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

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

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

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

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

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

3.1.5 PHYSIOGRAPHY AND SOILS

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

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

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

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

- Mattoon – Up to 25.6 acres (10.4 hectares) of land area for utility corridors and up to 15.9 acres (6.4 hectares) of land area for transportation corridors.
- Tuscola – Up to 32.4 acres (13.1 hectares) of land area for utility corridors and up to 6.7 acres (2.7 hectares) of land area for transportation corridors.
- Jewett – Up to 358 acres (145 hectares) of land area for utility corridors and ***no soil disturbance*** of land area for transportation corridors.
- Odessa – Up to 341 acres (138 hectares) of land area for utility corridors and up to 1.8 acres (0.7 hectare) of land area for transportation corridors.

3.1.6 GROUNDWATER

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

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

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

adequate to support the required 3,000 gallons (11,356 liters) per minute process water demand while maintaining aquifer sustainability for current and future uses.

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

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

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

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

3.1.7 SURFACE WATER

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

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

Construction of the proposed water supply pipeline at the Mattoon Site would cross ***up to*** five surface waters, the proposed CO_2 pipeline ***and transmission line*** at the Tuscola Site would cross ***five*** surface waters, the proposed CO_2 pipeline at the Jewett Site would cross approximately 30 surface waters, and the proposed CO_2 and water supply pipelines at the Odessa Site would cross approximately four ephemeral

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

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

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

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

3.1.8 WETLANDS AND FLOODPLAINS

DOE assessed the potential impacts to wetland and floodplain resources based on field verification (wetland delineations) and National Wetland Inventory (NWI) mapping. The Mattoon and Tuscola sites included field verification for the power plant sites and other project components (e.g., utility corridors), allowing for a quantitative analysis using potential acreage (hectares) of impacts. The Jewett and Odessa

sites included field verification for only the power plant sites and relied on NWI mapping for all other project components, allowing for a qualitative assessment limited to wetland type occurring within the project component areas. This assessment was conducted in accordance with 10 CFR 1022 "Compliance with Floodplain and Wetland Environmental Review Requirements."

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

Illinois Department of Natural Resources (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 U.S. Army Corps of Engineers (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.

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

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

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

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

sequestration site. Up to 4.2 acres (1.7 hectares) of wetlands would potentially be impacted along the transmission line and CO_2 corridors.

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

The proposed Odessa Power Plant Site contains no jurisdictional wetlands; therefore, construction and operations would not directly impact wetland resources. NWI mapping indicates the sequestration site and the utility corridors contain several surface water features (see Sections 3.1.7 and 3.1.15). With the exception of wetlands at the power plant site, all other areas would require a wetland delineation to verify NWI mapping.

3.1.9 BIOLOGICAL RESOURCES

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

There are no ***known*** unique or rare aquatic or terrestrial habitats present at any of the alternative sites or corridors ***(see Sections 4.9, 5.9, 6.9, 7.9, and Appendix A)***. Therefore, no direct impacts to these resources are expected. The majority of the land proposed for construction at the Mattoon and Tuscola sites is active cropland. Reclaimed mine land and pastureland are the principal lands at the Jewett Site, and ranch land and scrubland are the principal lands at the Odessa Site. The habitats present at each alternative site are prevalent within the respective regions.

Up to 200 acres (81 hectares) of land at the power plant site may be converted to industrial use. With the exception of the Mattoon Site, up to 10 acres (4 hectares) of land at each alternative sequestration site could also be converted to industrial use. Because the Mattoon and Tuscola power plant and sequestration sites have been actively farmed with row crops, the potential for resident wildlife populations at these sites is low ***(see Sections 4.9 and 5.9)***. Therefore, impacts related to the displacement of wildlife communities for these sites would be minimal. The Jewett and Odessa sites provide a greater opportunity for wildlife to be present due to the lack of current intrusive human activities ***(see Sections 6.9 and 7.9)***. As a result, resident wildlife populations within the areas to be used by the FutureGen Project would be lost or permanently displaced. Displaced wildlife would likely relocate to similar adjacent habitats that are prevalent in the respective regions of the Jewett and Odessa sites.

The proposed Mattoon Power Plant Site contains a small farm pond that may be directly impacted through placement of fill during site construction. Aquatic habitats and species would be lost; however, this impact would be minimal as the pond provides low-value habitat. The Jewett Power Plant Site contains three intermittent tributary streams and three human-made impoundments that could be directly impacted through placement of fill during site construction. Two of these features are disturbed and the third is an ephemeral stream of moderate value. Aquatic habitats and species may be lost through

construction; however, this impact would be minimal as none of these features is known to contain any habitat or species that are not plentiful in this area of Texas ***(see Section 6.9)***. These features could potentially be avoided during the site layout and planning process. No surface waters exist on either the Tuscola or Odessa Power Plant sites.

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

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

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

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

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

If listed species were ***discovered*** to occur within construction areas, they could be directly impacted through temporary loss of habitat or through casualties. Surveys would be conducted before ground breaking activities to confirm the presence or absence of species. If species were found in the vicinity of disturbance, consultation would be initiated with respective agencies to develop and implement species

protection plans to avoid impacts. Consultation with the IDNR would be initiated for a site in Illinois. In Texas, consultation would be initiated with the Texas Parks and Wildlife Department. At any site, consultation would be initiated with the U.S. Fish and Wildlife Service (FWS).

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

3.1.10 CULTURAL RESOURCES

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

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

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

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

At the Odessa Site, the Texas Historical Commission (THC) has concurred that no additional cultural resource investigations are necessary at the plant site, the CO_2 pipeline corridor east of the proposed

power plant, or the proposed transmission line north of the power plant; however, an archaeological survey would be required for the proposed transmission line corridor south of the power plant, all water pipeline corridors, and for the CO_2 corridors east and west of the sequestration site. A distinguishing feature of the Odessa alternative is the potential for paleontological resources. However, because fossil-bearing rock formations are extensive throughout the region, impacts to unique or irreplaceable paleontological resources are considered low. Consultation with the THC is recommended at the Odessa Site to determine the need for cultural resource investigations associated with any new road construction or improvements to existing roads that may occur.

3.1.11 LAND USE

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

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

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

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

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

Although stacks at any of the sites must be lighted to meet Federal Aviation Administration (FAA) regulations, Tuscola is the only site that would require FAA notification and evaluation. A 250-foot

(76-meter) stack constructed at nearly any location on the proposed Tuscola Power Plant Site would extend into the controlled airspace around the Tuscola Airport. Construction would require advance FAA notification and evaluation.

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

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

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

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

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

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

- The Mattoon process water pipeline**s** would affect mostly agricultural, recreational, and transportation land uses along ***up to*** 14.3 miles (23 kilometers) ***depending on the*** corridor ***selected***. The CO_2 pipeline would be constructed within the power plant site boundaries.

- The Tuscola process water pipeline would affect agricultural use and road ROW along 1.5 miles (2.4 kilometers) of corridor. The CO_2 pipeline would be constructed along 11 miles (17.7 kilometers) of existing ROWs.
- The Jewett process water pipeline would affect range land along up to 1 mile (1.6 kilometers) if an on-site well is not used. The CO_2 pipeline would be constructed mainly along cattle ranching and oil and gas production lands for up to 59 miles (95 kilometers).
- The Odessa process water pipeline would affect mainly scrubland along 24 to 54 miles (38.6 to 86.9 kilometers) of corridors depending on the option selected. The CO_2 pipeline would affect land use along 2 to 72 miles (3.2 to 115 kilometers) of corridors, with up to 58 miles (93.3 kilometers) within existing ROW. Intra-well piping would also be required at the sequestration site.

3.1.12 AESTHETICS

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

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

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

The landscape surrounding the proposed Mattoon Power Plant and Sequestration Site is primarily farmland with relatively flat topography. Two residential properties directly adjacent to the proposed power plant site, two residences within 0.25 mile (0.4 kilometer), and approximately 20 residences within a 1-mile (1.6-kilometer) radius of the site would have unobstructed views of the facility. Up to 16 miles

(25.7 kilometers) of a new transmission line and ROW may be required; however, this line would mainly traverse croplands and be within 0.25 mile (0.4 kilometer) of a few residential properties.

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

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

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

3.1.13 TRANSPORTATION AND TRAFFIC

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

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

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

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

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

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

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

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

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

Construction and operations activities at the proposed Odessa Power Plant Site would mainly impact FM 1601. This roadway would degrade from LOS A to LOS D during construction and from A to B

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

3.1.14 NOISE AND VIBRATION

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

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

DOE considered the following generally accepted relationships (***MTA, 2004***) in evaluating human response to relative changes in noise level:

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

Based on these relationships, DOE adopted a 3-dBA increase in the ambient noise level at sensitive receptors located adjacent to the project boundary as a threshold indicating that ***the potential impacts would be significant. F***urther detailed noise analysis ***was conducted to evaluate the impacts at mobile source receptors whenever the 3-dBA threshold was exceeded using the Federal Highway Administration's (FHWA) Traffic Noise Model (TNM), Version 2.5 modeling software.*** If below the 3-dBA threshold, DOE concluded that the anticipated increase in noise levels resulting from project-related activities would not be noticeable and would require no further analysis. Residences and any schools, hospitals, nursing homes, houses of worship, and parks within the 1-mile (1.6-kilometer) ROI were considered sensitive receptors in this analysis.

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

- For the Mattoon Site, noise levels would increase by as much as 41 and 37 dBA at the two closest residences (30 feet [9.1 meters] from the site boundary). An increase above the 3-dBA threshold would occur within about ***2.4*** miles (3.***9*** kilometers) of the site boundary, which includes Riddle Elementary School and several dozen residences on the western side of Mattoon.

- For the Tuscola Site, noise levels would increase by as much as 45.7 dBA at the three closest residences (adjacent to the site boundary). An increase above the 3-dBA threshold would occur within about 1.***5*** miles (***2.4*** kilometers) of the site boundary, encompassing much of downtown Tuscola.
- For the Jewett Site, noise levels would increase by as much as ***15*** dBA at Wilson Chapel (0.25 mile [0.4 kilometer] from the site boundary). No other sensitive receptors are within the radius of the 3-dBA threshold.
- For the Odessa Site, noise levels would increase by as much as ***6*** dBA at the ***two*** closest residence***s*** (0.***2***5 mile [0.***4*** kilometer] from the site boundary). No sensitive receptors are within the radius of the 3-dBA threshold.

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

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

- Noise levels for the Mattoon Site would increase by as much as 21 dBA at the two closest residences and by as much as 13 dBA at three other residences within approximately 1 mile (1.6 kilometers) of the site boundary.
- Noise levels for the Tuscola Site would increase by as much as 25 dBA at the three closest residences and by as much as 15 dBA at four other residences within approximately 1 mile (1.6 kilometers) of the site boundary.
- Noise levels for the Jewett Site would increase by up to ***17*** dBA at Wilson Chapel (not used for regular services)***.*** No other sensitive receptors are within the radius of the 3-dBA threshold.
- ***Noise levels for*** the Odessa Site ***would increase by up to 4.1 dBA at the two closest residences. N***o ***other*** sensitive receptors are within the radius of the 3-dBA threshold.

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

- For the Mattoon Site, noise levels would increase by as much as 6 to 9 dBA at the two closest residences. An increase above the 3-dBA threshold may occur within a radius of 1.***5*** miles (***2.4*** kilometers) of the center of the site, which includes about a dozen residences.
- For the Tuscola Site, noise levels would increase by as much as 12 dBA at the three closest residences. An increase above the 3-dBA threshold may occur within a radius of 1 mile (1.***6*** kilometers) of the center of the site, which includes ***about*** seve***n*** residences.
- For the Jewett Site, noise levels would increase by ***as much as 6 dBA*** at Wilson Chapel***.*** ***No other sensitive receptors are within the radius of the 3-dBA threshold.***.
- At the Odessa Site, no sensitive receptors are within the radius of the 3-dBA threshold.

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

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

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

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

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

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

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

- For the Mattoon Site, noise levels would increase by as much as 8 dBA on CH 13 south of CH 18, by ***5*** dBA on CH 18 east of CH 13, and by 2 dBA on SR 121 near the site.
- For the Tuscola Site, noise levels would increase by up to 14***.1*** dBA on CR 750E north of U.S. 36, up to 7***.2*** dBA on CR 1050N west of U.S. 45, and less than 3 dBA on U.S. 36 east of CR 750E.
- For the Jewett Site, there are no residences along local access route FM 39; no impacts to sensitive receptors are anticipated.
- For the Odessa Site, noise levels would increase by up to ***6*** dBA at one residence on ***Avenue J, near*** FM 1601 north of I-20 and by less than 3 dBA near I-20.

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

- For the Mattoon Site, noise levels would increase by up to 4 dBA on CH 13 south of CH 18, less than 2 dBA on CH 18 east of CH 13, and less than 1 dBA on SR 121 near the site.
- For the Tuscola Site, noise levels would increase by as much as 9***.4*** dBA on CR 750E north of U.S. 36, up to ***4.1*** dBA on CR 1050N west of U.S. 45, and less than 3 dBA on U.S. 36 east of CR 750E.
- For the Jewett Site, there are no residences along local access route FM 39; no impacts to sensitive receptors are anticipated.
- For the Odessa Site, noise levels would increase ***less than*** 3 dBA at one residence on ***Avenue J, near*** FM 1601 north of I-20 and less than 1 dBA near I-20.

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

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

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

3.1.15 UTILITY SYSTEMS

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

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

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

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

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

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

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

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

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

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

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

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

3.1.16 MATERIALS AND WASTE MANAGEMENT

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

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

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

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

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

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

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

Comparable risks from onsite chemical storage requirements would occur at any of the four alternative plant sites. Precautions would be taken to prevent and mitigate the impacts of releases of

hazardous materials and waste during construction and routine operations, and personnel would be trained and equipped to respond to spills when they occur.

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

3.1.17 HUMAN HEALTH, SAFETY, AND ACCIDENTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The FutureGen Power Plant would be equipped to remove most H_2S that is captured with CO_2 and to recover the sulfur. However, future power plants may more efficiently convert coal to electricity while capturing and sequestering CO_2 if they do not remove most of the H_2S from the captured gases. To further investigate this possibility, DOE and the Alliance are considering whether to perform short-duration tests of sequestration of the CO_2 without first removing most of the H_2S. These co-sequestration tests would involve pipeline transport and sequestration of CO_2 mixed with about two percent H_2S ***(20,000 ppmv) or 200 times greater than the base case, which assumed the H_2S concentration would be 100 ppmv***. There could be two tests that would have durations of approximately ***one*** week each. ***Because these tests would occur for a very short period of time (a total of two weeks), it would be very unlikely that an accidental release would occur during co-sequestration testing. Nevertheless,***

additional model simulations of pipeline ruptures or punctures to represent releases during the co-sequestration experiment were conducted, as discussed in Section 4.5.5 of the Final Risk Assessment Report. These results show that the distance downwind where the public could be exposed to H_2S at levels that could result in adverse effects are significantly greater than for the base case, and thus more people could be exposed, if a release occurred during an experiment. While the distances where adverse effects occur, as listed in the Risk Assessment, are quite high (tens of miles), they are likely greatly overestimated in the model, as it assumes that the wind would be maintained at the same stability class, wind speed and direction over a substantial amount of time (e.g., 19 hours for Jewett). Although short-term testing of co-sequestration (CO_2 with H_2S) may be considered for two weeks during the DOE-sponsored phase of the proposed project, no decision has been made yet to pursue the co-sequestration testing, and further NEPA review may be required before such tests could be conducted. If co-sequestration would be considered for a longer period of time under DOE funding, further NEPA review would be required. To minimize the potential for releases during the co-sequestration experiments, additional protective measures could be implemented, including inspection of the pipeline before and after the tests and not allowing any excavation along the pipeline route during the tests.

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

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

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

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

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

and sold, the need to produce ***elemental*** sulfur and, and therefore, the need for the Claus unit and the risks associated with it would be eliminated.

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

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

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

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

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

3.1.18 COMMUNITY SERVICES

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

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

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

3.1.19 SOCIOECONOMICS

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

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

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

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

All four alternative sites would be eligible to receive tax abatement on property tax revenues for a period of 10 years. This would result in a loss of revenue for each site per year as follows: Mattoon, $10,188; Tuscola, $6,695; Jewett, $5,884; and Odessa, $2,779.

3.1.20 ENVIRONMENTAL JUSTICE

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

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

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

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

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
No-Action Alternative			
No impact to environmental resources; no change in existing conditions. Under the No-Action Alternative, DOE would not share in the cost for constructing and operating the FutureGen Project. Without DOE funding, it would be unlikely that the Alliance would soon undertake the commercial-scale integration of CO_2 capture and geologic sequestration with a coal-fueled power plant.			
Proposed Action – Air Quality			
Construction: Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term impacts on local air quality.	**Construction:** Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term impacts on local air quality.	**Construction:** Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term impacts on local air quality.	**Construction:** Air emissions of criteria pollutants from construction equipment and land disturbing activities would result in short-term ***impacts*** on local air quality.
Operations: Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be: Pollutant FG FG+Ambient NAAQS Conc. During Normal Plant Operation SO_2, 3-hr 0.717 123.75 1,300 SO_2, 24-hr 0.262 70.93 365 SO_2, Annual 0.184 10.65 80 NO_2, Annual 0.256 30.35 100 PM_{10}, 24-hr 0.524 57.86 150 PM_{10}, Annual 0.038 26.04 50 $PM_{2.5}$, 24-hr 0.524 32.46 35 $PM_{2.5}$, Annual 0.038 12.54 15 CO, 1-hr 11.333 5,622.76 40,000 CO, 8-hr 5.005 3,462.94 10,000 Conc. During Plant Upset Events[1] SO_2, 3-hr 511.819 634.85 1,300 SO_2, 24-hr 88.000 158.67 365 Units in micrograms per cubic meter Probability of exceeding PSD increment: Normal plant operation: zero percent (all[2]) Plant upset events: 0.23 percent (3-hr SO_2), zero percent (24-hr SO_2) Hg Emissions (tpy [mtpy]): 0.011 (0.010) Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)	**Operations:** Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be: Pollutant FG FG+Ambient NAAQS Conc. During Normal Plant Operation SO_2, 3-hr 0.536 123.57 1,300 SO_2, 24-hr 0.197 70.87 365 SO_2, Annual 0.048 10.52 80 NO_2, Annual 0.067 30.09 100 PM_{10}, 24-hr 0.393 57.73 150 PM_{10}, Annual 0.010 26.01 50 $PM_{2.5}$, 24-hr 0.393 32.33 35 $PM_{2.5}$, Annual 0.010 12.51 15 CO, 1-hr 9.470 5,620.90 40,000 CO, 8-hr 4.729 3,462.66 10,000 Conc. During Plant Upset Events[1] SO_2, 3-hr 511.958 634.99 1,300 SO_2, 24-hr 67.000 137.67 365 Units in micrograms per cubic meter Probability of exceeding PSD increment: Normal plant operation: zero percent (all[2]) Plant upset events: 0.22 percent (3-hr SO_2), zero percent (24-hr SO_2) Hg Emissions (tpy [mtpy]): 0.011 (0.010) Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)	**Operations:** Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be: Pollutant FG FG+Ambient NAAQS Conc. During Normal Plant Operation SO_2, 3-hr 0.820 34.85 1,300 SO_2, 24-hr 0.415 13.51 365 SO_2, Annual 0.483 3.10 80 NO_2, Annual 0.674 27.01 100 PM_{10}, 24-hr 0.829 55.83 150 PM_{10}, Annual 0.099 26.10 50 $PM_{2.5}$, 24-hr 0.829 30.16 35 $PM_{2.5}$, Annual 0.099 13.80 15 CO, 1-hr 10.447 4,018.62 40,000 CO, 8-hr 7.879 1,954.70 10,000 Conc. During Plant Upset Events[1] SO_2, 3-hr 511.913 545.94 1,300 SO_2, 24-hr 89.500 102.59 365 Units in micrograms per cubic meter Probability of exceeding PSD increment: Normal plant operation: zero percent (all[2]) Plant upset events: 1.66 percent (3-hr SO_2), 0.24 percent (24-hr SO_2) Hg Emissions (tpy [mtpy]): 0.011 (0.010) Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)	**Operations:** Air emissions of criteria pollutants from power plant and sequestration operations would increase ambient concentrations in air pollutants. Maximum increases would be: Pollutant[3] FG FG+Ambient NAAQS Conc. During Normal Plant Operation SO_2, 3-hr 0.542 52.89 1,300 SO_2, 24-hr 0.188 13.28 365 SO_2, Annual 0.248 5.49 80 NO_2, Annual 0.346 15.40 100 PM_{10}, 24-hr 0.376 51.71 150 PM_{10}, Annual 0.051 18.05 50 $PM_{2.5}$, 24-hr 0.376 20.71 35 $PM_{2.5}$, Annual 0.051 7.75 15 CO, 1-hr 8.418 7,234.37 40,000 CO, 8-hr 4.855 3,906.86 10,000 Conc. During Plant Upset Events[1] SO_2, 3-hr 511.979 564.33 1,300 SO_2, 24-hr 73.000 86.09 365 Units in micrograms per cubic meter Probability of exceeding PSD increment: Normal plant operation: zero percent (all[2]) Plant upset events: 0.09 percent (3-hr SO_2), zero percent (24-hr SO_2) Hg Emissions (tpy [mtpy]): 0.011 (0.010) Total HAP Emissions (tpy [mtpy]): 0.321 (0.291)

[1] Unplanned restart emissions of PM_{10} and $PM_{2.5}$ do not occur during plant upset events. Unplanned restart emissions of NO_2 and CO_2 are lower than steady-state emissions (i.e., <2 percent and <0.2 percent, respectively), therefore impacts are lower.

