DOE/EA-1626

FINAL ENVIRONMENTAL ASSESSMENT

Midwest Geological Sequestration Consortium (MGSC) Phase III Large-Scale Field Test

Decatur, Illinois

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U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
$\mu g/m^3$	Micrograms per Meter Cubed
µS/cm	Microsiemens per Centimeter
2D	Two Dimensional
3D	Three Dimensional
ADM	Archer Daniels Midland Company
ANSI	American National Standard Institute
AOR	Area of Review
AQCR 075	West Central Illinois Intrastate AQCR
AQCR	Air Quality Control Region
ATSDR	Agency for Toxic Substances and Disease Registry
BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
BMPs	Best Management Practices
CAA	Clean Air Act
CARB	California Air Resources Board
CCAR	California Climate Action Registry
CCS	Carbon Capture and Storage
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CF	Center Frequency
CFR	Code of Federal Regulations
CH_4	Methane
cm	Centimeter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted Decibel
DNL	Day-night Average Sound Level
DOE	U.S. Department of Energy
DST	Drill Stem Test
e.g.	*Exempli gratia*, for example
EA	Environmental Assessment
EDR	Environmental Data Resources
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EOR	Enhanced Oil Recovery
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
et al.	*et alia*, and others

et seq.	*et sequens*, and the following one or ones
etc.	*et cetera*, and so on
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
ft^3	Cubic Feet
GHG	Greenhouse Gas
HAARGIS	Historic Architectural/Archeological Resources
HAPs	Hazardous Air Pollutants
HFCs	Hydrofluorocarbons
hp	Horsepower
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory Model
Hz	Hertz
i.e.	*id est*, that is
IAC	Illinois Administrative Code
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IHPA	Illinois Historic Preservation Agency
IL	Illinois
ILCS	Illinois Compiled Statutes
IPCB	Illinois Pollution Control Board
IPCC	Intergovernmental Panel on Climate Change
IRGA	Infrared Gas Analyzer
ISGS	Illinois State Geological Survey
kg	Kilogram
km	Kilometer
kPa	Kilopascals
kW	Kilowatt
kWh	Kilowatt Hour
lbs.	Pounds
Ldn	Equivalent Day Night Level
Leq	Equivalent Sound Level
Lw	Sound Power Levels
m	Meter
m^2	Square Meter
m^3	Cubic Meter
MACT	Maximum Achievable Control Technology
mD	Millidarcy
MDT	Modular Formation Dynamics Tester
MGSC	Midwest Geological Sequestration Consortium
mm	Millimeter
MMV	Monitoring, Mitigation, and Validation
Mt.	Mount
MW	Megawatt
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act

NESHAP	National Emission Standards for Hazardous Air Pollutants
NETL	National Energy Technology Laboratory
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NSA	Noise Sensitive Area
NSPS	New Source Performance Standards
NSR	New Source Review
O_3	Ozone
OSHA	Occupational Safety and Health Administration
Pb	Lead
PEMAf	Palustrine, Emergent, Temporarily Flooded, Farmed
PFCs	Perfluorocarbons
$PM_{2.5}$	Particulate Matter Less than 2.5 Micrometers in Aerodynamic Diameter
PM_{10}	Particulate Matter of 10 Micrometers or Less in Aerodynamic Diameter
ppm	Parts per Million
ppmv	Parts per Million by Volume
PSD	Prevention of Significant Deterioration
psi	Pounds per Square Inch
psia	Pounds per Square Inch Absolute
psig	Pounds per Square Inch Gauge
PVC	Polyvinyl Chloride
PWL	Power Level
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
Rd.	Road
RRA	Resource Rich Area
SDWA	Safe Drinking Water Act
sec	Second
SF_6	Sulfur Hexafluoride
SHPO	State Historic Preservation Office or Officer
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
sqft	Square Feet
TEG	Triethylene Glycol
THPO	Tribal Historic Preservation Officer
TL	Transmission Loss
TMDL	Total Maximum Daily Load
tpy	Tons per Year
U.S.	United States

UIC	Underground Injection Control
UNFCCC	United Nations Framework Convention on Climate Change
USC	United States Code
USDA	U.S. Department of Agriculture
USDW	Underground Source of Drinking Water
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compounds
VSP	Vertical Seismic Profile

USE OF SCIENTIFIC NOTATION

Very small and very large numbers are sometimes written using scientific notation rather than as decimals or fractions. This notation uses exponents to indicate the power of 10 as a multiplier (i.e., 10^n, or the number 10 multiplied by itself n times; 10^{-n}, or the reciprocal of the number 10 multiplied by itself n times).

For example: $10^3 = 10 \times 10 \times 10 = 1{,}000$

$$10^{-3} = \frac{1}{10 \times 10 \times 10} = 0.001$$

In scientific notation, large numbers are written as a decimal between 1 and 10 multiplied by the appropriate power of 10:

4,900 is written $4.9 \times 10^3 = 4.9 \times 10 \times 10 \times 10 = 4.9 \times 1{,}000 = 4{,}900$.
0.049 is written 4.9×10^{-2}.
1,490,000 or 1.49 million is written 1.49×10^6.