[2] all = all pollutants and associated averaging period.

[3] ***Best and Final Offer (BAFO) Odessa CO_2 pipeline (Option 2) would require a sulfur removal plant. Potential emissions from additional sulfur removal operations would be minimal because the process occurs in an enclosed system. The additional sulfur removal would be required for the original proposal, as well as for the BAFO Option 2.***

FG = FutureGen; tpy = tons per year; NAAQS = National Ambient Air Quality Standards; PSD = Prevention of Significant Deterioration; HAP = Hazardous Air Pollutant; Hg = mercury.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Climate and Meteorology			
Construction and Operations: No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºFahrenheit [F] [17.8ºCelsius (C)]) days (average): 7.5 Snowfall: 1 snowfall of 6 inches (15.2 centimeters) or more and one ice glaze event per year. ***Tornado intensity* F1 or greater *within an 850 sq. mi. area*: *24 over 50 years*** Severe or extreme drought conditions, potential for wildfire; increased number of water trucks to reduce fugitive dust.	**Construction and Operations:** No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºF [17.8ºC]) days (average): 6 Snowfall: 1 snowfall of 6 inches (15.2 centimeters) or more and one ice glaze event per year. ***Tornado intensity* F1 or greater *within an 850 sq. mi. area*: *10 over 50 years*** Same as Mattoon.	**Construction and Operations:** No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºF [17.8ºC]) days (average): rare Snowfall: Annual snowfall is less than 1.5 inches (3.8 centimeters) and ice glaze events are rare. ***Tornado intensity* F1 or greater *within an 850 sq. mi. area*: *7 over 50 years*** Same as Mattoon.	**Construction and Operations:** No impacts to climate or meteorology. Potential for severe temperature or weather conditions that could temporarily delay construction or affect operations are: Subzero (<0ºF [17.8ºC]) days (average): rare Snowfall: Annual snowfall is less than 4.5 inches (11.4 centimeters) and ice glaze events are rare. ***Tornado intensity* F1 or greater *within an 850 sq. mi. area*: *6 over 50 years*** Same as Mattoon.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Geology			
Construction: **Target Formation:** Formation: Mt. Simon Injection depth: 1.3 to 1.6 miles (2.1 to 2.6 kilometers) Formation: St. Peter (Optional target reservoir) Injection depth: 0.9 mile (1.4 kilometers) Predicted CO_2 Plume Radius: 1.2 miles (1.9 kilometers)	**Construction:** **Target Formation:** Formation: Mt. Simon Injection depth: 1.3 to 1.5 miles (2.1 to 2.4 kilometers) Formation: St. Peter (Optional target reservoir) Injection depth: 0.9 mile (1.4 kilometers) Predicted CO_2 Plume Radius: 1.1 miles (1.8 kilometers)	**Construction:** **Target Formation:** Formation: Woodbine (Primary) Injection depth: 1 to 1.1 miles (1.6 to 1.8 kilometers) Formation: Travis Peak (Secondary) Injection depth: 1.7 to 2.1 mile (2.7 to 3.4 kilometers) Predicted CO_2 Plume Radius: 1.7 miles (2.7 kilometers)	**Construction:** **Target Formation:** Formation: Delaware Mountain Group ***(primary)*** and ***Lower*** Queen Formation ***(secondary)*** Injection depth: 0.4 to 1 mile (0.6 to 1.6 kilometers) Predicted CO_2 Plume Radius: 1 mile (1.7 kilometers)
Caprock: Formation: Eau Claire Shale Thickness: 500 to 700 feet (152 to 213 meters) Well penetrations (ROI): No known	**Caprock:** Formation: Eau Claire Shale Thickness: 500 to 700 feet (152 to 213 meters) Well penetrations (ROI): No known	**Caprock (Primary):** Formation: Eagle Ford Shale Thickness: 400 feet (122 meters) Well penetrations (ROI): 8 known, up to 57	**Caprock:** Formation: Queen-Seven Rivers Thickness: 700 feet (213 meters) Well penetrations (ROI): 2 known, up to 16
Operations:	**Operations:**	**Operations:**	**Operations:**
Earthquake potential: Intensity: Medium (magnitude <5) Likelihood: Possible but not common	**Earthquake potential:** Intensity: Same as Mattoon Likelihood: Same as Mattoon	**Earthquake potential:** Intensity: Medium (magnitude <4) Likelihood: Possible but not common	**Earthquake potential:** Intensity: Medium (magnitude <6) Likelihood: Possible but not common
Earthquake occurrences since 1974: Number: 29 Magnitude: 2.7 to 5.0 Distance: Within 100 miles (161 kilometers)	**Earthquake occurrences since 1974:** Number: 30 Magnitude: 2.4 to 5.1 Distance: Within 120 miles (193 kilometers)	**Earthquake occurrences since 1974:** Number: 4 Magnitude: 2.3 to 3.4 Distance: Within 100 miles (161 kilometers)	**Earthquake occurrences since 1974:** Number: 40 Magnitude: 2.3 to 5.7 Distance: Within 120 miles (193 kilometers)

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Geology (continued)			
Faults: Although no detailed mapping of faults, recent 2D seismic lines indicate no major faulting at the injection site. Possibility exists for faults associated with nearby anticline; however, these are likely sealing faults. Closest Major Fault: New Madrid 200 miles (322 kilometers) south-southwest. **Potential for Adverse Impacts:** Radon displacement: Low Induced seismicity: Low CO_2 leakage due to seal penetrations or faults: Low	**Faults:** Although no detailed mapping of faults, recent 2D seismic lines indicate no major faulting at the injection site. Strong possibility exists for faults associated with steep flank of nearby anticline; however, these are likely sealing faults. Closest Major Fault: New Madrid 230 miles (370 kilometers) south-southwest. **Potential for Adverse Impacts:** Same as Mattoon.	**Faults:** Multiple surface faults within 10 miles (16 kilometers). Closest Major Fault: Mexia-Talco 30 to 35 miles (48.2 to 56.3 kilometers) sealing fault, New Madrid 400 miles (644 kilometers) north-northeast. **Potential for Adverse Impacts:** Same as Mattoon.	**Faults:** No detailed mapping of faults. Quiescent basement fault beneath ROI. Closest Major Fault: Rio Grande Rift system 210 miles (338 kilometers); New Madrid greater than 800 miles (1,287 kilometers). **Potential for Adverse Impacts:** Same as Mattoon.

ROI = Region of influence.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Physiography and Soils			
Construction: Soil disturbance (including loss, change of composition and potential of spill contamination).	**Construction:** Soil disturbance (including loss, change of composition and potential of spill contamination).	**Construction:** Soil disturbance (including loss, change of composition and potential of spill contamination).	**Construction:** Soil disturbance (including loss, change of composition and potential of spill contamination).
Power Plant Site: Up to 200 acres (81 hectares) permanently lost.	**Power Plant Site:** Same as Mattoon.	**Power Plant Site:** Same as Mattoon.	**Power Plant Site:** Same as Mattoon.
Sequestration Site: Power Plant and Sequestration Site on same parcel of land.	**Sequestration Site**: Up to 10 acres (4 hectares) permanently lost.	**Sequestration Site**: Same as Tuscola.	**Sequestration Site**: Same as Tuscola.
Utility Corridors: Up to 25.6 acres (10.4 hectares) temporarily disturbed.[1]	**Utility Corridors:** Up to 32.4 acres (13.1 hectares) temporarily disturbed.	**Utility Corridors:** Up to 358 acres (145 hectares) temporarily disturbed.	**Utility Corridors:** Up to 341 acres (138 hectares) temporarily disturbed. ***Up to 744 acres (301 hectares).***[1]
Transportation Corridors: Up to 15.9 acres (6.4 hectares) disturbed through construction of infrastructure within the power plant site.	**Transportation Corridors**: Up to 6.7 acres (2.7 hectares) disturbed through construction of infrastructure within the power plant site.	**Transportation Corridors:** ***Existing railroad and road corridors are in place, therefore there would be no soil disturbance through construction of the infrastructure within the power plant site.***	**Transportation Corridors**: Up to 1.8 acres (0.7 hectare) disturbed through construction of infrastructure within the power plant site. ***Sulfur removal plant may require additional transportation corridors.***[2]
Operations: Low potential for contamination due to minor spills at the power plant site and along utility corridors.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.

[1] If the BAFO options are selected then up to 744 acres (301 hectares) would be impacted; BAFO Odessa process water pipeline corridor would have soil disturbance up to 103 acres (41.7 hectares); Odessa Option 1 CO_2 pipeline, 545 acres (221 hectares); and up to 96 acres (38.8 hectares) for CO_2 pipeline spurs.
[2] BAFO Odessa CO_2 pipeline (Option 2) may require transportation corridors for the sulfur removal plant at the FutureGen Power Plant site or another site (currently unknown).

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Groundwater			
Construction: No groundwater use, impacts are not anticipated.	**Construction:** No groundwater use, impacts are not anticipated.	**Construction:** No groundwater use, impacts are not anticipated.	**Construction:** No groundwater use, impacts are not anticipated.
Operations: Process water source; treated wastewater, no impacts to local aquifers anticipated.	**Operations:** Process water source; ***industrial reservoir filled with water from Kaskaskia River.*** Short-term impacts from supplemental use of groundwater.	**Operations:** Groundwater impact due to increase in aquifer use for power plant process water. Sustainability of aquifer would be maintained.	**Operations:** Groundwater impact due to increase in aquifer use for power plant process water.
Aquifer: n/a	Aquifer: Mahomet (supplemental only)	Aquifer: Carrizo-Wilcox	Aquifer: Undetermined, multiple options*;* ***CRMWD would supply water, adequate capacity.***[2]
Aquifer capacity: n/a	Aquifer capacity: ***over 400 MGD*** (*> 1.5 **b**illion liters per day*)[1]	Aquifer capacity: 1.23×10^8 m^3/day	Aquifer capacity: 1.28×10^7 to 7.2×10^7 m^3/day
Potable groundwater use to depth: Approximately 175 feet (53.3 meters)	Potable groundwater use to depth: Approximately 100 feet (31 meters)	Potable groundwater exists to depth: Approximately 1,400 feet (427 meters)	Potable groundwater exists to depth: Approximately 1,500 feet (457 meters)
Usage of capacity: n/a	Usage of capacity: 26 percent (short-term)	Usage of capacity: 4 percent	Usage of capacity: 7 to 39 percent
Depth to CO_2 injection zone: Mt. Simon: 1.3 to 1.6 miles (2.1 to 2.6 kilometers) St Peter (optional): 0.9 mile (1.4 kilometers)	Depth to CO_2 injection zone: Mt Simon: 1.3 to 1.5 miles (2.1 to 2.4 kilometers) St Peter (optional): 0.9 mile (1.4 kilometers)	Depth to CO_2 injection zone: Woodbine: 1.0 mile (1.6 kilometers); Travis Peak: 1.7 miles (2.7 kilometers)	Depth to CO_2 injection zone: 0.4 mile (0.6 kilometer)
Impacts of CO_2 sequestration on ***underground source of drinking water*** considered unlikely. Abandoned wells penetrating primary seal would need to be assessed and closed properly.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Existing wells through Caprock: 0	Existing wells through Caprock: 0	Existing wells through Caprock: Up to 57	Existing wells through Caprock: Up to 16

[1] Figure represents the sustained yield of the aquifer, not total capacity (ISWS, 2007). Lyondell-Equistar well field currently has a capacity of 16 to 17 MGD (61 to 64 MLD).
[2] BAFO Odessa, CRMWD would supply process water utilizing 3 reservoirs and 4 active well fields. Groundwater would be used during the summer months to meet peak demands. FutureGen consumption equals 1.6×10^4 m^3/day (4.3 MGD), which is minimal compared to the aquifer capacities reported in Table S-A and Table 2-A for the municipal well field in Ward County (9.0×10^4 m^3/day [24.0 MGD]) and compared to the regional aquifer capacity values presented in the Table.
n/a = not applicable.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Surface Water			
Construction: Low potential for increased sediment loads, stream channel erosion, and non-point source pollution from land disturbance and stream crossings.	**Construction:** Same as Mattoon.	**Construction:** Same as Mattoon.	**Construction:** Same as Mattoon.
Pipeline stream crossings: 5	Pipeline stream crossings: *4*	Pipeline stream crossings: 30	Pipeline stream crossings: Approximately 3 to 6 ***ephemeral draws plus Pecos River***[1]
Operations: Streams affected: Cassell and Kickapoo creek flows reduced by ***diversion of effluent discharge water*** from Mattoon and possibly Charleston wastewater treatment plants ***to provide process water (3,000 gallons per minute [gpm] [11,356 liters per minute [lpm]). Proposed reservoir would provide flexibility to mitigate downstream flow impacts.***	**Operations:** Streams affected: Kaskaskia River flows reduced by process water withdrawals (3,000 gpm [11,356 lpm]) from Lyondell-Equistar reservoir.	**Operations:** Streams affected: No water withdrawals.	**Operations:** Streams affected: No water withdrawals. ***Up to 4.3 MGD (3,000 gpm).***[2]
Sanitary discharge from plant site: Municipal treatment, no surface water discharges or impacts anticipated.	Sanitary discharge from plant site: On-site system, effluent recycled from process water. Additional option for municipal treatment, no surface water discharges or impacts anticipated.	Sanitary discharge from plant site: On-site system, effluent recycled from process water, no surface water discharges or impacts anticipated.	Sanitary discharge from plant site: On-site system, effluent recycled from process water, no surface water discharges or impacts anticipated.
No CO_2 pipeline stream crossings.	Low potential for impacts from CO_2 pipeline leaks at stream crossings.	Same as Tuscola.	Same as Tuscola.

[1] BAFO Odessa CO_2 pipeline (Options 1 and 2) would cross the Pecos River (impaired stream).
[2] BAFO Odessa process water option would withdraw up to 4.3 MGD (3,000 gpm) from surface water: O.H. Ivie Reservoir, E.V. Spence Reservoir, and Lake S.B. Thomas (42.8 MGD available aggregate capacity).

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Wetlands and Floodplains			
Construction: **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below:	**Construction:** **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below:	**Construction:** **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below:	**Construction:** **Power Plant Site:** Site design and layout would avoid impacts to wetlands that are on site as indicated below:
Wetlands present: Low quality farm pond 0.05 acre[1] (0.02 hectare)	Wetlands present: None	Wetlands present: Low quality up to 2 acres (0.8 hectare) Moderate quality up to 0.1 acre (0.04 hectare) Low quality ponds up to 18 acres (7.3 hectares)	Wetlands present: None
Floodplains present: None	Floodplains present: None	Floodplains present: None	Floodplains present: None
Sequestration Site: The sequestration site is located on the same property as the power plant site.	**Sequestration Site:** Injection wells would be placed to avoid wetlands and floodplains.	**Sequestration Site:** Injection wells would be placed to avoid wetlands and floodplains.	**Sequestration Site:** Injection wells would be placed to avoid wetlands and floodplains.
	Wetlands present: 4 areas ***for a total of*** up to ***5*** acres[1] (2 hectares)	Wetlands present: Over 43* **National Wetlands Inventory (NWI) mapping indicates that over 43 forested, scrub-shrub, and emergent wetlands associated with streams and on-channel stock ponds are also located within the region of influence (ROI). Wetland delineation required for verification.*	Wetlands present: None mapped* **Indicated by NWI mapping. Wetland delineation would be required for verification.*
Floodplains present: None	Floodplains present: None	Floodplains present: 25 percent of ROI in 100-year floodplains	Floodplains present: Currently unmapped* **Natural Resources Conservation Service (NRCS) soils data indicate that there are areas within the sequestration site that range from "none" to "rare" to "frequent."*

[1] *Wetland acreage (hectares) are based upon field-verified wetland delineations conducted in August 2006.*

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Wetlands and Floodplains (continued)			
Utility and Transportation Corridors: Directional drilling and site planning would be used to avoid these features ***and minimize impacts.***	**Utility and Transportation Corridors:** Directional drilling and site planning would be used to avoid these features ***and minimize impacts***.	**Utility and Transportation Corridors:** Directional drilling and site planning would be used to avoid these features ***and minimize impacts***.	**Utility and Transportation Corridors:** Directional drilling and site planning would be used to avoid these features ***and minimize impacts***.
Wetlands: up to 29.2 acres[1] (11.8 hectares)	Wetlands: up to 4.2 acres[1] (1.7 hectares)	Wetlands: Over 90 ***acres**** **NWI mapping indicates that over 90 forested, scrub-shrub, and emergent wetlands associated with streams and on-channel stock ponds are also located within the ROI. Wetland delineation required for verification.*	Wetlands: None mapped* ***Up to 23.9 acres (9.7 hectares) *[2]*** **Indicated by NWI mapping. Wetland delineation would be required for verification.*
Floodplains: In certain segments	Floodplains: In certain segments	Floodplains: Portions of all seven segments of CO_2 pipeline	Floodplains: In certain segments of CO_2 pipeline
Temporary impacts from placement of construction equipment and trenching for underground utilities.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Operations: No impacts to wetlands or floodplains are anticipated.	**Operations:** Water levels in process water reservoir would fluctuate due to water uptakes. Minimal impact anticipated because pond currently experiences these types of fluctuations and the wetland is low value.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.

[1] Wetland acreage (hectares) are based upon field-verified wetland delineations conducted in August 2006.
[2] BAFO Odessa process water pipeline would potentially impact 1 intermittent Palestine wetland up to 8 acres (3.2 hectares). Odessa CO_2 pipeline (Options 1 and 2) would potentially impact up to 15.9 acres (6.4 hectares) for a total impact of 23.9 acres (9.7 hectares).

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Biological Resources			
Construction: **Power Plant Site:** Up to 200 acres (81 hectares) row crops would be lost.	**Construction:** **Power Plant Site:** Same as Mattoon.	**Construction:** **Power Plant Site:** Up to 200 acres (81 hectares) of mixed oak/grassland would be lost.	**Construction:** **Power Plant Site:** Up to 200 acres (81 hectares) of mesquite lotebush-brush and mesquite-juniper brush would be lost.
1 farm pond could be impacted, resulting in a permanent loss of aquatic habitat.	No aquatic habitat present.	3 intermittent tributary streams; 3 man-made impoundments could be impacted, resulting in permanent loss of aquatic habitat.	No aquatic habitat present.
		Potential T&E species present include the Navasota ladies'-tresses. Surveys may be required.	Potential T&E species present at the sequestration site includes the Texas Horned Lizard. Surveys may be required.
Sequestration Site: Same footprint as power plant site, no additional loss.	**Sequestration Site:** Up to 10 acres (4 hectares) row crops would be lost.	**Sequestration Site:** Up to 10 acres (4 hectares) mixed oak/grassland would be lost.	**Sequestration Site:** Up to 10 acres (4 hectares) mesquite-juniper brush would be lost.
Potential threatened and endangered (T&E) species present include the Indiana Bat. Surveys may be required.	Consultation with Illinois Department of Natural Resources, no threatened or endangered species are expected to occur within the sequestration site.	Potential T&E species present include the interior least tern, Houston toad, Bachman's sparrow, white-fared Ibis and state rare invertebrates. Surveys may be required.	Potential T&E species present include the Texas horned lizard. Surveys may be required.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Biological Resources (continued)			
Utility Corridors: Up to 35.3 miles (56.8 kilometers) total, of which 18.8 miles (30.3 kilometers) within new ROW, primarily agricultural row crops would be lost.	**Utility Corridors:** Up to 31.9 miles (51.3 kilometers) total, of which 16.9 miles (27.2 kilometers) within new ROW, primarily agricultural row crops would be lost.	**Utility Corridors:** Up to 63 miles (101 kilometers) total, of which 13 miles (20.9 kilometers) within new ROW, primarily oak/grassland (high quality deer and turkey hunting ground) would be ***temporarily impacted during pipeline construction.***	**Utility Corridors:** Up to 128.5 miles (207 kilometers) total, of which 68.7 miles (111 kilometers) within new ROW, primarily ***non-arable brush lands would be impacted.***
Aquatic habitat of 5 perennial streams could be temporarily impacted by trenching.	Aquatic habit limited, intermittent streams.	Aquatic habitat of 14 perennial and 39 intermittent streams could be temporarily impacted by trenching.	Intermittent/ephemeral streams only, limited aquatic habitat.
Potential T&E species present include the Indiana Bat, Kirkland's snake, and Eastern sand darter. Surveys may be required.	Potential T&E species present include Kirkland's snake. Surveys may be required.	Potential T&E species present include interior least tern, Houston toad, Bachman's sparrow, white-fared Ibis and state rare invertebrates. Surveys may be required.	Potential T&E species present include the Texas horned lizard. Surveys may be required.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Cultural Resources			
Construction: No known cultural resources at the power plant or sequestration site, no impacts anticipated. Phase I survey may be needed for certain utility corridor segments.	**Construction:** Same as Mattoon. Same as Mattoon.	**Construction:** No known cultural resources at the power plant site, no impacts anticipated. Known cultural sites along CO_2 pipeline corridor segments: A-C; 3 B-C; 15 C-D; 13 D-F; 1 F-H; 3 33 recorded sites within region of influence of sequestration site. Phase I surveys and consultation would be needed for these CO_2 pipeline segments.	**Construction:** Same as Jewett. Phase I survey needed for all water, CO_2 pipeline, and transmission line corridors. Consultation needed for potential cultural resources at the sequestration site. Fossil bearing rock formations are extensive in the region of the sequestration site; however, no impacts to unique or irreplaceable invertebrate paleontological resources anticipated. Vertebrate paleontological resources could be impacted.
Operations: Impacts would only occur during construction.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.	**Operations:** Same as Mattoon.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Land Use			
Construction: **Power Plant Site:** Land conversion, acres affected: Up to 200 acres (81 hectares)	**Construction:** **Power Plant Site:** Land conversion, acres affected: Same as Mattoon.	**Construction:** **Power Plant Site:** Land conversion, acres affected: Same as Mattoon.	**Construction:** **Power Plant Site:** Land conversion, acres affected: Same as Mattoon.
Change of land use: Farmland to industrial.	Change of land use: Same as Mattoon.	Change of land use: Industrial storage and pasture to industrial.	Change of land use: Ranch, oil and gas to industrial.
Oil or gas wells displaced: 0	Oil or gas wells displaced: 0	Oil or gas wells displaced: Up to 3	Oil or gas wells displaced: Up to 2
Prime farmland converted: Up to 200 acres (81 hectares), Land Evaluation and Site Assessment (LESA) points = 255 which exceeds the 225 threshold. Site would be reevaluated for change in land use.	Prime farmland converted: Up to 200 acres (81 hectares), LESA points = 239. Site would be reevaluated for change in land use.	Prime farmland converted: Up to 5 acres (2 hectares)	Prime farmland converted: None
Surrounding land uses: 2 residences (directly adjacent) 2 residences (within 0.25 mile [0.4 kilometer]) 20 residences (within 1 mile [1.6 kilometers])	Surrounding land uses: 3 residences (adjacent) 7 residences (within 0.5 mile [0.8 kilometer]); several dozen (within one mile [1.6 kilometers])	Surrounding land uses: 1 small chapel and cemetery (within 1 mile [1.6 kilometers]) no residences.	Surrounding land uses: 3 habitable residences (within 1 mile [1.6 kilometers]
Airspace and Federal Aviation Administration (FAA) conformance: Stacks would be lighted; FAA notification not required.	Airspace and FAA conformance: Stacks would be lighted; FAA notification required.	Airspace and FAA conformance: Same as Mattoon.	Airspace and FAA conformance: Same as Mattoon.
Conforming with zoning requirements: No conflict.	Conforming with zoning requirements: Same as Mattoon.	Conforming with zoning requirements: Same as Mattoon.	Conforming with zoning requirements: Same as Mattoon.
Current zoning: Enterprise Zone: industrial.	Current zoning: Industrial.	Current zoning: None; surrounded by industrial properties.	Current zoning: None; industrial facilities in the vicinity.
Sequestration Site: Land use acres changed: Same as Power Plant Site.	**Sequestration Site:** Land use acres changed: Up to 10 acres (4 hectares) farmland to industrial.	**Sequestration Site:** Land use acres changed: Up to 10 acres (4 hectares) ranch and state land to industrial.	**Sequestration Site:** Land use acres changed: Up to 10 acres (4 hectares) grazing and oil and gas production to industrial.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Land Use (continued)			
Mineral Rights: Option contract includes mineral rights for 444 acres (180 hectares). May require purchase of additional rights to include 0.25 mile (0.4 kilometer) buffer.	**Mineral Rights:** Option to 10 acres (4 hectares). Title searches for remainder of site are underway.	**Mineral Rights:** 50-year lease option with a waiver for mineral rights for at least three injection sites; however, title searches would need to be conducted.	**Mineral Rights:** University of Texas controls land and historically provide subsurface access through easements. Title searches would need to be conducted. The University has indicated it would grant a 50-year lease.
Utility Corridors: Approximate new ROW 18.8 miles (30.3 kilometers) (approximate): 11 to 27 miles (17.7 to 43.5 kilometers) variable width. ***Approximately new ROW 1 mile (1.6 kilometers).[1]***	**Utility Corridors:** Approximate new ROW up to 16.9 miles (27.2 kilometers) variable width.	**Utility Corridors:** Approximate new ROWs between 10 miles (16.1 kilometers) and 13 miles (20.9 kilometers) variable width.	**Utility Corridors:** Approximate new ROW 68.7 miles (111 kilometers) variable width. ***Approximately new ROW 2 miles (25.7 kilometers).[2]***
Impacts of new ROW: Temporary disruption of existing use, existing uses could continue after construction. Temporary impact to the use of Lincoln Prairie Grass Bike Trail during construction of process water pipeline from City of Charleston.	Impacts of new ROW: If the 3-mile (4.8-kilometer) ROW for the transmission line is selected, nine landowners would be temporarily impacted; existing uses could continue after construction.	Impacts of new ROW: Same as Mattoon.	Impacts of new ROW: Same as Mattoon.
Operations: **Power Plant Site:** Site is approximately 444 acres (180 hectares), with 200 acres (81 hectares) permanently converted; remaining 244 acres (99 hectares) could be leased for continued agricultural use.	**Operations:** **Power Plant Site:** Site is approximately 345 acres (140 hectares), with 200 acres (81 hectares) permanently converted; remaining 145 acres (59 hectares) could be leased for continued agricultural use.	**Operations:** **Power Plant Site:** Site is approximately 400 acres (162 hectares), with 200 acres (81 hectares) permanently converted; remaining 200 acres (81 hectares) could continue as pasture.	**Operations:** **Power Plant Site:** Site is approximately 600 acres (243 hectares), with 200 acres (81 hectares) permanently converted; remaining 400 acres (162 hectares) could continue as ranch land.
Sequestration Site: Same as power plant site.	**Sequestration Site:** 10 acres (4 hectares) permanently converted; remaining land could remain in agricultural use.	**Sequestration Site:** 10 acres (4 hectares) permanently converted; remaining land could remain as ranch land.	**Sequestration Site:** 10 acres (4 hectares) permanently converted; remaining land could continue as ranch land and oil and gas activities.

[1] BAFO Mattoon process waterline would require approximately 1 mile (1.6 kilometers) of new ROW.
[2] BAFO Odessa process waterline would require approximately 1 mile (1.6 kilometers) of new ROW.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Aesthetics			
Power Plant Site: **Construction**: Visual intrusion, traffic and noise to nearby residences.	**Power Plant Site:** **Construction**: Same as Mattoon.	**Power Plant Site:** **Construction**: There are no nearby residences; thus, no visual intrusion, traffic or noise impacts.	**Power Plant Site:** **Construction**: Same as Mattoon.
Operations: Visual intrusion, traffic and noise to nearby residences.	**Operations**: Same as Mattoon.	**Operations**: Same as Mattoon.	**Operations**: Same as Mattoon.
Nearby receptors: 2 residences (adjacent to site) 2 residences (within 0.25 mile [0.4 kilometer) 20 residences (within 1 mile [1.6 kilometers])	Nearby receptors: 3 residences (adjacent to site) 7 residences (within 0.5 mile [0.8 kilometer]) Several dozen residences (within 1 mile [1.6 kilometers])	Nearby receptors: No residences (adjacent to or within 1 mile [1.6 kilometers] of site)	Nearby receptors: No residences (adjacent to site) 4 residences (within 0.5 mile [0.8 kilometer])
Daytime visibility: Downtown Mattoon, motorists, and communities within 7 to 8 miles (11.3 to 13 kilometers).	Daytime visibility: Downtown Tuscola, motorists, and communities within 7 to 8 miles (11.3 to 13 kilometers).	Daytime visibility: 0.5 to 1 miles (0.8 to 1.6 kilometers).	Daytime visibility: Motorists within 7 to 8 miles (11.3 to 13 kilometers).
Visibility from public areas: Lake Mattoon and Paradise Lake.	Visibility from public areas: Ervin Park	Visibility from public areas: None	Visibility from public areas: None
Nighttime visibility: Downtown Mattoon, travelers on roadways, and communities within 7 to 8 miles (11.3 to 12.9 kilometers).	Nighttime visibility: Downtown Tuscola, travelers on roadways, and communities within 7 to 8 miles (11.3 to 12.9 kilometers).	Nighttime visibility: minimal	Nighttime visibility: Travelers on roadways and a few residences within 7 to 8 miles (11.3 to 12.9 kilometers).
Sequestration Site: Nearby receptors: Same as power plant site.	**Sequestration Site:** Nearby receptors: Up to 10 residential properties.	**Sequestration Site:** Nearby receptors: Minimal, travelers on adjacent county roads.	**Sequestration Site:** Nearby receptors: Up to 3 residential properties and travelers along I-10.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Aesthetics (continued)			
Utility Corridors: Temporary receptor impacts (buried utilities): The use of Prairie Grass Bike Trail and 1st and 2nd streets and Lafayette Avenue would be temporarily interrupted during construction of utilities. Permanent receptor impacts (High Voltage Transmission Line [HVTL] utilities): Residential properties within 0.25 mile (0.4 kilometer) would have view of HVTL.	**Utility Corridors:** Temporary receptor impacts (buried utilities): 12 residences within 0.25 mile (0.4 kilometer) of proposed CO_2 pipeline may experience visual impacts during construction layout. Permanent receptor impacts (HVTL utilities): 150 residential properties within 0.25 mile (0.4 kilometer) would have view of HVTL.	**Utility Corridors:** Temporary receptor impacts (buried utilities): Receptors adjacent to up to 45 miles (72.4 kilometers) of CO_2 pipeline. Permanent receptor impacts (HVTL utilities): Minimal receptors along up to 2 miles (3.2 kilometers) of new transmission line would have view of HVTL.	**Utility Corridors:** Temporary receptor impacts (buried utilities): Receptors adjacent to up to 54 miles (86.9 kilometers) of water pipeline and 6 miles (9.7 kilometers) of CO_2 pipeline. Permanent receptor impacts (HVTL utilities): Up to 4 residences and travelers along I-20 for up to 2 miles (3.2 kilometers) of new transmission line would have view of HVTL. ***Potential visual impacts of sulfur removal plant and 2 booster pumps.[1]***

[1] BAFO Odessa CO_2 pipeline (Option 2) may result in potential visual impacts from the sulfur removal plant at the FutureGen Power Plant or another location (currently unknown) and 2 booster pumps (located on CO_2 pipeline).

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Transportation and Traffic			
Construction: **Power Plant Site:** SR 121 would temporarily degrade from Level of Service (LOS) C to D, which represents traffic conditions approaching unstable flow; however, this is typically considered acceptable for a temporary condition (44 months). CR 13 (between SR 121 and CH 18) would temporarily degrade from LOS A to C, which represents stable flow. Truck routes may be designated to include I-57, CH 18, and CR 13 to reduce traffic through Mattoon. **Utility Corridors:** Up to 35 one-way trips would be added to existing afternoon peak period; however, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary. **Transportation Corridors:** Upgrade of CR 13 and the intersection of CR 13 and SR 121 are planned and would cause localized traffic delays; however, a state-required traffic management plan would limit major disruption of traffic, and delays would be temporary.	**Construction:** **Power Plant Site:** CR 1050N and CR 750E would temporarily (44 months) degrade from LOS A to C, which represents stable traffic flow. Truck routes may be designated to include I-57, US 36, CR 1050N and CR 750E to reduce traffic through Tuscola. **Utility Corridors:** Up to 45 one-way trips would be added to existing afternoon peak period; however, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary. **Transportation Corridors:** No roadway or intersection improvements planned; therefore, no impacts to vehicular traffic are expected. Construction of new railroad sidetrack is expected to have minimal and temporary impacts to existing CSX Railroad operations because the CSX ROW in this location contains switching facilities that would allow approaching trains to be switched away from the track to which the sidetrack is being connected.	**Construction:** **Power Plant Site**: FM 39 would temporarily degrade from LOS B to D, which represents traffic conditions approaching unstable flow; however, this is typically considered acceptable for a temporary condition. SH 164 would temporarily (44 months) degrade from LOS B to C, which represents stable flow. **Utility Corridors**: Up to 60 one-way trips would be added to existing afternoon peak period; however, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary. **Transportation Corridors:** No roadway or intersection improvements planned, and therefore, no impacts to transportation resources are expected. Construction of new railroad sidetrack is expected to have temporary impacts to existing Burlington Northern Santa Fe Railroad operations. Impacts would be minimized by completing connection during hours when this track has lightest expected traffic.	**Construction:** **Power Plant Site**: FM 1601 would temporarily degrade from LOS A to D, which represents traffic conditions approaching unstable flow; however, this is typically considered acceptable for a temporary (44 months) condition. **Utility Corridors**: Up to 110 one-way trips would be added to existing afternoon peak period, because construction of utilities would be spread out along the length of corridors, delays to traffic are expected to be minor and temporary. **Transportation Corridors:** One grade-separated crossing would be required to extend FM 1601 under railroad and would result in temporary localized traffic delays (additional traffic numbers for this project component were included in traffic analysis conducted for proposed power plant site). Construction of new railroad sidetrack is expected to have temporary impacts to existing Union Pacific Railroad operations. Impacts would be minimized by completing connection during hours when this track has lightest expected traffic.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Transportation and Traffic (continued)			
			Minor temporary disruptions to traffic on 1 major and 47 minor roads.[1] ***Minor temporary disruptions to traffic on 4 major and 119 minor roads.[2]*** ***Sulfur removal plant and 2 booster pumps may require additional transportation corridors.[3]***
Construction/Operations: Changes to traffic signal timings may be required at the CH 18/I-57 ramp intersections to accommodate changes in the turning volumes.	**Construction/Operations:** Changes to traffic signal timings may be required at the US 36/I-57 ramp intersections to accommodate changes in the turning volumes at those intersections.	**Construction/Operations:** Changes to traffic signal timings may be required at the US 79/I-45 ramp intersections to accommodate changes in turning volumes at those intersections.	**Construction/Operations:** Traffic signals may be required at two key intersections on FM 1601 to accommodate changes in the turning volumes.
Operations: CR 13 (between SR 121 and CH 18) would degrade from LOS A to B, which represents reasonably free flow of traffic. Other roadway LOSs would remain the same.	**Operations:** CR 1050N and CR 750E would degrade from LOS A to B, which represents reasonably free flow of traffic. Other roadway LOS would remain the same.	**Operations:** FM 39 and SH 164 would degrade from LOS B to C, which represents stable flow of traffic. Other roadway LOS would remain the same.	**Operations:** CR FM 1601 would degrade from LOS A to B, which represents reasonably free flow of traffic. Other roadway LOS would remain the same.
Rail traffic on Canadian National main line and Peoria spur would increase by 10 and 71 percent, respectively, or less than two additional trains per day.	Rail traffic on CSX rail line would increase by 36 percent or less than two additional trains per day.	Rail traffic on Burlington Northern Santa Fe line would increase up to 14 percent or less than two additional trains per day.	Rail traffic on Union Pacific line would increase up to 11 percent or less than two additional trains per day.
Approximately one additional train per day at two at-grade crossings of Peoria spur would delay traffic 6 to 7 minutes at each crossing. No additional railroad crossing protection would be required.	Approximately one additional train per day at CR 750E at-grade rail crossing would delay traffic 6 to 7 minutes. Actuated gates and warning lights would be required at one existing at-grade crossing (CR 750E at CSX rail line).	No traffic delays associated with increased rail traffic are expected. No at-grade crossings would be impacted.	Same as Jewett.

[1] BAFO Odessa process water pipeline construction would result in minor, temporary disruptions to traffic on 1 major and 47 minor roads.
[2] BAFO Odessa CO_2 pipeline construction would result in minor, temporary disruption to traffic on 4 major and 119 minor roads.
[3] BAFO Odessa CO_2 pipeline (Option 2) may require the construction of a new access road and additional transportation corridors for the sulfur removal plant at the FutureGen Power Plant site or another site (currently unknown) and potential access to 2 booster pumps (located on the CO_2 pipeline).