A positive exponent indicates a number larger than or equal to one; a negative exponent indicates a number less than one.

1.0 INTRODUCTION

1.1 Summary

Carbon dioxide (CO_2) is a natural and important component of the atmosphere: animals and plants produce CO_2 during respiration, and plants need it for photosynthesis; however, high concentrations of CO_2 in the atmosphere can exert a "greenhouse" effect that traps heat within the Earth's atmosphere. Global emissions of CO_2 from human activity have increased from an insignificant level two centuries ago to over twenty-one billion metric tons per year by 2003 (DOE, 2007a). The most notable human activity associated with the generation of CO_2 emissions is the combustion of carbon-based fuels (including oil, natural gas, and coal). Many scientists, including the Intergovernmental Panel on Climate Change (IPCC), recognize a danger that even a modest increase in the Earth's temperature (called "global warming") could alter the global climate and cause significant adverse consequences for human health and welfare (DOE, 2007a).

In one of many governmental efforts to address the concerns outlined above, the Department of Energy (DOE) established the Carbon Sequestration Program in 1997 with the focus of conducting research and development (R&D) activities to evaluate and develop carbon sequestration technologies. Carbon sequestration involves capturing and storing CO_2 emissions prior to release into the atmosphere, as well as enhancing natural carbon uptake and storage processes. Geologic sequestration involves the permanent storage of CO_2 in deep unmineable coal seams, depleted oil and gas reservoirs, or saline (saltwater-filled) formations. Impermeable caprocks and/or geologic structural or stratigraphic traps retain the CO_2 in the formation similar to natural gas storage trapping mechanisms. As a part of this program, DOE formed a nationwide network of regional partnerships to help determine the best approaches for capturing and permanently storing gases that can contribute to global climate change. The Regional Carbon Sequestration Partnerships are a government/industry effort tasked with determining the most suitable technologies, regulations, and infrastructure needs for carbon capture, storage, and sequestration in different areas of the country. The regional partnerships' initiative is being implemented in three phases:

- Phase I, Characterization (2003-2005): Characterized opportunities for carbon sequestration, including potential geologic storage formations and trapping mechanisms;
- Phase II, Validation (2005-2009): Small scale field tests are currently under way to verify the injection rates, storage media, and trapping mechanisms; and
- Phase III, Deployment (2008-2017): Conduct large volume carbon storage validation tests.

Geographical differences in fossil fuel use and available sequestration sinks across the United States dictate regional approaches to sequestration of CO_2 and other greenhouse gases. The seven partnerships that currently form this network include over 350 state agencies, universities, and private companies, spanning 41 states, two Indian nations, and four Canadian provinces. In addition, agencies from six member countries of the Carbon Sequestration Leadership Forum are participating in the Validation Phase field tests. The Midwest Geological Sequestration Consortium (MGSC) is one of these regional partnerships and this Environmental Assessment (EA) focuses on one of its proposed projects.

The current annual CO_2 emissions in the MGSC region are 336 million short tons (304 million metric tons). Previous research indicates that the target Mount (Mt.) Simon Sandstone has an estimated 29.8 to 119.4 billion short tons (27.1 to 108.6 billion metric tons) of CO_2 storage capacity. The low end of this capacity is enough to hold half of the region's estimated CO_2 emissions for the next 100 years, which would be 16.6 billion short tons (15.1 billion metric tons) sequestered (NETL, 2008a).

DOE proposes to co-fund an $84,274,927 project located on property of the MGSC partner Archer Daniels Midland Company (ADM). DOE's 79.2% share is $66,730,912 and the non-DOE 20.8% share is $17,544,015. The Decatur ADM Complex is on the east side of the city of Decatur, Illinois, in Macon County. The overall objective of this project would be to demonstrate the ability of the Mt. Simon Sandstone, a major regional saline reservoir in the Illinois Basin, to accept and retain approximately 1.1 million short tons (1 million metric tons) of CO_2 injected over a period of three years.

The major efforts of this proposed project would include:

- Regional geologic characterization,
- Public outreach and education,
- Permitting and NEPA compliance,
- Site geologic characterization and modeling,
- Well drilling and completion,
- Infrastructure development,
- CO_2 procurement,
- Transportation and injection operations,
- Operational and environmental monitoring,
- Site closure,
- Post injection monitoring and modeling,
- Project assessment, and
- Post-test site planning (MGSC, 2008).

New construction would include a surface facility, an approximately 3,000-foot (914 meter (m)) long pressurized pipeline, and 2,000 feet (609 m) of ductwork carrying uncompressed CO_2. The facility would include the CO_2 compression and dehydration equipment necessary to capture and condition the CO_2 from the ADM ethanol production plant. The facility would be capable of delivering approximately 1.1 million short tons (1 million metric tons) of CO_2 over a three-year period. The pressurized pipeline would deliver the CO_2 from the compression-dehydration facility to the injection well. Prior to construction of the facility, all required permits would be obtained from the Illinois Environmental Protection Agency (IEPA) and other appropriate regulatory authorities.