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Noise and Vibration			
Construction: Noise increase (above background level) at closest receptors to plant site: 2 residences: increase of up to 41 A-weighted sound measurement (dBA) (30 feet [9.1 meters] from boundary) Noise exceeding 3 dBA increase above background noise level (impact threshold) within *2.**4*** miles (3.***9*** kilometers) from the site boundary. Receptors affected: One school; several dozen residences **Construction Traffic:** Noise increase above background: CH 13 south of CH 18: <8 dBA CH 18 east of CH 13: <***5*** dBA SR 121 near site: 2 dBA **Startups/Restarts:** Noise increase at closest receptors: 2 residences: up to 21 dBA (30 feet [9 meters]) 3 residences: up to 13 dBA (<1 mile [1.6 kilometers]) **Routine Operations:** Noise increase (above background level) at closest receptors to plant site: 2 residences: 6 to 9 dBA (30 feet [9.1 meters] from boundary)	**Construction:** Noise increase (above background level) at closest receptors to plant site: 3 residences: up to 45.7 dBA (adjacent to boundary) 3 residences: up to 9.2 dBA (within 1 mile (1.6 kilometers) Noise exceeding 3 dBA increase (impact threshold) within 1.***5*** miles (*2.**4*** kilometers) from the site boundary. Receptors affected: Numerous residences (much of downtown Tuscola) **Construction Traffic:** Noise increase above background: CR 750E north of US 36: <14.***1*** dBA CR 1050N west of US 45: <7.***2*** dBA US 36 east of CR 750E: <***1*** dBA **Startups/Restarts:** Noise increase at closest receptors: 3 residences: up to 25 dBA (adjacent to boundary) 4 residences: up to 15 dBA (<1 mile [1.6 kilometers]) **Routine Operations:** Noise increase (above background level) at closest receptors to plant site: 3 residences: up to 12 dBA (adjacent to boundary)	**Construction:** Noise increase (above background level) at closest receptors to plant site: Chapel: <***15*** dBA (0.25 mile [0.4 kilometer]) Noise exceeding 3 dBA increase (impact threshold) within 1.9 miles (3.1 kilometers) from the site boundary. Receptors affected: None **Construction Traffic:** No residence along local access route FM 39; no sensitive receptors impacted. **Startups/Restarts:** Noise increase at closest receptors: Chapel: <***17*** dBA (0.***25*** mile [0.***4*** kilometers]) **Routine Operations:** Noise increase (above background level) at closest receptors to plant site: No residences: <3 dBA Chapel: <***6*** dBA (0.***25*** mile [0.***4*** kilometer])	**Construction:** Noise increase (above background level) at closest receptors to plant site: ***2*** residences: <***6*** dBA (*0.**25*** mile [0.***4*** kilometer]) Noise exceeding 3 dBA increase (impact threshold) within 1.9 miles (3.1 kilometers) from the site boundary. Receptors affected: None ***Temporary elevated noise levels 12 churches, 5 schools***[1] **Construction Traffic:** Noise increase above background: FM 1601 ***north*** of I-20: <***6*** dBA Near I-20: <3 dBA **Startups/Restarts:** Noise increase at closest receptors: ***2*** residences: <***4.1*** dBA (*0.**25*** mile [0.***4*** kilometers]) **Routine Operations:** Noise increase (above background level) at closest receptors to plant site: ***2*** residences: <3 dBA ***Sulfur removal plant and 2 booster pumps***[2]

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Noise and Vibration (continued)			
Routine Operations (continued): Noise exceeding 3 dBA threshold within 1.***5*** miles (*2.**4*** kilometers) from the center of the site. Receptors affected: 12 residences *3 dBA is the threshold level for human hearing.*	**Routine Operations (continued):** Noise exceeding 3 dBA threshold within 1 mile (1.***6*** kilometers) from the center of the site. Receptors affected: ***7*** residences *3 dBA is the threshold level for human hearing.*		
On-Site Train Operations: Noise increase at closest receptors to rail loop during unloading: 2 residences: <17 dBA 3 residences: <3 dBA (1 mile [1.6 kilometers]) Potential vibration impact within Federal Transit Administration (FTA) threshold of 200 feet (61.0 meters) from rail loop: 1 residence Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.	**On-Site Train Operations:** Noise increase at closest receptors to rail loop during unloading: ***7*** residences: <3 dBA (1 mile [1.6 kilometers]) Potential vibration impact within FTA threshold of 200 feet (61.0 meters) from rail loop: No residences Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.	**On-Site Train Operations:** Noise increase at closest receptors to rail loop during unloading: No residences: <3 dBA Chapel: <3 dBA Potential vibration impact within FTA threshold of 200 feet (61.0 meters) from rail loop: No residences Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.	**On-Site Train Operations:** Noise increase at closest receptors to rail loop during unloading: ***2*** residences: <3 dBA Potential vibration impact within FTA threshold of 200 feet (61.0 meters) from rail loop: No residences Potential impact to residences within 1 mile (1.6 kilometers) from rail car shakers could generate noise levels up to 118 dBA.
Operations Traffic: Noise increase above background: CH 13 south of CH 18: <4 dBA CH 18 east of CH 13: <2 dBA SR 121 near site: <1 dBA	**Operations Traffic:** Noise increase above background: CR 750E north of US 36: <9.***4*** dBA CR 1050N west of US 45: <***4.1*** dBA US 36 east of CR 750E: <3 dBA	**Operations Traffic:** No residence along local access route FM 39; no sensitive receptors impacted.	**Operations Traffic:** Noise increase above background: FM 1601 ***north*** of I-20: <***3*** dBA near I-20 <***1*** dBA
Train Traffic: The frequency of occurrence of noise at current levels from passing trains would increase by 71 percent on the Peoria spur and 10 percent on the Canadian National main line (less than two additional trains per day).	**Train Traffic:** The frequency of occurrence of noise at current levels from passing trains on the CSX rail line would increase by 24 to 36 percent (less than two additional trains per day).	**Train Traffic:** The frequency of occurrence of noise at current levels from passing trains on the Burlington Northern Santa Fe rail line would increase by 14 percent (less than two additional trains per day).	**Train Traffic:** The frequency of occurrence of noise at current levels from passing trains would increase by 11 percent on the Union Pacific rail line (less than two additional trains per day).

[1] BAFO construction of the Odessa process water pipeline would have temporary elevated noise levels to 12 churches and 5 schools, and the population near the pipeline construction zones, especially near the proposed process water supply.
[2] BAFO Odessa sulfur removal plant and 2 booster pumps (located on CO_2 pipeline) could potentially increase noise levels.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Utility Systems			
Potable Water: Source: Municipal system Sufficient capacity: Yes Pipelines: 1 mile (1.6 kilometers)	**Potable Water**: Source: Municipal system Sufficient capacity: Yes Pipelines: <1 mile (<1.6 kilometers)	**Potable Water:** Source: Same as process water Sufficient capacity: Yes Pipelines: Same as process water	**Potable Water:** Source: Same as process water Sufficient capacity: Yes Pipelines: Same as process water
Process Water: Source: Mattoon and possibly Charleston Wastewater Treatment[1] Plants Sufficient capacity: Yes 7.1 MGD (26.9 MLD) Pipelines: Possibly up to 14.3 miles[2] (23 kilometers)	**Process Water:** Source: Lyondell-Equistar & Kaskaskia River Sufficient capacity: Yes 150 million-gallon (568 million-liter) holding pond Pipelines: 1.5 miles (2.4 kilometers)	**Process Water:** Source: Groundwater Carrizo-Wilcox Sufficient capacity: Yes 3,000 gallons (11,356 liters) per minute Pipelines: <1.0 mile (<1.6 kilometer)	**Process Water:** Source: Groundwater Multiple aquifers***; combination of groundwater and surface water processed through the City of Odessa water treatment plant.***[4] Sufficient capacity: Yes Based on state geologist report Pipelines: 24 to 54 miles (38.6 to 86.9 kilometers)
Sanitary Wastewater: Source: Municipal system Sufficient capacity: Yes Pipelines: 1.25 mile (2 kilometers)	**Sanitary Wastewater:** Source: Municipal system Sufficient capacity: Yes Pipelines: 0.9 mile (1.4 kilometers)	**Sanitary Wastewater:** Source: New on-site system Sufficient capacity: Yes Pipelines: No pipeline required	**Sanitary Wastewater:** Source: New on-site system Sufficient capacity: Yes Pipelines: No pipeline required
Electrical Transmission: Transmission Capacity - Preliminary indication that capacity exists. Further study required: Yes (Midwest Independent System Operator [MISO] Study ongoing)	**Electrical Transmission:** Transmission Capacity - Preliminary indication that capacity exists. Further study required: Yes (MISO Study ongoing)	**Electrical Transmission:** Transmission Capacity – Upgrade needed prior to operation. Further study required: No	**Electrical Transmission:** Transmission Capacity – Upgrade needed prior to operation. Further study required: No
Possibility of curtailment[3]: Yes New or upgraded lines: 0.5 to 16 miles (0.8 to 25.7 kilometers)	Possibility of curtailment[3]: Yes New or upgraded lines: 0.5 to 17 miles (0.8 to 27.3 kilometers)	Possibility of curtailment[3]: Yes New or upgraded lines: 0 to 2 miles (0 to 3.2 kilometers)	Possibility of **curtailment[3]:** Yes New or upgraded lines: 0.7 to 1.8 miles (1.1 to 2.9 kilometers) ***Sulfur removal plant and 2 booster pumps***[5]

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Utility Systems (continued)			
Natural Gas: Sufficient capacity: Yes 42 million cubic feet per hour (mcf/hr) (1.3 million cubic meters per hour [mcm/hr]) Pipelines: 0.25 mile (0.4 kilometer) **CO_2 Pipeline:** No off-site pipeline required.	**Natural Gas:** Sufficient capacity: Yes 42 mcf/hr (1.3 mcm/hr) Pipelines: No pipeline required. **CO_2 Pipeline:** New ROW: 11 miles (17.7 kilometers)	**Natural Gas:** Sufficient capacity: Yes 12 mcf/hr (0.3 mcm/hr) Pipelines: Same as Tuscola. **CO_2 Pipeline:** New ROW: 6 to 9 miles (10 to 14 kilometers)	**Natural Gas:** Sufficient capacity: Yes 12 mcf/hr (0.3 mcm/hr) Pipelines: Same as Tuscola. **CO_2 Pipeline:** New ROW: 2 to ***16*** miles (3 to **25.7** kilometers)

[1] ***If a*** larger reservoir (200 million gallons [757 million liters]) ***is constructed,*** then connection to the Charleston WWTP may not be necessary.
[2] Process water from the effluent of the municipal WWTPs of Mattoon with a 6.2-mile (10.0-kilometer) pipeline and possibly Charleston with 8.1 miles (13.0-kilometers) of pipeline, could result in up to 14.3 miles (23 kilometers) of total pipeline ROW.
[3] Curtailment occurs when the system controller from the Independent System Operator observes a thermal or voltage limit overload for an operating situation or, upon performing a contingency analysis, predicts a thermal or voltage limit overload for a planned project.
[4] BAFO Odessa process water would come from the City of Odessa water treatment plant that uses a combination of groundwater and surface water.
[5] BAFO Odessa CO_2 pipelines (Option 2) would require a sulfur removal plant either at the FutureGen Power Plant site or another site (currently unknown). Use of the Comanche Creek pipeline would require 2 booster pumps.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Materials and Waste Management			
Construction Materials: No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs:	**Construction Materials:** No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs:	**Construction Materials:** No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs:	**Construction Materials:** No new sources required. Local and national suppliers well established with adequate production capacity to meet FutureGen needs:
Concrete: 500 yd^3/hr (382 m^3/hr)	Concrete: 330 yd^3/hr (252 m^3/hr)	Concrete: 550 yd^3/hr (420 m^3/hr)	Concrete: >230 yd^3/hr (>176 m^3/hr)
Asphalt: 750 tons/hr[1] (680 metric tons/hr)	Asphalt: 1,900 tons/hr[1] (1,700 metric tons/hr)	Asphalt: 8,000 tons/day[1] (7,257 metric tons/day)	Asphalt: >2,500 tons/day[1] (2,268 metric tons/day)
Aggregate: 900,000 tpy (816,466 mtpy)	Aggregate: 4.4 million tpy (4 MMT per year)	Aggregate: multiple suppliers, production rates not available	Aggregate: Same as Jewett.
Construction of process water reservoir would increase fill and spoils handling requirements.			
Construction Waste: Regional landfill availability of up to 116 years – Adequate capacity.	**Construction Waste:** Same as Mattoon.	**Construction Waste:** Regional landfill availability of up to 132 years – Adequate capacity.	**Construction Waste:** Regional landfill availability of up to 177 years – Adequate capacity.
Construction Hazardous Waste: Small amounts of hazardous waste generated. Resource Conservation and Recovery Act (RCRA) permit not required.	**Construction Hazardous Waste:** Same as Mattoon.	**Construction Hazardous Waste:** Same as Mattoon.	**Construction Hazardous Waste:** Same as Mattoon.
5 hazardous waste landfills within approximately 100 to 400 miles (161 to 644 kilometers).	Same as Mattoon.	2 hazardous waste landfills within 300 miles (483 kilometers).	1 hazardous waste landfill within 60 miles (96.6 kilometers).
>14 million yd^3 (>10 million m^3) available disposal capacity at closest hazardous waste landfill site.	Same as Mattoon.	2.7 million yd^3 (2 million m^3) available disposal capacity as closest landfill.	5.0 million yd^3 (3.8 million m^3) available disposal capacity at closest site.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Materials and Waste Management (continued)			
Operations Materials: FutureGen demand represents 3.5 percent of coal consumption by electric utilities within the state.	**Operations Materials:** Same as Mattoon.	**Operations Materials:** FutureGen demand represents 1.9 percent of coal consumption by electric utilities within the state.	**Operations Materials:** Same as Jewett.
Chemicals and materials required for operations are common and readily available; markets exist for sulfur, bottom slag, byproducts, and ash.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.[2]
Operations Waste: Sanitary landfill availability same as identified for construction.	**Operations Waste:** Same as Mattoon.	**Operations Waste:** Same as Mattoon.	**Operations Waste:** Same as Mattoon.[2]
Operations Hazardous Waste: Hazardous waste landfill availability same as identified for construction.	**Operations Hazardous Waste:** Same as Mattoon.	**Operations Hazardous Waste:** Same as Mattoon.	**Operations Hazardous Waste:** Same as Mattoon.
Potential for Spills and Releases: Some risk due to on-site chemical storage requirements. Precautions would be taken to prevent and mitigate the impacts of releases of hazardous materials and waste during construction and routine operations (see Table S-12, Human Health, Safety, and Accidents for evaluations or potential ammonia spills).	**Potential for Spills and Releases:** Same as Mattoon.	**Potential for Spills and Releases:** Same as Mattoon.	**Potential for Spills and Releases:** Same as Mattoon.

[1] Illinois reported by tons/hr and Texas by tons/day for capacity.

[2] BAFO Odessa CO_2 pipeline (Option 2) would require a sulfur removal plant. The additional sulfur byproduct would be sold or disposed of in the same manner as the sulfur from the FutureGen Power Plant.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents			
Occupational Risks	**Occupational Risks**	**Occupational Risks**	**Occupational Risks**
Construction: Predicted number of annual accident cases (based on expected workforce for the entire project):	**Construction:** Predicted number of annual accident cases (based on expected workforce for the entire project):	**Construction:** Predicted number of annual accident cases (based on expected workforce for the entire project):	**Construction:** Predicted number of annual accident cases (based on expected workforce for the entire project) ***except for construction risks associated with the longer CO_2 pipelines and the greater number of wells***[1]**:**
Average workforce (350) Total recordable cases = 20 Lost workday cases = 11 Fatalities = <1 (0.1)	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Peak workforce (700) Total recordable cases = 39 Lost workday cases = 22 Fatalities = <1 (0.2)	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Operations: Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):	**Operations:** Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):	**Operations:** Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):	**Operations:** Predicted number of annual accident cases (based on expected workforce of 200 for all project facilities):
Total recordable cases = 2 Lost workdays cases = 1 Fatalities = <1 (0.002)	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Hazardous Air Emissions	**Hazardous Air Emissions**	**Hazardous Air Emissions**	**Hazardous Air Emissions**
Construction: No appreciable risks from hazardous air emissions to general public.	**Construction:** No appreciable risks from hazardous air emissions to general public.	**Construction:** No appreciable risks from hazardous air emissions to general public.	**Construction:** No appreciable risks from hazardous air emissions to general public.
Plant Operations: Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) $= 0.084 \times 10^{-6}$	**Plant Operations:** Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) $= 0.022 \times 10^{-6}$	**Plant Operations:** Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) $= 0.222 \times 10^{-6}$	**Plant Operations:** Total Cancer Risk (vs. EPA risk criterion of 1×10^{-6}) $= 0.114 \times 10^{-6}$
Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0007	Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0002	Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0017	Total Hazard Coefficient (vs. EPA risk criterion of 1) = 0.0009

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents (continued)			
Unintentional Sequestration Releases	**Unintentional Sequestration Releases**	**Unintentional Sequestration Releases**	**Unintentional Sequestration Releases**
Construction: Not applicable prior to operation of sequestration facilities.	**Construction:** Not applicable prior to operation of sequestration facilities.	**Construction:** Not applicable prior to operation of sequestration facilities.	**Construction:** Not applicable prior to operation of sequestration facilities.
Pipeline Operations: Number of individuals potentially impacted by release from pipeline rupture (risk rated as extremely unlikely [1 or more occurrences in 10,000 to 1 million years]): CO_2 Adverse effect[2]: 0 Irreversible[3]: 0 Life threatening[4]: 0 H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0	**Pipeline Operations:** Number of individuals potentially impacted by release from pipeline rupture (risk rated as unlikely [1 or more occurrences in 100 to 10,000 years]): CO_2 Same as Mattoon. H_2S Adverse effect: 7 Irreversible: ≤1 Life threatening: <1	**Pipeline Operations:** Number of individuals potentially impacted by release from pipeline rupture (risk rated as unlikely [1 or more occurrences in 100 to 10,000 years]): CO_2 Same as Mattoon. H_2S Adverse effect: 52 Irreversible: <1 Life threatening: 1	**Pipeline Operations:** Number of individuals potentially impacted by release from pipeline rupture (risk rated as unlikely [1 or more occurrences in 100 to 10,000 years]): CO_2 Same as Mattoon. H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0
Number of individuals potentially impacted by release from pipeline puncture (risk rated as extremely unlikely [1 or more occurrences in 10,000 to 1 million years]): CO_2 Adverse effect: 0 Life threatening: 0 H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0	Number of individuals potentially impacted by release from pipeline puncture (risk rated as unlikely [1 or more occurrences in greater than 1 million years]): CO_2 Adverse effect: 0 Life threatening: 0 H_2S Adverse effect: 1 Irreversible: 0 Life threatening: 0	Number of individuals potentially impacted by release from pipeline puncture (risk rated as likely (≥1 in 100 years) to unlikely [1 occurrence per 100 to 10,000 years]): CO_2 Same as Mattoon. H_2S Adverse effect: 6 Irreversible: 0 Life threatening: 0	Number of individuals potentially impacted by release from pipeline puncture (risk rated as unlikely [1 or more occurrences in 100 to 10,000 years]): CO_2 Same as Mattoon. H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0 ***BAFO CO_2 pipeline Options 1 and 2: approximately same level of risk and potential impacts.[5]***

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents (continued)			
Sequestration Operations: Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely [1 occurrence per 10,000 to 1 million years]): CO_2 Adverse effect: 0 Irreversible: 0 Life threatening: 0 H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0 Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 1 Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 1	**Sequestration Operations:** Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely): CO_2 Same as Mattoon. H_2S Adverse effect: <1 Irreversible: 0 Life threatening: 0 Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 6 Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 6	**Sequestration Operations:** Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely): CO_2 Same as Mattoon. H_2S Adverse effect: 4 Irreversible: 0 Life threatening: 0 Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 0.4-26 Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 0.4-26	**Sequestration Operations:** Number of individuals potentially impacted by unintentional release from wellhead failure (risk rated as extremely unlikely): CO_2 Same as Mattoon. H_2S Adverse effect: 0 Irreversible: 0 Life threatening: 0 Number of individuals potentially impacted by slow upward leakage of H_2S from injection well (risk rated as extremely unlikely): Adverse effect: 0.3 Number of individuals potentially impacted by slow upward leakage of H_2S from other existing wells (risk rated as extremely unlikely): Adverse effect: 0.3

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Human Health, Safety, and Accidents (continued)			
Catastrophic Accidents/Terrorism or Sabotage **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[5] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 26 Life threatening: 4 SO_2 Irreversible: 19 Life threatening: 10 H_2S Irreversible: 143 Life threatening: 4 **Ammonia Spills:** Evaluations of potential ammonia spills indicate that both workers and the general public could be affected if a leak from a tank valve, a tanker truck spill, or a tank rupture occurred. Estimated distance for potential adverse effect from a tanker truck release: 14,763 feet (4,500 meters)	**Catastrophic Accidents/Terrorism or Sabotage** **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[5] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 21 Life threatening: 3 SO_2 Irreversible: 15 Life threatening: 8 H_2S Irreversible: 115 Life threatening: 3 **Ammonia Spills:** Same as Mattoon. Estimated distance for potential adverse effect from tanker a truck release: 14,107 feet (4,300 meters)	**Catastrophic Accidents/Terrorism or Sabotage** **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[5] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 17 Life threatening: 2 SO_2 Irreversible: 12 Life threatening: 5 H_2S Irreversible: 92 Life threatening: 2 **Ammonia Spills:** Same as Mattoon. Estimated distance for potential adverse effect from a tanker truck release: 15,092 feet (4,600 meters)	**Catastrophic Accidents/Terrorism or Sabotage** **Operations:** Number of individuals potentially impacted by catastrophic release at plant site[6] (risk of terrorism/sabotage cannot be predicted): CO Irreversible: 2 Life threatening: 0 SO_2 Irreversible: 2 Life threatening: 1 H_2S Irreversible: 12 Life threatening: 0 ***Sulfur removal plant: minimal additional risk[7]*** **Ammonia Spills:** Same as Mattoon. Estimated distance for potential adverse effect from a tanker truck release: 15,584 feet (4,750 meters)

[1] BAFO Odessa CO_2 pipeline (Option 1) presents 3 times greater risk than Option 2; both options present several times greater risk of construction accidents than the original proposal.

[2] Adverse effects – Health effects ranging from headache or sweating to irreversible effects, including death or impaired organ function.

[3] Irreversible adverse effects – Health effects to include death, permanent impaired organ function and other effects that impair everyday functions.

[4] Life threatening effects – Subset of irreversible adverse effects that may lead to death.

[5] BAFO Odessa CO_2 pipelines (Options 1 and 2) have the same level of risks and potential impacts as the original proposal. There would be a slight risk of an accident or event with 2 pipelines rather than just 1 pipeline in the same ROW.

[6] Pipeline rupture and puncture impacts are shown in a separate category of Table S-12. None of the sites had predicted irreversible or life threatening effects to the public from CO_2.

[7] BAFO Odessa CO_2 pipeline (Option 2) could potentially have a minimal risk of accident, terrorism and sabotage from the addition of a second sulfur removal plant or a larger sulfur removal plant.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Community Services			
Construction and Operations: Impacts to community services during the operational phase of the proposed facilities would be minor; less than 1 percent reduction to the capacity for community services.	**Construction and Operations:** Same as Mattoon.	**Construction and Operations:** Same as Mattoon.	**Construction and Operations:** Same as Mattoon.
No impact on healthcare. The ratio of hospital beds per thousand residents would remain at approximately 3.***8***.	No impact on health care. The ratio of hospital beds per thousand residents would remain at approximately 3.***2***.	No impact on health care. The ratio of hospital beds per thousand residents would remain at approximately 2.6.	No impact on health care. The ratio of hospital beds per thousand residents would remain at approximately 4.5.
During operations, school enrollment would increase by approximately 0.08 percent, which would result in minimal impacts to capacity of local public school systems.	During operations, school enrollment would increase by approximately 0.07 percent, which would result in minimal impacts to capacity of local public school systems.	During operations, school enrollment would increase by approximately 0.22 percent, which would result in minimal impacts to capacity of local public school systems.	During operations, school enrollment would increase by approximately 0.36 percent, which would result in minimal impacts to capacity of local public school systems.

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Socioeconomics			
Construction: A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 74 percent. Residences within facility viewshed that could experience adverse impact to property values: 2 residences (adjacent to site) 2 residences (within 0.25 mile [0.4 kilometer]) 20 residences (within 1 mile [1.6 kilometers]) ***Tax abatements for 10 years resulting in loss of property taxes: $10,188 per year***	**Construction:** A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 80 percent. Residences within facility viewshed that could experience adverse impact to property values: 3 residences (adjacent to site) 7 residences (within 0.5 mile [0.8 kilometer]) Several dozen residences (beyond 1 mile [1.6 kilometers]) ***Tax abatements for 10 years resulting in loss of property taxes: $6,695 per year***	**Construction:** A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 65.6 percent. Residences within facility viewshed that could experience adverse impact to property values: None ***Tax abatements for 10 years resulting in loss of property taxes: $5,884 per year***	**Construction:** A potential influx of construction workers could cause a beneficial, short-term impact to housing market and could increase the hotel occupancy rate to 72.6 percent. Residences within facility viewshed that could experience adverse impact to property values: None ***Tax abatements for 10 years resulting in loss of property taxes: $2,799 per year***
Operations: Permanent workers and facility operations would result in: Overall percent increase in population: 0.04 Permanent jobs: 200 Induced jobs: 240 Percent increase workers: 0.08 Impact to housing market: Percent decrease for sale: 2.2 Percent decrease for rent: 0.4	**Operations:** Permanent workers and facility operations would result in: Overall percent increase in population: 0.04 Same as Mattoon. Impact to housing market: Percent decrease for sale: 3.0 Percent decrease for rent: 1.3	**Operations:** Permanent workers and facility operations would result in: Overall percent increase in population: 0.10 Permanent jobs: 200 Induced jobs: 113 Percent increase workers: 0.09 Impact to housing market: Percent decrease for sale: 4.5 Percent decrease for rent: 0.8	**Operations:** Permanent workers and facility operations would result in: Overall percent increase in population: 0.20 Permanent jobs: 200 Induced jobs: 113 Percent increase workers: 0.18 Impact to housing market: Percent decrease for sale: 7.8 Percent decrease for rent: 3.9

Table 3-3. Summary Comparison of Impacts

Mattoon	Tuscola	Jewett	Odessa
Proposed Action – Environmental Justice			
Construction: No disproportionately high and adverse impact to minority populations. No such populations are present as defined under Executive Order (EO) 12898 within the ROI.	**Construction:** Same as Mattoon.	**Construction:** Minority populations are interspersed within the ROI, however, impacts would not be considered disproportionately high and adverse under EO 12898.	**Construction:** Same as Jewett.
Low-income populations are located within the ROI when compared to regional and national percentages; however, impacts would not be considered disproportionately high and adverse under EO 12898. Short-term job creation during construction.	Same as Mattoon.	Same as Mattoon.	Same as Mattoon.
Operations: Aesthetics, transportation, noise, and socioeconomic impacts resulting from operations were determined not to have a disproportionately high and adverse effect to minority or low-income populations.	**Operations:** Same as Mattoon.	**Operations:** Noise impacts resulting from operations were determined not to have a disproportionately high and adverse effect to minority or low-income populations.	**Operations:** Aesthetics and noise impacts resulting from operations were determined not to have a disproportionately high and adverse effect to minority or low-income populations.
Long-term job creation during operation may benefit low-income populations.	Long-term job creation during operation may benefit low-income populations.	Long-term job creation during operation may benefit low-income populations.	Long-term job creation during operation may benefit low-income populations.
The potential risks to health, although unlikely, were determined to be from a slow, upward leak of H_2S from an injection or existing well. A potential risk could also occur from a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.	The potential risks to health were determined to be from the unlikely event of a pipeline rupture or puncture and the extremely unlikely event of a slow, upward leakage of H_2S from an injection or existing well, or a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.	The potential risks to health were determined to be from the unlikely event of a pipeline rupture or puncture, the extremely unlikely event of a wellhead equipment rupture, and a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.	The potential risks to health were determined to be from a catastrophic accident; however, the risk of terrorism or sabotage events cannot be predicted. An ammonia spill from a tank valve, a tanker truck spill, and a tank rupture is also a potential risk. This potential would be uniform with the general population and, therefore, no disproportionately high and adverse impacts are anticipated to minority or low-income populations.

3.2 INCOMPLETE AND UNAVAILABLE INFORMATION

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

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

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

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

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

3.2.1 OVERALL DATA GAPS ASSOCIATED WITH CARBON CAPTURE AND GEOLOGIC SEQUESTRATION

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

Many of the technology gaps associated with coal gasification and CO_2 capture are engineering problems or challenges that the FutureGen Project would attempt to solve in a way that makes these

technologies economically viable in future power plants. However, some areas related to the fate, movement, impacts, and risks associated with CO_2 that is injected underground are not entirely understood and may be considered scientifically controversial. A substantial body of information on the transport and storage of gases injected underground already exists and is derived from the geologic storage of natural gas, the deep injection of hazardous waste, and the injection of CO_2 in hydrocarbon reservoirs for enhanced oil recovery (EOR). However, several issues related to the transport and long-term geologic storage of CO_2 require further consideration.

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

3.2.2 FUTUREGEN RISK ASSESSMENT

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

3.2.2.1 Pipeline Transport

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

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

as a function of enthalpy-pressure-temperature phase relationships for supercritical CO_2 gas and for mixed CO_2 and H_2S gas.

3.2.2.2 CO_2 Storage

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

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

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

3.2.2.3 Incomplete or Unavailable Geologic Data

Mattoon and Tuscola

There are no site-specific data with regard to the porosity and permeability of the target Mt. Simon formation, because the nearest well that penetrates the formation is 36 miles (57.9 kilometers) from the proposed Mattoon Site and 56 miles (90.1 kilometers) from the proposed Tuscola Site. This information would be gained via test borings after site selection. ***The primary reservoir uncertainty at the Mattoon and Tuscola sites is the volume of effective porosity. This uncertainty is primarily driven by the distance of the site (36 miles [58 kilometers] and 56 miles [90 kilometers], respectively) from the nearest well with subsurface data in the Mt. Simon formation.*** Porosity and permeability are unknown because most of the data in the Mt. Simon formation is from shallower gas storage locations, and porosity and permeability usually decrease with depth, are especially below 1.5 miles (2.4 kilometers). Reduced permeability could impact injectivity; however, sensitivity analyses indicate injectivity could be 33 to 50 percent lower than expected, but still be sufficient to meet the project objectives. The Eau Claire seal, which is a mixed siltstone-shale layer, also has not been penetrated at the site, so its properties are uncertain. While the Eau Claire seal is well documented as a good seal for natural gas storage at other locations, if it has more siltstone than shale at the Mattoon or Tuscola sites, the seal is not likely to be as effective as if it is predominantly shale. The characterization of the seal is relevant to its ability to safely store the injected CO_2.

Jewett

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

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

Odessa

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

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

3.2.2.4 Reservoir Modeling

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

3.2.2.5 Subsurface Ecosystems

The scientific community has paid little attention to the impacts of subsurface ecosystems due to geologic sequestration. Although surficial microbial ecology has been extensively researched, far less

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

3.2.2.6 Risk Assessment Methodology

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

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

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

3.2.3 INCOMPLETE OR UNAVAILABLE INFORMATION RELATING TO THE FUTUREGEN PROJECT DESIGN

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

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

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

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

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

3.2.4 INCOMPLETE OR UNAVAILABLE INFORMATION RELATING TO THE AFFECTED ENVIRONMENT

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

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

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

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

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

3.3 POTENTIAL CUMULATIVE IMPACTS

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

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

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

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

3.3.1 CUMULATIVE IMPACTS OF FUTUREGEN TECHNOLOGY

3.3.1.1 Potential Alternative Operating Scenarios under FutureGen

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

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

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

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

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

The amount of oil recovered would vary based on site-specific conditions. However, a nominal estimate would be three barrels of incremental oil produced per metric ton of CO_2 injected (EU DG JRC, 2005). During the DOE-sponsored phase, up to 1.7 million tons (1.5 MMT) per year of CO_2 from the

FutureGen Project could be used for EOR. Over this four-year period, this could result in the additional recovery of up to 18 million barrels of oil. The excess CO_2 could also be used for enhanced coalbed methane (ECBM) recovery. Descriptions of potential areas for EOR and ECBM relative to the candidate sites are provided in Section 3.3.2.

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

3.3.1.2 Advancement of Near-Zero Emissions Power Plants

General Technology Advancement

The FutureGen Project would be developed to provide the research needed to foster new FutureGen-like power plants (to reduce GHG emissions) by the private sector. It is reasonably foreseeable that the lessons learned from the FutureGen Project would enable both DOE and private companies to invest further in similar power plants, which may replace traditional coal-fueled power plants as they near the end of their economic lifespan and/or be built to satisfy growing electricity demand.

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

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

However, recent escalation in material, engineering, and construction costs have resulted in higher development costs, and many proposed projects have already been significantly delayed or cancelled.

Cumulatively, FutureGen and other successful projects would advance the future commercialization potential of coal gasification power plants integrated with carbon capture and geologic sequestration. While FutureGen, itself, would not achieve the goal of "near zero emissions" to the air, future power plants could meet this goal. Although it is impossible to predict the rate of future commercialization, the advancement of near zero-emissions power plants could have a beneficial cumulative impact by reducing GHG emissions related to coal-fueled energy production. Furthermore, carbon capture and geological sequestration could also be applied to other types of fossil-fueled power generating and industrial facilities.

Greenhouse Gas Emissions and Sequestration

Six gases—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—have been identified as the primary contributors to the greenhouse effect. Three gases (CO_2, CH_4, and N_2O) comprise 98 percent of greenhouse gas emissions (EIA, 2004), and CO_2 far surpasses other GHGs both in quantity emitted and in its relative contribution to climate change effects. Thus, CO_2 is the primary focus of mitigation efforts for greenhouse gas emissions (see generally DOE, 2007b). Water vapor also contributes to the greenhouse effect, although water vapor is not the primary focus of current mitigation efforts.

It has been estimated that CO_2 concentrations in the atmosphere have increased by 31 percent since 1750 (IPCC, 2001) and by 19 percent from 1959 to 2003 (Keeling and Whorf, 2005). Fossil fuel combustion is the primary contributor to increasing concentrations of CO_2 in the atmosphere (IPCC, 2007). Although CO_2 is not currently regulated as an air pollutant at the Federal level, it is generally regarded by a large body of scientific experts as contributing to global warming and climate change (IPCC, 2007). The EPA and state regulatory agencies are considering CO_2 regulations that could be promulgated in the near future.

Project Emissions

Annual CO_2 emissions from FutureGen are estimated to be approximately 0.28 million tons (0.25 MMT) per year of full time operation, assuming a 90 percent CO_2 capture and sequestration rate is achieved. Over the DOE-sponsored period, it is estimated that a total of 1.1 million tons (1.0 MMT) of CO_2 would be emitted from the facility. If carbon capture and permanent sequestration continues over a 50-year life span, the project could emit 14 million tons (12.7 MMT) of CO_2.

For comparison, predicted annual CO_2 emission rates from FutureGen are much smaller than the 2003 aggregate (all sources) annual CO_2 emissions of 253 million tons (230 MMT) in Illinois, 739 million tons (670 MMT) in Texas, and 6,410 million tons (5,815 MMT) in the entire continental U.S. Annual CO_2 emission rates from FutureGen represent an incremental increase from current estimated annual CO_2 emissions of approximately 0.1 0.04 and 0.004 percent, respectively, for these geographic areas.

In terms of mass emission rate of CO_2 per megawatt of power output (lbs/MWh), the FutureGen project plant is predicted to emit between 114 lb/MWh to 244 lb/MWh as an annual average, including start-up and upset events. Compared to the steady-state emissions of other fossil technologies, FutureGen would emit substantially less CO_2 than a state-of-the art non-capture plant (e.g., bituminous coal fueled IGCC = 1,714 lb/MWh, bituminous coal fueled supercritical pulverized coal power plant = 1,773 lb/MWh, or natural gas fueled combined cycle power plant = 797 lb/MWh [see DOE, 2007c]).

While emitting much less CO_2 per megawatt-hour of electricity compared to conventional coal-fueled power plants, FutureGen would still contribute to atmospheric concentrations of CO_2. Global emissions of CO_2 resulting from fossil fuel combustion has been estimated to be 28 billion tons (25 billion metric tons) in the year 2003 (Marland, et al. 2006) and more than 33 billion tons (30 billion metric tons) in 2006 (DOE, 2007a). To realize a net reduction in CO_2 emissions, FutureGen would have to offset an equivalent amount of electricity generating capacity from one or more unmitigated power plants. With or without offsets, FutureGen's individual contribution to global CO_2 emissions and potential climate change is extremely small.

After the DOE-sponsored project period ends, the power plant could be operated without carbon capture and sequestration. If this occurs, the total production of CO_2 would be emitted to the atmosphere. In the event of upsets in the carbon capture and sequestration components of the facility, all of the generated CO_2 may likewise be emitted to the atmosphere. Upsets are likely to occur, but the duration of these events should be short (hours or days).

Project Sequestration

The power plant is being designed to capture at least 90 percent of its CO_2. During the project period, FutureGen would capture and sequester between 1.1 and 2.8 million tons (1.0 and 2.5 MMT) per year of CO_2 in a deep saline formation. Over the four-year DOE-sponsored period, between 4.4 and 11.2 million tons (4.0 and 10.2 MMT) of CO_2 would be stored in a deep saline formation, with the opportunity to sequester more if the plant operations and sequestration field provide such an opportunity. Site selection criteria have required injectivity for 55 million tons (50 MMT) of CO_2 over the life of the project, with the possibility of sequestering much more although possibly in other nearby formations or at new injection well locations. Conceivably, FutureGen facilities could sequester up to 140 million tons (125 MMT) over a 50-year lifespan.

For comparison of the injection rates (tons per year), there is currently no geologic sequestration of CO_2 occurring in Illinois, other than small research experiments. The Permian Basin in western Texas and eastern New Mexico currently inject 30 million tons (27 million metric tons) per year into petroleum reservoirs for enhanced oil recovery (DOE, 2007a).

Geologic sequestration, either in saline reservoirs and/or in enhanced oil recovery projects, would likely continue after the project period ends. For comparison to the storage capacity (in tons), potential CO_2 storage capacity in the Illinois Basin has been estimated (DOE, 2007a) as 154 to 485 million tons (140 to 440 MMT) in oil and gas reservoirs, 2.5 to 3.6 billion tons (2.3 to 3.3 billion metric tons) in unminable coal seams, and 32 to 127 billion tons (29 to 115 billion metric tons) in the saline reservoirs of the St. Peter Sandstone and the Mt. Simon Sandstone. Eastern Texas has reported (DOE, 2007a) 4.4 billion tons (4.0 billion metric tons) of potential CO_2 storage capacity in oil and gas reservoirs plus tens of billions of tons of storage capacity in a combination of coal seams, gas-bearing shale, and saline formations. Western Texas has reported (DOE, 2007a) 13 billion tons (12 billion metric tons) of capacity in saline formations alone. At any of the sites, the CO_2 injected by FutureGen would occupy much less than 1 percent of the storage capacity in the host state (assuming a total of up to 55 million tons (50 MMT) would be injected).

If the excess CO_2 captured (that portion above the 1.1 million tons (1.0 MMT) of CO_2 that must be stored per year during the project period) is sold for enhanced oil recovery or enhanced gas recovery, there could be an added revenue stream for the project, increased production from the oil or gas fields, increased jobs, and other benefits. The negative side is that produced oil or natural gas would lead to a release of greenhouse gases as these commodities are combusted. However, without additional domestic production from enhanced oil or natural gas recovery projects, imports would be consumed instead, resulting in the same levels of CO_2 emissions.

Project Technology Deployment: Immediate Impact on Electric Power Industry

No Action Alternative

If the FutureGen Project is not funded (i.e., the No Action Alternative), a significant delay is foreseeable in the development and deployment of IGCC power generation systems that are fully integrated with carbon capture and storage. Private industry may voluntarily take on projects that

include IGCC with carbon capture and sequestration but only if suitable financial incentives exist (e.g., enhanced oil recovery, enhanced gas recovery, or enhanced coal-bed methane recovery), and there would be little chance that projects would be developed that inject CO_2 into deep saline formations. Given the geographic distribution and storage potential of saline reservoirs (both domestic and international), this particular type of storage formation is of high importance for widespread deployment of geologic sequestration, especially in regions that do not have extensive oil, natural gas, or coal deposits.

It is possible that other FutureGen-like projects will be initiated by other countries (e.g., Magnum Project in the Netherlands, ZeroGen in Australia). Even if other projects go forward, the ability to deploy these technologies within the U.S. may be significantly delayed without considerable involvement of U.S. industrial participants, allowing these participants to gain experience. Finally, FutureGen is a major component of the U.S.'s current technology-based strategy to limit climate change, and a failure to fund FutureGen may have significant domestic and international political implications. Such implications include an increased domestic reliance on less plentiful, higher priced fuels such as natural gas, an increased economic burden resulting from such reliance, as well as a continued deployment of environmentally less preferable alternatives (e.g., conventional power plants without carbon capture and sequestration), especially in rapidly developing economies such as India and China.

If the No Action Alternative is chosen and the project is not built and operated, there would be no contribution to atmospheric greenhouse gas concentrations from this project. However, if a conventional power plant is built to provide the electricity that would have been produced by FutureGen, that power plant would emit to the atmosphere around 3 million tons (2.7 MMT) of CO_2 per year. If a delay occurs in the deployment of carbon capture and sequestration technologies within the electric power industry, greater amounts of CO_2 would be emitted to the atmosphere than would occur if the technology is deployed rapidly. The same could occur for other industries that might benefit from the research, development and demonstration that FutureGen would offer.

Proposed Action

If the FutureGen Project is funded, there would be a series of potential economic, environmental, and political benefits, many of which overlap. Potential benefits include:

Economic – Successful operation of FutureGen would provide an engineering design and cost basis for future electric generating plants that emit minimal criteria pollutants, CO_2, and mercury. This design and cost basis would yield multiple economic benefits to the entire domestic economy by:

- ***establishing the engineering, cost and operating knowledge necessary to encourage the adoption and further deployment of similar systems by private industry;***
- ***providing operating experience such that IGCC with carbon capture and sequestration will be considered established technologies and not the "high cost, high risk" ventures they are considered to be today;***
- ***producing the necessary information to policy-makers and regulators so that technically sound regulations can be developed and much needed new generation capacity can be developed with regulatory certainty;***
- ***creating a research and development platform that will substantially accelerate the demonstration and deployment of new technologies; and***
- ***allowing continued use of price-stable, domestically plentiful coal in a more environmentally friendly manner.***

Environmental – In a similar manner, the successful operation of FutureGen would provide multiple environmental benefits by:

- ***proving a means to produce electricity from coal while emitting to the air much smaller quantities of criteria pollutants, CO_2 and mercury, compared to conventional power plants;***
- ***establishing the design basis to enable accelerated deployment of carbon capture and sequestration technologies as a carbon management tool;***
- ***accelerating the replacement and/or retrofitting of older, less efficient and less environmentally preferable electricity generating plants;***
- ***providing much needed data to accelerate the development, permitting and construction of environmentally preferable electricity generating facilities;***
- ***demonstrating a means to reduce the trend of increasing emissions of CO_2; and***
- ***sharing these technology options with coal rich, energy intensive economies (e.g., India and China) through international involvement.***

Policy – the successful operation of FutureGen would generate a number of national and international benefits by:

- ***demonstrating U.S. leadership in geologic sequestration;***
- ***establishing a necessary design basis to advance the Nation's technology-based climate policy;***
- ***showing one environmentally preferable option for further utilization of coal, both domestically and internationally; and***
- ***providing necessary information to facilitate international cooperation on climate related policy.***

Future Propagation of Capture and Geologic Sequestration Technology

Power Plant Design and Efficiency

Power plants that capture and sequester CO_2 with high efficiency must be designed and built specifically to do so. Until such a design is proven by successful construction and operation, the conservative and risk averse electric power industry is likely to resist regulatory programs that would curb emissions. The DOE Energy Information Administration indicates in their reference case that nearly 292 GW of new electricity generating capacity will be constructed through 2030. Approximately 90 percent of that new domestic capacity is anticipated to use fossil fuels and none would be equipped with carbon capture and sequestration. While the technologies tested at FutureGen may not directly address all new capacity additions or the existing coal-based fleet of approximately 300 GW, the knowledge and experience that would result from the CO_2 sequestration component (transport, injection and monitoring) of FutureGen would be directly transferable when post-combustion CO_2 capture technologies become practical.

One disadvantage of FutureGen's approach to carbon management is that the power plant must divert a sizable fraction of the total electricity production to operating the carbon capture and sequestration facilities. The result is that FutureGen would realize a net electricity production rate that would be comparable to that of many older, less efficient power plants. This means that more coal must be consumed to generate the same amount of electricity as the plant would produce without carbon capture and sequestration. Research and development work at the FutureGen facility would aim to reduce this penalty in energy conversion efficiency. In the longer term, much more efficient power plants will be needed to reduce the rate at which coal supplies (and other fossil fuels) are depleted.

Pipelines

If carbon capture and sequestration is widely deployed at power plants across the Nation, pipelines must be constructed to transport the CO_2 to sequestration sites. The extent of new pipelines would depend on the extent to which new power plants were located near or adjacent to saline aquifers or other sequestration targets. Typical pipeline construction and operational impacts would be associated with this component of a widespread deployment across the U.S. As stated in Section 3.3.1.1, an increase in the number of CO_2 pipelines nationally could result in the development of new rights-of-way that could cause changes in land use and ownership, land clearing and soil disturbance, utility and road crossings, wetland disturbance, habitat disturbance, and potential surface leaks of CO_2.

Greenhouse Gas Emissions

While many variables would influence the deployment of FutureGen-like technologies, deployment is likely to be restricted to local opportunities based on economic feasibility, unless a regulatory program is established to compel carbon capture and sequestration. Further delay in the establishment of such a legal/regulatory requirement means that power plants would continue to be built without carbon capture and sequestration. With further delay, the rate of CO_2 emissions will likely continue to increase. With further delay, the concentration of CO_2 in the atmosphere will likely continue to grow, and the potential for global climate change will increase.

Geologic Sequestration

Geologic sequestration of CO_2 is a promising technology that is being actively investigated and tested nationally and internationally by DOE and other organizations (Davison et al., 2001; IPCC, 2005). Unlike commercial projects associated with natural resource (oil and natural gas) extraction efforts, most of the research projects are at a pilot scale or smaller. FutureGen offers an opportunity to conduct research at a larger scale, while also accelerating the widespread deployment of geologic sequestration across the electric power industry. Initial reviews (DOE, 2007a, b) of the geologic storage potential suggest that there is ample pore space in deep sedimentary rock layers to contain the CO_2 emitted by power plants and other industries. Concerns about the safety and permanence of the storage can best be addressed through carefully gained experience. An environmental concern is that injected CO_2 would displace native fluids (mostly salt water) that would migrate to the near surface or surface environment where it would mix with fresh water, making it unfit for its current uses. As geologic sequestration is widely deployed, such displacement of native fluids would occur with a potential for contamination of fresh water supplies, streams, rivers, or lakes. Mitigation techniques should be developed to help correct these situations, and DOE is funding research in relevant areas.

Enhanced Oil Recovery, Enhanced Coal Bed Methane Recovery, and Enhanced Natural Gas Recovery

Generally, a volume of CO_2 (at reservoir temperature and pressure) equal to the volume of previously produced oil or natural gas (also at reservoir temperature and pressure) can be injected into depleted reservoirs without displacing native fluids to the land surface. Injections of CO_2 can also be used to help recover more oil or natural gas. Oil and natural gas recovered by these techniques would then be combusted in engines, combustion turbines, steam boilers, space heaters, fuel cells, etc. with the result that the carbon in these fuels would, in most cases, be released to the atmosphere in the form of CO_2. This CO_2 would offset some of the benefit from the capture and geologic sequestration of CO_2 generated from the power plant. However, the process does result in a net benefit compared to a situation where no CO_2 is captured and stored, but the oil and natural gas are produced by other means.

3.3.1.3 Summary of the Cumulative Impacts of FutureGen Technology

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

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

Since coal is anticipated to continue in its major role for world electricity generation in the near future, implementation of carbon capture and storage technologies will be a critical component to any CO_2 reduction strategy (MIT, 2007; NRDC, 2007). The FutureGen Project may be the first opportunity to integrate and demonstrate at an appropriate scale the technologies needed to allow for wide-spread implementation of integrated coal gasification, carbon capture, and geological sequestration in the near-future. The integration and implementation of these technologies offers one major option for the development of a broad-based strategy to address GHG emissions reduction and potential global warming impacts.

3.3.2 RELEVANT PAST AND ONGOING ACTIVITIES

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

3.3.2.1 Relevant Past and Ongoing Activities in Illinois

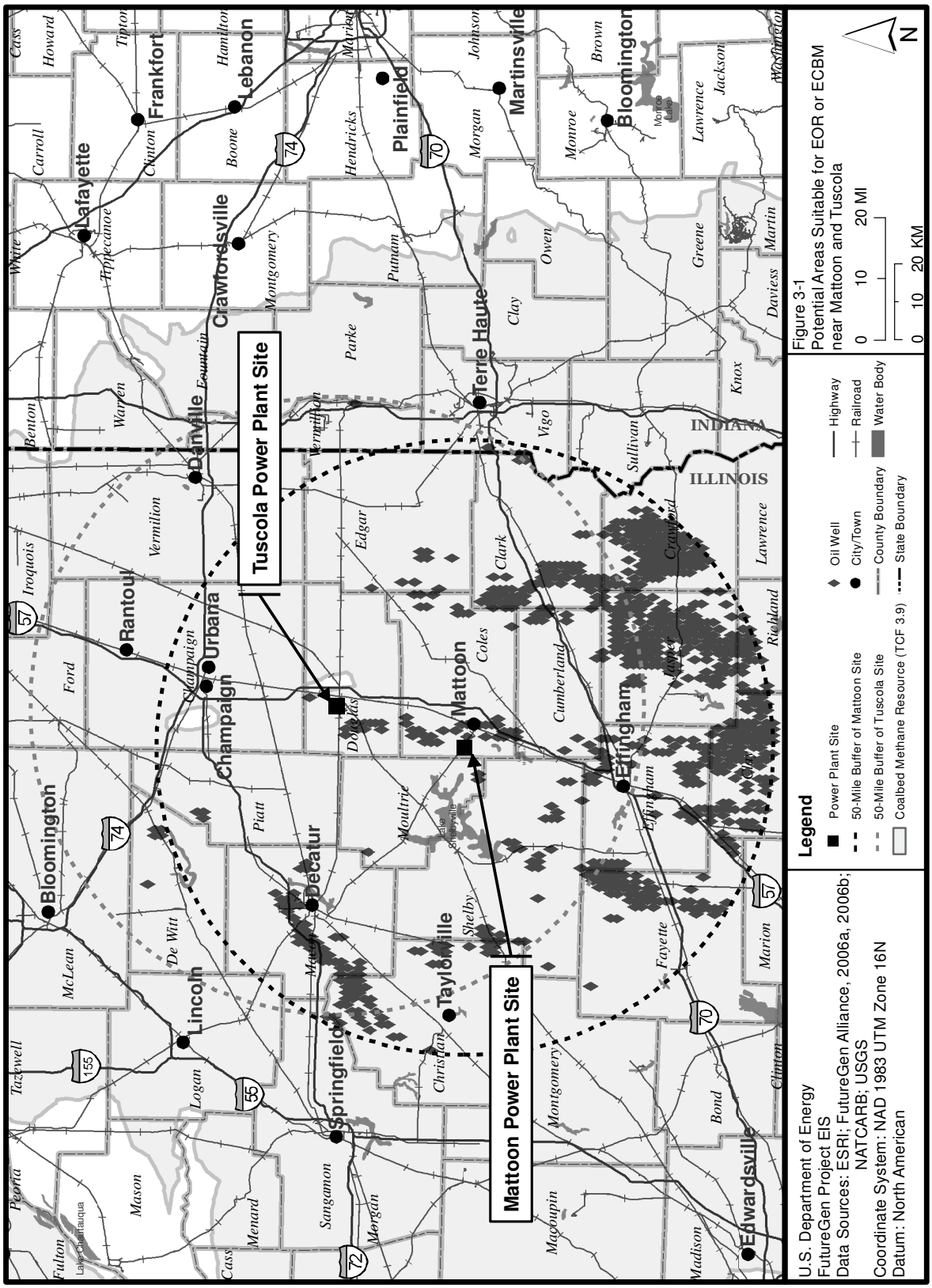
The Illinois coal industry began to decline in the 1990s after the federal government established stricter sulfur emission standards. However, a resurgence in the coal industry resulted from advances in clean-coal technology that made it possible to use Illinois coal and still meet the strictest air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

The existing oil production industry in Illinois could provide an opportunity for EOR. During the 2004 reporting period, at least 3,700 oil wells across 48 individual oil fields produced 649,000 barrels of

oil within 50 miles (80.5 kilometers) of Mattoon or Tuscola. In Mattoon, 212 oil wells at two fields produced over 39,000 barrels of oil in 2004 (ISGS, 2004). These statistics do not include inactive oil fields (as of 2004). There are also good opportunities for ECBM recovery throughout the region. Figure 3-1 depicts oil wells and coalbed methane areas within a 50-mile (80.5-kilometer) radius of both Mattoon and Tuscola.

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

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


Tuscola Power Plant Site
Mattoon Power Plant Site
Champaign
Urbana
Danville
Rantoul
Bloomington
Decatur
Springfield
Lincoln
Taylorville
Mattoon
Effingham
Terre Haute
Martinsville
Plainfield
Lebanon
Frankfort
Crawfordsville
Lafayette
Edwardsville
INDIANA
ILLINOIS
Legend
Power Plant Site
50-Mile Buffer of Mattoon Site
50-Mile Buffer of Tuscola Site
Coalbed Methane Resource (TCF 3.9)
Oil Well
City/Town
County Boundary
State Boundary
Highway
Railroad
Water Body
U.S. Department of Energy
FutureGen Project EIS
Data Sources: ESRI; FutureGen Alliance, 2006a, 2006b; NATCARB; USGS
Coordinate System: NAD 1983 UTM Zone 16N
Datum: North American
Figure 3-1
Potential Areas Suitable for EOR or ECBM near Mattoon and Tuscola
0 10 20 MI
0 10 20 KM
N

3.3.2.2 Relevant Past and Ongoing Activities in Texas

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

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

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

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

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

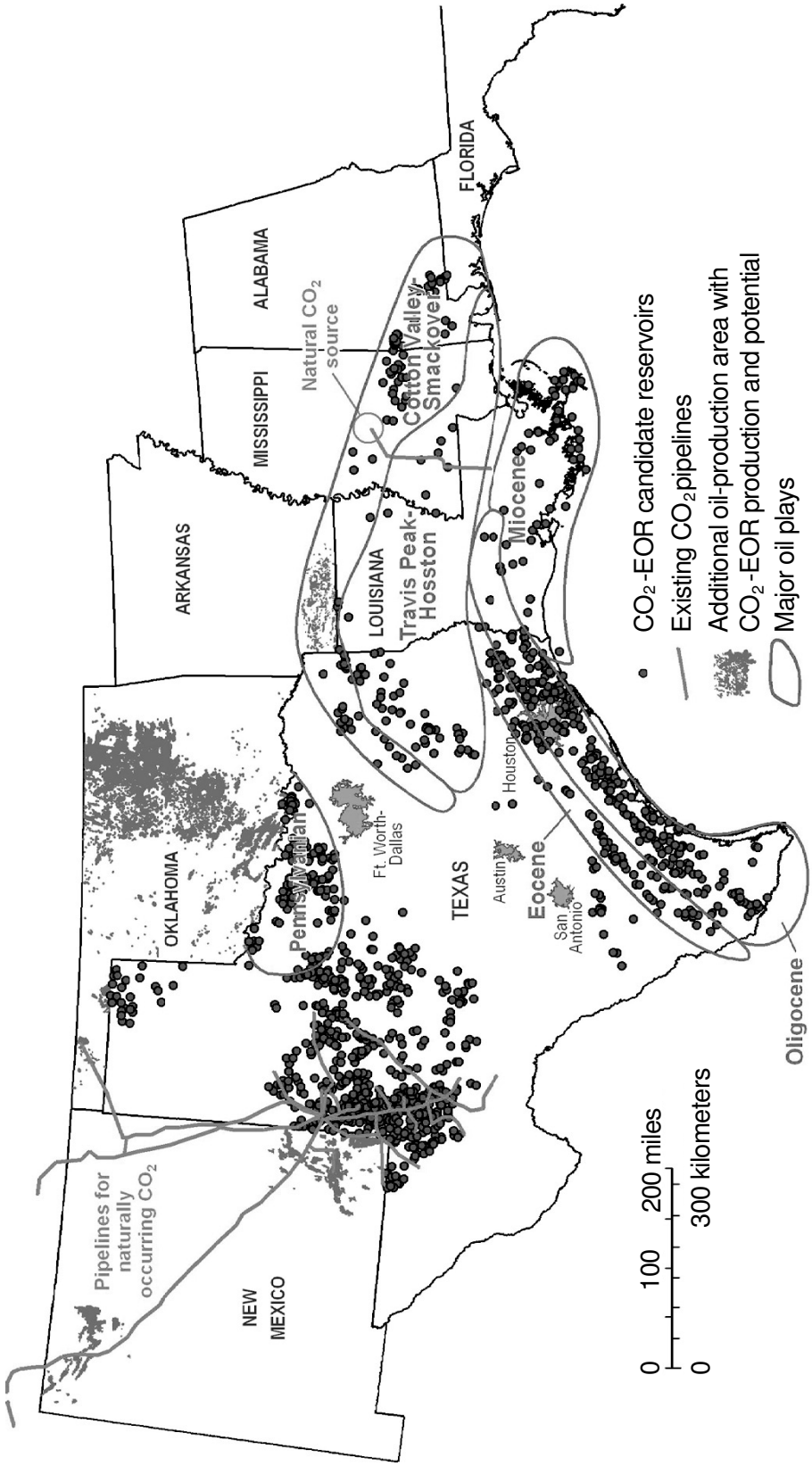
In 2005, Texas and Union Pacific developed a partnership to move freight lines away from densely populated urban areas across the state (Texas Office of the Governor, 2005b). Funding and specific

projects have not been determined. The movement of rail lines would lead to safer crossings, less hazardous cargo carried through populated areas, and greater freight movement efficiency.

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

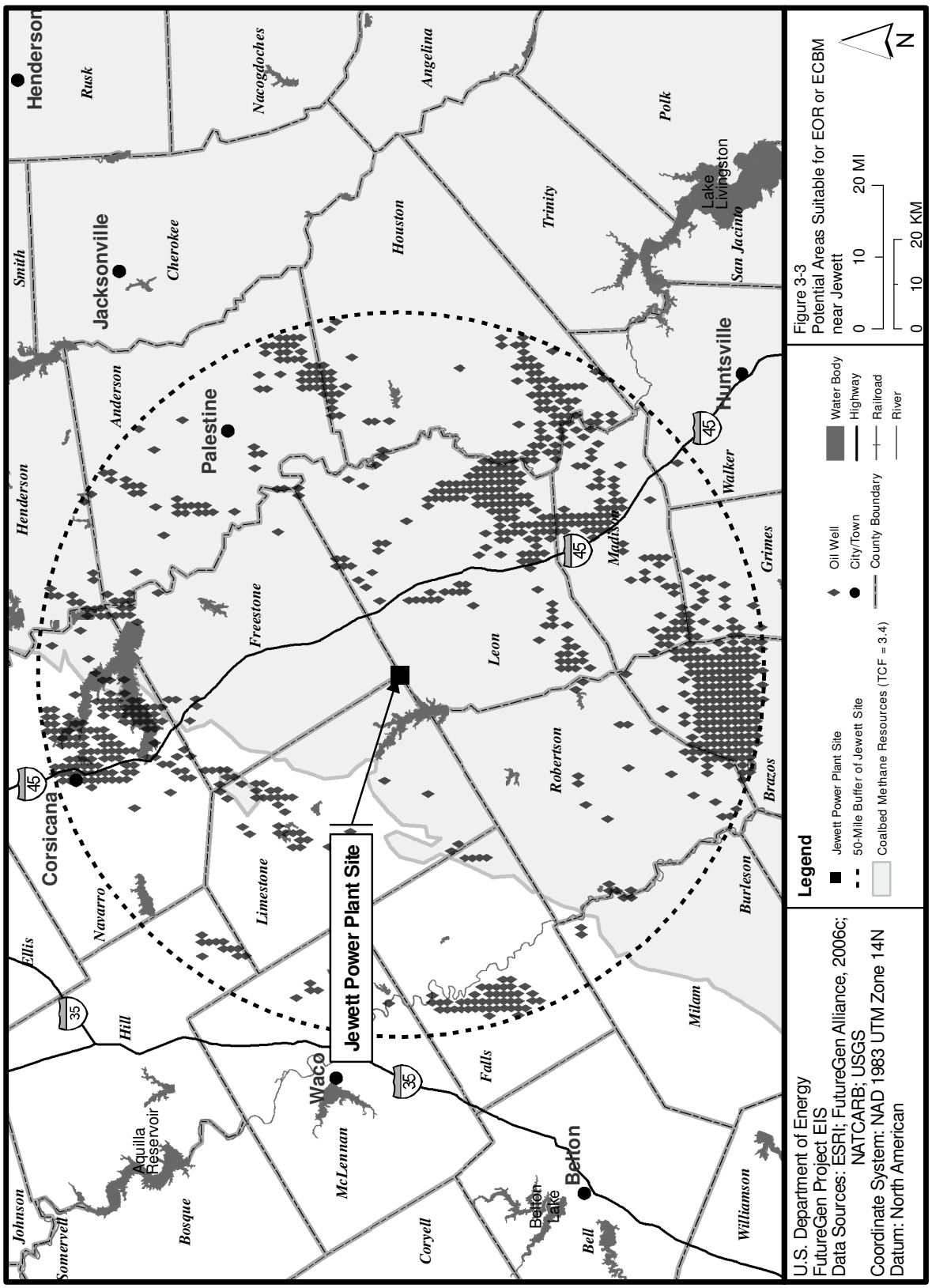
Texas has numerous opportunities for EOR. The Bureau of Economic Geology (BEG) at the University of Texas estimates that Texas has more than 1.4 billion tons (1.3 billion metric tons) of sequestration capacity (Holtz et al., 2005). Furthermore, BEG estimates that, in the Gulf Coast (outside of the traditional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

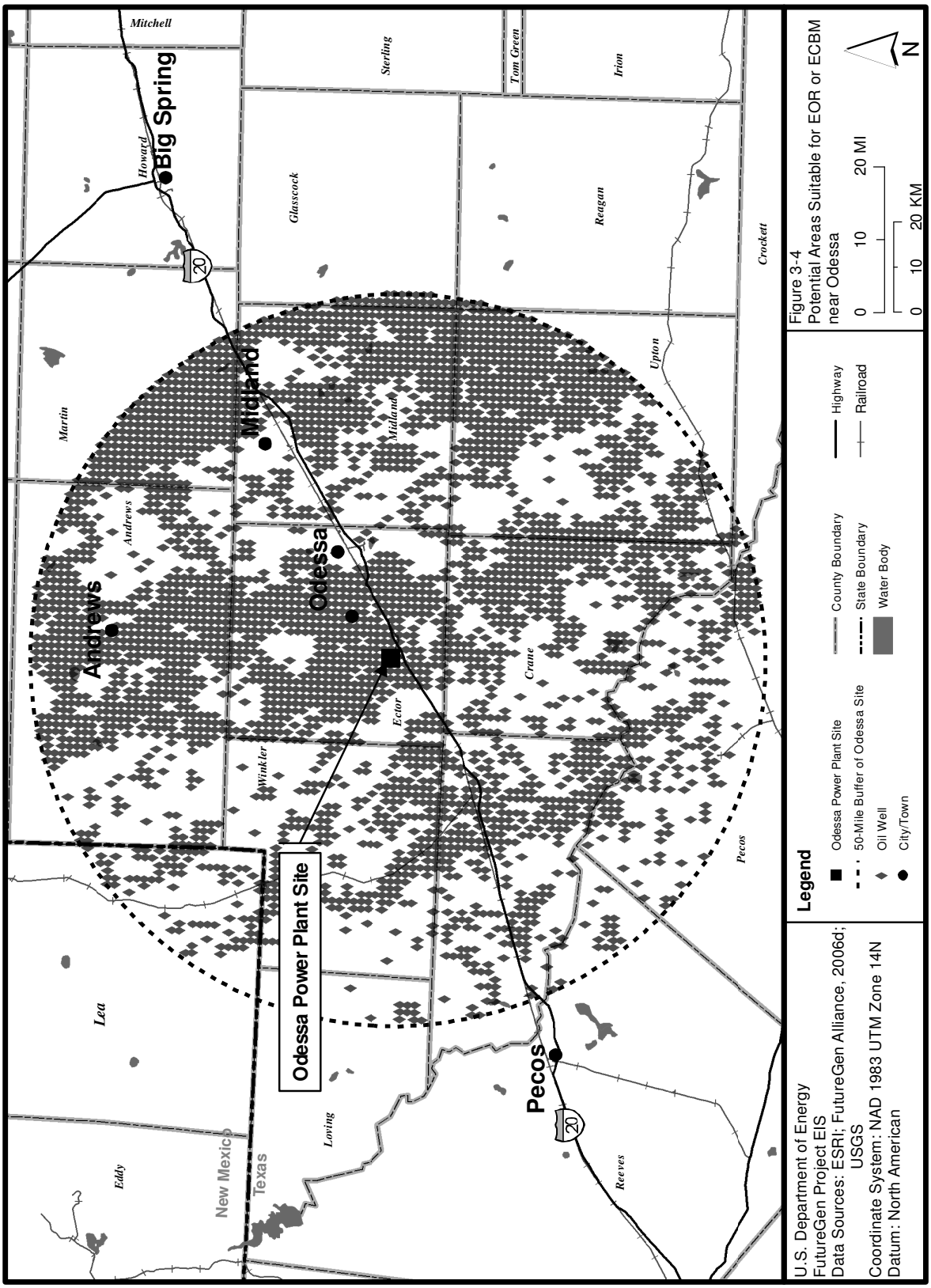
Near the Odessa candidate site, an existing CO_2 pipeline may be the most likely avenue to deliver FutureGen CO_2 to any number of local oil fields. Figure 3-4 depicts oil wells within a 50-mile (80.5-kilometer) radius of the Odessa Site. Comparatively, much greater opportunities exist for EOR than ECBM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



Source: Holtz et al., 2005

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


Henderson
Rusk
Nacogdoches
Smith
Jacksonville
Cherokee
Angelina
Houston
Trinity
Polk
Lake Livingston
San Jacinto
Anderson
Palestine
Huntsville
Walker
Madison
Grimes
Freestone
Leon
Robertson
Brazos
Corsicana
Navarro
Limestone
Jewett Power Plant Site
Ellis
Hill
Waco
Falls
Milam
Burleson
McLennan
Aquilla Reservoir
Bosque
Johnson
Somervell
Coryell
Belton Lake
Belton
Bell
Williamson
45
35
Legend
Jewett Power Plant Site
50-Mile Buffer of Jewett Site
Coalbed Methane Resources (TCF = 3.4)
Oil Well
City/Town
County Boundary
Water Body
Highway
Railroad
River
U.S. Department of Energy
FutureGen Project EIS
Data Sources: ESRI; FutureGen Alliance, 2006c; NATCARB; USGS
Coordinate System: NAD 1983 UTM Zone 14N
Datum: North American
Figure 3-3
Potential Areas Suitable for EOR or ECBM near Jewett
0 10 20 MI
0 10 20 KM
N


Mitchell
Big Spring
Howard
Sterling
Tom Green
Irion
Glasscock
Reagan
Crockett
Martin
Midland
Upton
Andrews
Odessa
Crane
Ector
Winkler
Pecos
Odessa Power Plant Site
Lea
Eddy
New Mexico
Texas
Loving
Reeves
Pecos
20
Legend
Odessa Power Plant Site
50-Mile Buffer of Odessa Site
Oil Well
City/Town
County Boundary
State Boundary
Water Body
Highway
Railroad
Figure 3-4
Potential Areas Suitable for EOR or ECBM near Odessa
0 10 20 MI
0 10 20 KM
N
U.S. Department of Energy
FutureGen Project EIS
Data Sources: ESRI; FutureGen Alliance, 2006d; USGS
Coordinate System: NAD 1983 UTM Zone 14N
Datum: North American

3.3.3 REASONABLY FORESEEABLE FUTURE ACTIONS NEAR ALTERNATIVE SITES

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

3.3.3.1 Mattoon and Tuscola

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

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

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

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

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

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

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

3.3.3.2 Jewett

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

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

Project	Description
Fossil Fuel Power Plants[1]	
NRG Limestone Electric Generating Station	800-MW lignite coal-fueled boiler (Unit 3) at the existing plant in Jewett, Texas, adjacent to the Jewett Site. Expected operation date is 2012.
Oak Grove Mgmt. Co., LP (TWU)	1600-MW lignite coal-fueled power plant located in Robertson County. Site would be 12 miles (19.3 kilometers) north of Franklin, Texas, and 12 miles (19.3 kilometers) southwest of the Jewett Site. Expected operation date is 2009. This project would be near the existing Calvert coal mine.
Sandow 5 (replaces ALCOA units)	434-MW lignite coal-fueled power plant located in Rockdale, Milan County, Texas. Proposed plant would be 50 miles (80.5 kilometers) southwest of the Jewett Site. Expected operation date is 2007.
Sandy Creek En. Assocs., LP	600-MW coal-fueled power plant that would use PRB coal. Plant location would be 31 miles (49.9 kilometers) northwest of the Jewett Site on Rattlesnake Road in Riesel, McLennan County, Texas. Expected operation date is 2008.
Twin Oaks Power III, LP (Sempra)	600-MW lignite coal-fueled power plant that would be located in Robertson County, Texas, 8 miles (12.9 kilometers) north of Calvert and 31 miles (49.9 kilometers) north of the Jewett Site. Expected operation date is 2010. This project would be near the existing Twin Oaks coal mine.
Alternative Energy Projects	
No projects identified	

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

Project	Description
Geologic Sequestration Projects	
Gulf Coast Basin, Southeast Regional Carbon Sequestration Partnership	In the Gulf Coast Basin, the Southeast Regional Carbon Sequestration Partnership will build upon the Frio Basin Project by testing a model for early CO_2 injection into an oil reservoir, followed by long-term, large-volume storage in underlying brine formations. A total of 15,000 tons (13,608 metric tons) of CO_2 is expected to be injected. Fifteen potential sites for the project have been identified and the selected site has yet to be determined (NETL, 2006b).
Transportation Projects	
FM 39 Relocation	The Texas Westmoreland Coal Company plans to relocate a section of FM 39 and the current train overpass to reclaimed land to facilitate the continuation of mining operations. This relocation is scheduled to begin in 2007 and be completed in approximately 1 year (FG Alliance, 2006c).
Texas Department of Transportation (TxDOT) roadway improvements (widening or new roads)	There are numerous TxDOT projects planned in the ROI, including improvements to FM 60 from FM 50 to Snook, FM 2154 from FM 2818 to SH 40, SH 21 from Kurten to the Navasota River, SH 6 from Hearne to Calvert, FM 60 from SH 6 to FM 158, US 79 Rockdale Relief Route, and SH 249 from Montgomery County to SH 6 (FG Alliance, 2006c).
Trans-Texas Corridor (TTC-35)	TxDOT is evaluating a TTC-35 that would parallel the existing I-35 from the Oklahoma border through Central Texas to the border with Mexico. If developed, this corridor would run north-south approximately 40 miles (64.4 kilometers) west of the Jewett Site. Construction could begin in 2011 pending environmental clearance to determine the corridor's ultimate alignment. A tier-one EIS for the project was issued in April 2006 (TxDOT, 2006a).

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

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

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

3.3.3.3 Odessa

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

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

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

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

3.3.4 POTENTIAL CUMULATIVE IMPACTS FOR ALTERNATIVE SITES

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

3.3.4.1 Mattoon and Tuscola

One new coal IGCC plant is proposed within 50 miles (80.5 kilometers) of Mattoon, as well as several alternative energy projects (e.g., bio-diesel and ethanol plants). The primary concern regarding these projects is the potential for cumulative air emissions. The proposed Taylorville Energy Center (IGCC power plant) would be a large-quantity generator of air pollution subject to PSD requirements. Table 3-9 lists the allowable emissions in tons per year as cited in the draft construction permit for the

project (IEPA, 2006a). These criteria pollutant emission levels are similar to the maximum emissions predicted for the FutureGen Project during the DOE-sponsored phase.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Although water needs for all of the proposed ethanol plants are not published, the Andersons Champaign plant would use approximately 1 million gallons (3.8 million liters) of groundwater a day. Local residents expressed concerns about the ability of the aquifer to sustain this withdrawal. Therefore, it is reasonably foreseeable that water withdrawals from the Mahomet Aquifer may constrain these types of projects in the future. ***It is unknown to what extent the other proposed ethanol plants would use surface water instead of groundwater.*** Based on the ratio of water use to ethanol production for the Andersons Champaign ethanol plant, the five proposed ethanol plants could collectively require ***4.1*** million gallons (5.1 million liters) of water ***daily***. However, processing may consume only 30 percent of the water and the remaining 70 percent (in the form of wastewater) could be filtered and either reused by the plant or returned to the aquifer. ***If the biofuels projects used similar amounts of water, the combined water usage for the biofuel and ethanol plants would be 7.5 MGD (28.4 MLD).***

In comparison, the FutureGen Project (running at 85 percent capacity) could use up to 1.3 ***billion*** gallons (5.1 ***billion*** liters) of water annually ***(assuming 4.3 MGD [16.28 MLD]),*** which is nearly ***one half that projected for*** the combined operation of the ***proposed biodiesel and*** ethanol plants, although the FutureGen Project would completely consume (i.e., evaporate) its water intake.

According to a 2006 study by the Illinois State Water Survey, the Mahomet Aquifer (located north of Douglas County) is one of four aquifer systems in Illinois in the most need of study and planning (ISWS, 2006). The Mahomet aquifer is the major groundwater resource for east-central Illinois. Many communities, industries, and irrigators depend on the aquifer for their supply, collectively consuming approximately 100 MGD (378 MLD). While the sustained yield of the Mahomet aquifer has been estimated to be in excess of 400 MGD (1,514 MLD), over-development of the aquifer can occur in localized areas. New field data coupled with computer modeling of the aquifer system is needed to examine development alternatives for community planners (ISWS, 2007). For example, within the Mahomet Aquifer region, population projections for these communities suggest that by 2020, the Mahomet Aquifer region may increase by 100,000 people to a total of 900,000. While the populations and water demands of Douglas and Coles counties to the south of the aquifer region (including the Cities of Mattoon and Tuscola) have remained relatively unchanged over the last 20 years, the communities of Springfield, Decatur, Bloomington and Danville (also outside the aquifer region) are examining the use of Mahomet Aquifer groundwater as an alternative to surface reservoirs with the potential to double the demand on the aquifer (increase demand by 80 MGD [303 MLD]).

Because the primary water sources proposed ***for FutureGen*** in either Mattoon or Tuscola would come from the effluent of existing wastewater treatment facilities (municipal or industrial) and not groundwater, no ***direct*** cumulative impacts to the sustainability of groundwater withdrawals are expected to result from the FutureGen Project. ***However, p***rocess water for the Tuscola Site would be supplied by Kaskaskia River through an existing intake structure, and during certain low flow periods the Kaskaskia River source could be supplemented by groundwater withdrawals from wells owned by the Lyondell-Equistar Chemical Company. These groundwater withdrawals, if needed, would be temporary and are not expected to have any ***substantial*** cumulative impact to the sustainability of groundwater withdrawals within the region. ***Furthermore, the Lyondell-Equistar Chemical Company is considering becoming a zero-discharge facility. If this occurred, the current water requirement would be reduced by 86 percent (saving 1.87 MGD [7.08 MLD]). This would off-set some of the water requirement for the FutureGen Project. In addition, increasing population and treated sanitary water discharge upstream along the Kaskaskia River will increase downstream water levels and availability for the Tuscola FutureGen site. Currently the average daily flow from the Urbana/Champaign Sanitation District is 7.68 MGD (29.07 MLD) with a maximum daily flow of 27.25 MGD (103.15 MLD). Based on population growth anticipated for this District, the water flow in the Kaskaskia will continue to increase over the next decade. With the increased river volume and the possibility of the chemical company going to zero-***

discharge, the need to draw water from the Mahomet aquifer to service these industries or accommodate low flows in the Kaskaskia River in Tuscola will be virtually eliminated.

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

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

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

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

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

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

As indicated in Section 3.3.3.1, there are numerous opportunities for EOR in the Mattoon ROI. There are also opportunities for ECBM recovery throughout the region. Over time, it is possible that new EOR or ECBM projects could emerge as a result of new CO_2 streams in the region, including those from the proposed ethanol plants and possibly the FutureGen Project. This is evidenced by the proposed 140-mile (225-kilometer) CO_2 pipeline discussed in Section 3.3.2.1. The potential cumulative impacts resulting

from these undertakings would principally be related to construction of the necessary infrastructure to transport the CO_2 to the injection location, as well as the activities that would occur at injection and recovery sites. The types of impacts that could occur with new EOR or ECBM projects are described in 3.3.1.1.

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

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

3.3.4.2 Jewett

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

Cumulative air quality impacts within the ROI for the Jewett Site would largely be driven by the combined emissions of these proposed facilities, which would be expected to be substantially greater than the emission potential for the FutureGen Project. Table 3-12 summarizes the air emissions estimated for these proposed power plants. Should the projects go forward, they would release tens of thousands of tons of criteria pollutants into the atmosphere, which could adversely affect air quality, though the extent is unknown. The FutureGen Project would contribute up to ***5*** percent and 1.***7*** percent of the cumulative NO_2 and SO_2 emissions, respectively, and up to 1***.1*** percent of cumulative CO emissions. Because the Jewett Site is in an attainment area that is substantially below the NAAQS for these pollutants (see Section 6.2), the cumulative impact from NO_2, SO_2, and CO emissions from the FutureGen Project would not be expected to cause exceedance of NAAQS. Ambient concentrations of $PM_{2.5}$ ***may be*** much closer to the NAAQS (***based on the closest PM monitoring station, which is located near Houston, a more urban area***), and cumulative air emission from proposed facilities in the region would likely cause the $PM_{2.5}$ concentrations to increase. Detailed modeling of all the proposed sources, along with the existing sources and local air quality data, would be required to estimate more accurately whether the cumulative impact of the proposed sources could result in the $PM_{2.5}$ standard being exceeded. However, the FutureGen Project would represent less than 1***.5*** percent of the estimated future emissions of PM within 50 miles (80.5 kilometers) of Jewett.

While the FutureGen Project would emit pollutants, the levels would be very small, and future air quality degradation in the region would be dominated by the other proposed power plants. ***These proposed power plants (already in the permitting stage) and all other proposed sources of air pollutants would be expected to consume PSD increments and may affect emission levels allowed for projects***

permitted at a later time, including the FutureGen Project.

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

Project	MW	NO_2 (tpy [mtpy])	CO (tpy [mtpy])	VOC (tpy [mtpy])	PM/PM_{10} (tpy [mtpy])	SO_2 (tpy [mtpy])
Oak Grove, Lignite[1]	1,600	6,320 (5,733)	26,790 (24,303)	352 (319.3)	3,171 (2,877)	15,079 (13,679)
Limestone 3, Lignite[2]	800	1,752 (1,589)	13,395 (12,152)	176 (159.7)	1,402 (1,272)	2,103 (1,908)
Sandow 5, Lignite[2]	434	2,593 (2,352)	7,267 (6,593)	95 (86.2)	1,037 (940.8)	5,186 (4,705)
Sandy Creek, PRB[2]	600	1,793 (1,627)	4,276 (3,879)	104 (94.3)	1,434 (1,301)	3,585 (3,252)
Twin Oaks Power 3, Lignite[2]	600	2,037 (1,848)	4,276 (3,879)	104 (94.3)	1,018 (923.5)	5,818 (5,278)
Total – Planned Power Plants	***4,034***	***14,495 (13,149)***	***56,004 (50,806)***	***831 (754)***	***8,062 (7,314)***	***31,771 (28,822)***
FutureGen - max case	275	758 (687.6)	611 (554.3)	30 (27.2)	111 (100.7)	543 (492.6)
- target case		326 (295.7)	n/a[3]	n/a[3]	33 (29.9)	212 (192.3)
Total - max case		***15,253*** (***13,837***)	***56,615*** (***51,360***)	***861*** (***781***)	***8,173*** (***7,415***)	***32,314*** (***29,315***)
- target case		***14,821*** (***13,445***)	n/a[3]	n/a[3]	***8,095*** (***7,344***)	***31,983*** (***29,014***)
FutureGen Percent of Total - max case		***5.0*** percent	***1.1*** percent	***3.5*** percent	***1.4*** percent	***1.7*** percent
- target case		***2.2*** percent	n/a[3]	n/a[3]	***0.4*** percent	***0.7*** percent

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

Based on a nominal rate of 2 pounds (0.9 kilograms) of CO_2 generated for each kilowatt-hour for a pulverized coal power plant (EPA, 2006), power plants listed in Table 3-12 would emit approximately ***35*** million tons (***31.7*** MMT) of CO_2 annually.

In addition to the potential for cumulative air quality impacts, activities associated with the construction and operation of a new 800-MW unit at the adjacent NRG Limestone Electric Generating Station could result in additional traffic and noise in the immediate vicinity of the Jewett Site. However,

it is expected that these increases would be localized, and because there are few receptors in this area and traffic conditions are generally acceptable, these impacts are not expected to be severe.

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

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

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

Water availability in Texas is an overall concern in terms of cumulative impacts of new projects. The water required by other projects in the ROI (such as the proposed power plants) and their sources are unknown, but could reduce water availability in the region to some extent. ***The proposed Jewett site would be located in Limestone, Freestone and Leon counties, where each county lies within a different water planning region (G, C, H respectively). Based on state predictions of water use through 2060, water demand would increase in these planning areas by 38, 87 and 47 percent respectively, attributed largely to municipal demand (resident population growth). Across these three planning areas, existing surface water supplies would decrease by 4 percent and groundwater supplies would decrease by 17 percent by 2060. In planning region G, the Carrizo-Wilcox aquifer water supply would decrease by 13 percent by 2060 (TWDB, 2006).***

The withdrawal of ***3.1 billion gallons (4.9 billion liters) or 4,000 acre-feet of water annually*** for the FutureGen Project could affect groundwater supplies in the future. ***Based on the 2007 State Water Plan, the FutureGen Project would consume approximately 4 percent of the Carrizo-Wilcox Aquifer annual supply in water planning region G.*** The Jewett Site would have an on-site wastewater treatment facility and it is probable that the effluent would be recycled into the power plant. This would be consistent with the recommendations of the 2007 State Water Plan. Consistent with the state's effort to restore the Trinity River, the FutureGen Project would use BMPs during construction of the CO_2 pipeline and sequestration facilities to minimize degradation of the river's water quality.

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

3.3.4.3 Odessa

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

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

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

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

Water availability in west Texas is a chief concern in terms of cumulative impacts of new projects. Although there are not many large projects proposed within the ROI that would consume water, the withdrawal of ***3.1 billion gallons (4.9 billion liters) or 4,000 acre-feet of water annually*** for the FutureGen Project could affect future groundwater supplies. While the Texas Water Development Board has indicated that a number of existing well fields provide sufficient water for the FutureGen Project, regional population and industry growth over time may strain water supplies in the future. ***The proposed Odessa FutureGen site is located in water planning region F, where projected water demand between 2010 and 2050 is expected to increase by only 2 percent. Approximately 75 percent of current water demand is associated with agricultural irrigation and 78 percent of the region's existing water supply consists of groundwater from the Ogallala, Edwards-Trinity, Trinity and Pecos Valley aquifers. Water conservation strategies include advanced irrigation methods and reuse of treated municipal wastewater. The region is also looking to desalinate brackish groundwater and add new well fields for Midland and San Angelo (TWDB, 2006). Based on existing groundwater supplies in the region (all aquifers), the FutureGen Project would use approximately 1 percent of the annual groundwater supply in the region.***

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

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

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

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

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

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

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Groundwater	**Construction/Operations:** • No unavoidable adverse impacts would occur to groundwater resources. BMPs would be used to minimize impacts. • Some groundwater use would occur in Tuscola, Jewett, and Odessa. Impacts of water use are likely to be more important for the Odessa site.	**Construction/Operations:** • No mitigation measures warranted.
Surface Water	**Construction/Operations:** • No unavoidable adverse impacts would occur to surface water resources. BMPs would be used to minimize impacts. • Some surface water use would occur ***at*** Tuscola.	**Construction/Operations:** • No mitigation measures warranted.
Wetlands and Floodplains	**Construction:** • Construction of the proposed facility could result in unavoidable temporary impacts to wetlands along utility corridors. BMPs should prevent any adverse impacts from construction and operation of the FutureGen Project. **Operations:** • No unavoidable adverse impacts would occur to wetlands or floodplains. BMPs would be used to minimize impacts.	**Construction:** • Site design could avoid impacts to wetlands. New utility corridors could be located to avoid some wetlands. • Section 404 permits would be obtained for jurisdictional water-body and wetland alternations. As a permit condition, mitigation of wetland impacts would be in the form of direct replacement or other approved U.S. Army Corps of Engineers (USACE) and state mitigation requirements. Typical mitigation ratios for unavoidable impacts to wetlands would be 1:1 for open water and emergent wetlands, 1.5:1 for shrub wetlands, and up to 2:1 for forested wetlands. • Directional drilling of utilities in areas where mitigation is not required by the USACE would further reduce impacts to wetland resources. **Operations:** • No mitigation measures warranted.

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

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Biological Resources	**Construction:** • Permanent unavoidable land disturbance at the proposed power plant site would result in permanent habitat loss of up to 200 acres (81 hectares). Temporary disturbances to additional aquatic and terrestrial habitats would occur along proposed utility corridors. BMPs should prevent any adverse impacts to these terrestrial and aquatic habitats. • No known occurrences of threatened and endangered species; however, the potential exists for an adverse impact to threatened or endangered species within each of the proposed FutureGen Project sites. Surveys for these species before construction would determine if they occur in the area. BMPs and coordination with state and federal agencies should prevent any adverse impacts. **Operations:** • No unavoidable adverse impacts would occur to biological resources. BMPs would be used to minimize impacts.	**Construction:** • Mitigation for federal endangered species, if necessary, would be defined during consultation with the U.S. Fish and Wildlife Service and could include passive measures such as construction timing outside of critical breeding periods, or more aggressive measures such as complete avoidance of impacts. **Operations:** • No mitigation measures warranted.
Cultural Resources	**Construction:** • Although there are no known areas of cultural significance, the potential exists for an adverse impact to cultural resources (Jewett and Odessa CO_2 corridors, Tuscola electrical transmission corridor). Archaeological surveys would determine location of any cultural resources and the possible extent of impact. Construction of the proposed facility is not anticipated to have any unavoidable adverse impacts relevant to cultural resources. • Consultation with Native American tribes was initiated; no tribes have requested involvement, however, coordination is ongoing. The potential of unavoidable adverse impacts would be resolved once consultation is complete. • **Operations:** • No unavoidable adverse impacts would occur to cultural resources. BMPs would be used to minimize impacts.	**Construction:** • Consultation with the State Historic Preservation Officer (SHPO) for any new unforeseen areas of construction or ground disturbance not included within the EIS would be completed before construction to determine the need for cultural resource investigations and any appropriate mitigation measures. • Required management and mitigation measures regarding traditional cultural properties are unknown until consultation with Native American tribes is complete. **Operations:** • No mitigation measures warranted.

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

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Land Use	**Construction:** • Direct unavoidable impact due to displacement of oil and gas wells (Odessa and Jewett). • Direct impact to any residential property and prime farmland (Mattoon and Tuscola) located adjacent to the power plant site; introduces industrial construction adjacent to residential property. BMPs used for aesthetics, noise, and traffic should minimize any adverse impacts on adjacent land use resulting from project construction. • **Operations:** • No unavoidable adverse impacts would occur to land use. BMPs would be used to minimize impacts.	**Construction:** • Displaced oil and gas wells could be relocated. **Operations:** • No mitigation measures warranted. • FutureGen Project land that is not used for project purposes could be leased for agricultural use.
Aesthetics	**Construction/Operations:** • The proposed power plant (Mattoon and Tuscola) would cause a major unavoidable visual intrusion to residences within a 1-mile (1.6-kilometer) radius of the site. • Moderate unavoidable visual intrusion would occur for two residences near the Odessa site due to the presence of other industrial facilities that are visible in the general area and the FutureGen facility.	**Construction/Operations:** Potential mitigation measures that would reduce the aesthetic impacts of the facility include: • Enclosing some of the more “industrial” components of the plant in buildings. • Providing landscaping around the perimeter of the plant site to partially screen the plant from nearby residences and those passing by on the adjacent roads. • Selecting single-pole transmission towers to reduce the visual profile of the transmission towers. • Lighting design (e.g., luminaries with controlled candela distributions, well-shielded or hooded lighting, and directional lighting) could minimize potential for light pollution.
Transportation and Traffic	**Construction:** • Construction would create temporary localized adverse impacts due to the presence of additional trucks. BMPs should minimize additional impacts. • Temporary unavoidable impacts would occur to rail operations during construction of a new underpass (Odessa). **Operations:** • Changes to traffic signal timings may be required at ramp intersections to accommodate changes in the turning volumes.	**Construction:** • Truck traffic impacts would be mitigated through the use of signed truck routes to the proposed power plant site. Continued use of these routes during operations would reduce adverse impact. • At a minimum, trained rail construction flaggers would be required at all times during construction to accommodate traffic flow (Odessa). **Operations:** • No mitigation measures warranted.

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

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Noise and Vibration	**Construction:** • Construction would result in unavoidable temporary elevated noise impacts at the power plant site, increasing ambient noise levels at nearby receptors. BMPs would reduce impacts. **Operations:** • Operational traffic activities within the power plant site would result in unavoidable noise increases at nearby residences (Mattoon and Tuscola). BMPs would reduce impacts. • Noise and vibration from train rail car shakers could generate noise levels up to 118 dBA. • Numerous power plant components could generate increases in ambient noise levels and some could generate vibrations.	**Construction:** • Noise mitigation measures to limit the number of heavy trucks passing by residential receptors during construction would include diverting truck trips, scheduling more deliveries on rail, or purchasing the impacted property (Mattoon and Tuscola). **Operations:** • Sound enclosures*, barrier walls, earthen berms,* or dampening devices could be used whenever possible. In addition, alternate site configurations could be considered in order to position noise-producing equipment away from the impacted receptors (Mattoon and Tuscola). • Design of coal handling equipment would be evaluated during final design to reduce noise impacts to adjacent receptors.
Utility Systems	**Construction/Operations:** • No unavoidable adverse impacts would occur to utility systems. BMPs would be used to minimize impacts.	**Construction/Operations:** • No mitigation measures warranted.
Materials and Waste Management	**Construction/Operations:** • No unavoidable adverse impacts would occur to materials and waste management. BMPs would be used to minimize impacts.	**Construction/Operations:** • No mitigation measures warranted.
Human Health, Safety, and Accidents	**Construction/Operations:** • Unavoidable adverse impacts to human health and safety, although unlikely, could result from various types of accidents, sabotage and terrorism acts, ranging from small pipeline leaks to, in the worst case, a power plant explosion. Two separate risk studies were completed to identify and evaluate the risks of most importance. The results of the risk assessments would help planners and designers to reduce these risks during the planning, designing, construction, and operation of FutureGen. • The potential for large spills of ammonia with adverse impacts to human health would be low.	**Construction/Operations:** • ***Design the power plant to provide: safe egress from all confined areas; adequate ventilation; fire protection; pressure relief to safe locations; and a real-time monitoring for hazardous chemicals with an alarm system. Institute safety training and evacuation policies to address accidents.*** • Design the CO_2 pipeline with automatic emergency shut-off valves spaced at 5-mile (8.0-kilometer) intervals to reduce the quantity of gases that could be released in the event of a pipeline rupture. The affected area associated with a release event would be reduced approximately linearly with the reduction in the distance between the shut-off valves. Automatic shut-off valves could be placed at 3-mile (4.8-kilometer) or 1-mile (1.6-kilometer) intervals near populated areas to further reduce the quantity of gases that could be released from a pipeline rupture or puncture. • Thicker pipe walls or armored pipe guards could be used at water

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

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
		body and road crossings. • The Risk Assessment associated with the preparation of the EIS delineated potential areas affected by pipeline ruptures and punctures. Set-back areas could be specified for populated areas. Pipelines could also be routed to maximize the distance to populated areas and sensitive receptors. • Well head and pipeline protective barriers could be installed (e.g., chain-link fences and posts or barricades). • The pipeline would be buried to minimize accidental damage. Deeper burial of the pipeline (deeper than 3 feet [0.9 meters]) in areas with higher population densities could reduce the risk of damage caused by digging and trenching. • Bleed valves could be added to control location and direction of releases should a puncture occur. The valves may be able to be designed to maximize the production of dry ice, snow, which reduces the peak concentrations of pipeline gases. • The use of in-line inspection vehicles or intelligence pigs can detect very early evidence of corrosion. Increased monitoring for corrosion and frequent inspections and clean-outs could be implemented in populated areas, in addition to the Supervisory Control and Data Acquisition monitoring of pipeline pressure, temperature, and flow rate. • The quantity of ammonia stored on site could be decreased from a 30-day supply to a 2-week supply using two smaller tanks. • The transfers from the tanker truck to the pipeline leading to the tank could be conducted within a portable secondary containment system. • Inspection would be conducted of the tanker truck and connecting pipe valves.
Community Services	**Construction/Operations:** • No unavoidable adverse impacts would occur to community services. BMPs would be used to minimize impacts.	**Construction/Operations:** • No mitigation measures warranted.

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

Resource Area	Unavoidable Adverse Impacts	Possible Mitigation Measures
Socioeconomics	**Construction:** • Construction of the proposed facility would have unavoidable adverse impacts on residential properties located within, and adjacent to, the proposed power plant site property boundaries (Mattoon and Tuscola). BMPs should prevent any additional adverse impacts from construction and operations of the FutureGen Project. **Operations:** • Operation of the facility would have unavoidable adverse impacts on residents located very near the proposed power plant (Mattoon and Tuscola) through a potential unobstructed view of the facility, noise, and perhaps some dust or vibrations. The potential socioeconomic impact could be a reduction in property values for some homes very near or adjacent to the power plant.	**Construction:** • Purchase of the residences (two at Mattoon; three at Tuscola) would mitigate financial loss or other long-term impacts to residents from construction and operation of the FutureGen Project. • **Operations:** • See mitigation measures under aesthetics and noise.
Environmental Justice	**Construction/Operations:** • Construction and operation of the proposed facility are not anticipated to have any unavoidable adverse impacts related to environmental justice.	**Construction/Operations:** • No mitigation measures warranted.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Air Quality	• Water sprays from trucks could be used to control fugitive dust by wetting exposed soils during construction activities. • A phased construction period could be utilized to minimize vehicular emissions. • Plugging of identified abandoned wells within the injection area could be performed before the start of CO_2 injection operations, and plugging of injection wells at the conclusion of injection operations would be undertaken to prevent leakage of sequestered CO_2. • Trucks could be covered, equipment properly maintained, and the amount of vehicle trips and idling limited to minimize vehicular emissions.
Climate and Meteorology	• The facility would be designed to withstand high winds and extreme temperatures.
Geology	• Maintenance and monitoring of CO_2 injection wells would be performed to ensure they are operating properly. • Periodic mechanical integrity testing of injection well casings, tubing, and packers would be performed to prevent fluid movement through vertical channels adjacent to the injection well bores, and to detect any unexpected migration of CO_2 at the injection wells. • Monitoring of active or inactive wells that penetrate the primary seal within the subsurface ROI, including sealed and abandoned wells, would be conducted to detect leakage of CO_2 through these potential conduits. • Monitoring for microseismic events and increased pressures due to CO_2 injection would be performed to identify conditions that could cause fracturing of the sequestration formation and CO_2 escape. • A monitoring and tracking system for the CO_2 plume would be used to detect any unexpected migration of the CO_2 plume. • Remediation options for typical leakage scenarios at the CO_2 injection wells or abandoned wells would be developed before plant startup so that pipe ruptures, blow-outs, and leaks can be quickly identified and addressed.
Physiography and Soils	• Silt fences, sand bags, straw bales, trench plugs, and interceptor dikes would be utilized during construction to minimize soil erosion. • Soil wetting and phased construction would be utilized to reduce soil blowing. • Topsoil segregation during construction would minimize soil structure damage and allow the soil to be placed back into pre-construction uses (i.e., crop production). • Soils would be stabilized through post-construction revegetation and mulching of temporarily disturbed areas. • Permanently removed vegetation would be recycled to the extent practicable (e.g., mulch, pulp and paper products) to maximize re-utilization of these permanently lost resources. • Established Occupational Safety and Health Administration (OSHA) and EPA guidelines for labeling, segregation, and storage of hazardous materials would be used to minimize soil contamination from spills and handling.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Groundwater	• A Spill Prevention, Control, and Countermeasures Plan would be developed and implemented to minimize the potential for groundwater contamination due to uncontrolled or unmitigated releases of hazardous materials. • Monitoring systems would be installed at the sequestration site and areas within the subsurface ROI to detect CO_2 migration before it can come in contact with overlying groundwater resources. • Soil gas monitoring would be used to detect CO_2 migration into soils. • The lateral and vertical extent of the CO_2 plume would be monitored to detect any CO_2 migration beyond the sequestration reservoir.
Surface Water	• Engineering designs and construction techniques, required as part of the NPDES Permit and Stormwater Pollution Prevention Plan (SWPPP), would minimize surface water quality impacts. • Site design would incorporate stormwater treatment, effectively eliminating water quality impacts from contaminated stormwater runoff. • Silt fencing, storm sewer inlet/outlet protection, and use of sediment basins would be used to reduce the potential for sedimentation, turbidity, and runoff during construction. • Directional drilling under water bodies during underground utility pipeline construction would help reduce sedimentation, turbidity, and interruption of surface water flows. • Perpendicular crossings of streams within locations that could not be directionally drilled would reduce the linear impacts of construction. • Soils near surface water bodies would be stabilized through post-construction revegetation and mulching of temporarily disturbed areas to reduce additional sedimentation and runoff. • ***Hydrostatic test water would be obtained from bodies of water with sufficient volume and flow to supply required volumes for hydrostatic testing without significantly affecting downstream flow.***
Wetlands and Floodplains	• Engineering designs and construction techniques, required as part of the NPDES Permit and SWPPP, would minimize surface water quality impacts. • Silt fencing, hay bales, and other sediment and erosion control mechanisms would be used to minimize sedimentation into wetlands adjacent to construction sites. • Existing ROWs would be used whenever possible to limit impacts to previously disturbed wetlands or avoid wetland impacts. • Construction activities would be scheduled to occur during drier months to minimize the potential for impacts to floodplain soils and topographical features. • Equipment movement through and near wetland areas would be minimized to reduce the magnitude of temporary impacts. • The use of herbicides within or adjacent to wetlands would be limited to those approved for use in wetland areas. • Directional drilling would be used to reduce or avoid impacts to wetlands during pipeline construction.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Biological Resources	• Existing ROWs would be used whenever possible to confine impacts to previously disturbed terrestrial and aquatic habitats. • Standard pipeline construction practices, including silt fencing, hay bales, and other sediment and erosion control mechanisms, would be used to minimize impacts to aquatic habitat and species. • A soil erosion and sedimentation control plan would be implemented as required by applicable permits. • Equipment movement through and near riparian corridors would be minimized to reduce the magnitude of temporary impacts. • Construction activities would be scheduled for drier months to minimize the potential for impacts to aquatic habitats. • Directional drilling would be used to avoid impacts to aquatic habitat during pipeline construction. • Post-construction revegetation and mulching of temporarily disturbed areas would be conducted to decrease the recovery time for disturbed habitats. • ***Land clearing activities would be avoided during the peak nesting season (April 1-July 31) in order to avoid impacts to migratory birds. Additionally, surveys for raptors would be conducted if necessary.***
Cultural Resources	• If artifacts or other evidence of cultural resources were discovered during construction, operations in that area would cease and the area would be secured until the SHPO could be consulted regarding the discovery. • Consultation would occur with the caretakers of the cemetery located in the CO_2 pipeline corridor at the Jewett Site to determine BMPs needed to ensure that the cemetery remains undisturbed. At a minimum, the boundaries of the cemetery would be clearly marked and a buffer of 100 feet (30.5 meters) in all directions around the cemetery would be established within which no construction activity, including vehicular access or parking, would be allowed.
Land Use	• Careful selection of utility corridor routing during final design, particularly underground water and CO_2 lines, would be undertaken to minimize the potential for conflicts with the locations of existing oil, gas, and water wells. • Appropriate shoring of utility trenches and general BMPs during construction would minimize land use impacts throughout the corridors, especially in those areas where prime farmland exists. • Where utility corridors cross cropland (Mattoon and Tuscola), separation of topsoil during trenching and return of the topsoil to the top of the filled-in trench would be done to help maintain the productivity of the agricultural land following construction. • Farmland drain tiles on the Tuscola and Mattoon sites would be carefully replaced where they would be impacted by utility corridor construction.
Aesthetics	• Grading of stockpiled topsoil and reestablishment of native vegetation would be used to minimize landscape scarring after construction is complete.
Transportation and Traffic	• Traffic signal timing could be changed along designated corridors to accommodate necessary construction traffic. • Horizontal directional drilling would be utilized to run pipelines under roadways so that continued safe use of roadways could be achieved.
Noise and Vibration	• The number of heavy trucks passing by residential receptors would be regulated during construction. • Construction activities would likely occur during daytime hours and would comply with any local noise regulations related to construction.

Table 3-14. Possible BMPs to Minimize Potential Impacts from the FutureGen Project

Resource Area	Possible BMPs[1]
Utility Systems	• Existing utility locations would be mapped and checked before finalizing locations of new utility construction to avoid accidental disturbance of these existing underground utilities. • Inspectors would be employed to help ensure that construction does not interfere with existing lines. • In the event of an accident that damaged or severed an existing line, standard emergency procedures would be followed to notify the affected utility so that service is restored as soon as possible.
Materials and Waste Management	• Pollution prevention, waste minimization, and recycling measures would be used to reduce the amounts of waste generated. • Excess construction materials would be stored for potential later use to reduce amount of construction waste sent to landfills. • Recycling would be incorporated into construction and operations to minimize emissions and waste products.
Human Health, Safety, and Accidents	• A site safety plan that focuses on construction activities and provides for safety meetings would be prepared and implemented to help avoid injury during construction. • An OSHA-compliant Worker Protection Program would be established to effectively implement site safety plans, maintain Material Safety Data Sheets (MSDS), track chemical inventories, provide and track worker training, and assess and enforce site safety policies and procedures (e.g., worker personal protective equipment, spill prevention and control, noise monitoring, and construction safety). • Monitoring, cleanout, and inspection procedures for the CO_2 pipelines need to be developed and followed. These plans should include use of safety valves to isolate sections of the pipeline, bleed valves, and continuous pipeline monitoring with computer models to rapidly interpret changes in fluid densities, pressures, etc. • An emergency response plan with procedures to notify the public would be developed. • An SPCC plan would be prepared to describe spill prevention and control measures for the on-site ammonia storage tank and refilling operations. Daily inspection of the valves on the ammonia tank would be conducted to make sure that no leaks have occurred. All refilling operations would be conducted within a portable secondary containment system by trained workers only.
Community Services	The following fire protection measures would eliminate fire or explosion hazards at the power plant: • Good housekeeping practices would be utilized to control the accumulation of flammable and combustible waste materials and residues. • Chemicals would be properly stored to eliminate fire and incompatibility hazards. • MSDS would be available for consultation to determine the appropriate storage of incompatible chemicals. • All state and local fire codes would be adhered to during project operations. • Engineered safeguards and automatic fire suppression systems would be installed in all high risk areas.
Socioeconomics	• There are no BMPs related to Socioeconomics.
Environmental Justice	• There are no BMPs related to Environmental Justice.

[1] BMPs apply to all four candidate sites unless otherwise noted.

3.5 COMMITMENTS, USES, AND PRODUCTIVITY

3.5.1 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

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

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

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

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

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

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

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

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

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

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

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

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

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