The outlet CO_2 stream from the fermentor section of the ethanol production plant typically contains greater than 99% pure CO_2, saturated with water vapor at 80 degrees Fahrenheit (ºF) (approximately 27 degrees Celsius (°C)) and atmospheric pressure. Common impurities in the fermentor gas stream are hydrocarbons, nitrogen, and acetaldehyde in concentrations typically less than 200 parts per million by volume (ppmv). Other impurities in lesser amounts can include ethyl acetate, ethanol, oxygen, methanol, and hydrogen sulfide (Fisher, 2008).

The compression-dehydration facility includes an inlet water knockout prior to the first phase of compression. The first phase of compression would use one or more electrically driven screw compressors to compress the low pressure CO_2 from atmospheric pressure to 290 - 315 pounds per square inch absolute (psia) (2000 - 2170 kilopascals (kPa)). Cooling of the CO_2 after the initial compression phase would be achieved using an air-cooled exchanger or water-cooled shell-and-tube heat exchanger (Fisher, 2008).

A water knockout would be necessary before the 290 - 315 psia (2000 - 2170 kPa) CO_2 stream is routed to the next stage of compression. After being compressed to approximately 800 pounds per square inch gauge (psig) (5,516 kPa), the CO_2 will pass through the final stage of inter-cooling and water knockout, and then into a triethylene glycol (TEG) dehydrator system.

Water-saturated CO_2 would be fed to the bottom of an absorber tower containing structured packing where it would contact TEG counter-currently. The water laden “rich” TEG would leave the bottom of the absorber and would cross exchange with “lean” TEG in a heat exchange that cools the lean TEG on its way to the top of the absorber.

A propane-fired heater would heat the TEG to remove water vapor and regenerate the TEG in the stripper (Fisher, 2008). The dehydrated CO_2 would exit the top of the absorber and go to the final stage of compression, bringing the pressure to approximately 1200 - 1400 psig (8,274 – 9,653 kPa). If higher pressures are needed, the supercritical CO_2 will be pumped to the final required pressure using a multi-stage centrifugal pump (Fisher, 2008).

The pipeline that would transfer the CO_2 from the compression-dehydration facility to the CO_2 injection well would be a 4-inch to 6-inch (10.16 centimeter (cm) to 15.24 cm) diameter schedule 40 or 80 steel pipe designed to meet standards for the temperature and pressure of the CO_2 stream. The pipeline would be installed aboveground, following as much as possible the current pipeline alleys at the Decatur ADM Complex. The pipeline would be located only on ADM property.

The decision for DOE is to either fund or not fund the Proposed Action including the associated drilling and injection activities. ADM would not pursue the drilling and injection activities if DOE’s decision is to not fund the Proposed Action. Table 1.1 below is based on that premise.

Table 1.1. Comparison of Impacts		
Resource	**No-Action Alternative**	**Proposed Action**
Air Quality	No impacts, except the loss of beneficial impacts from reducing greenhouse gas, are expected.	Short-term, minor impacts would be limited to temporary diesel emissions and limited air emissions from a dehydration reboiler. The project would not produce emissions that would impede the area's conformity with the State Implementation Plan under the Clean Air Act. In contrast, there would be some beneficial impacts due to the reduction of greenhouse gas emissions.
Geology and Soils	No impacts	Some long-term increase in subsurface pressures due to CO_2 injection would be expected; however, the Proposed Action would not be expected to cause any measurable leakage of CO_2 from the storage formation to the surface or into another area in the subsurface. There is no more than an imperceptible risk of inducing seismic events due to increased reservoir pressure.
Water Resources	No impacts	The Proposed Action may cause some modest increase in water usage due to the drilling of injection and monitoring wells; however, any changes to water quality and quantity would likely be at the lowest detectable levels and full recovery of the resource would likely occur in a reasonable time*.
Wetlands	No impacts	No substantial impacts to local wetlands would be expected. Any unexpected impacts to wetlands would be confined to the immediate project area and would not cause any regional impacts.

Table 1.1. Comparison of Impacts

Resource	No-Action Alternative	Proposed Action
Terrestrial Vegetation	No impacts	The injection site is fallow. No critical habitats are present. Changes would be limited to a small area and would not be expected to affect the viability of the resources.
Wildlife	No impacts	Some local disturbance and displacement of wildlife may occur; however, any changes to wildlife would be limited to a small portion of the population and would not be expected to affect the viability of the resource. Full recovery would occur in a reasonable time, considering the size of the project and the affected species' natural state.
Land Use	No impacts	Impacts to land use, if any, would be localized and limited to the immediate project area.
Population	No impacts	The effect on size and demographic characteristics of the local population, if any, would be minimal.
Employment and Income	No impacts	The effect on the local economy, labor conditions, and availability of production or consumer resources, if any, would be primarily beneficial, temporary, and of short duration.
Infrastructure	No impacts	Some minor impacts to the existing traffic patterns and level of congestion could be expected during drilling and construction activities; however, no long-term impacts in the immediate or surrounding area are expected.
Parks and Recreation	No impacts	Minimal impact to recreational activities in the immediately surrounding area but any disturbance would be minor, temporary in duration, and in character with existing uses of the project area including a nearby park.

Table 1.1. Comparison of Impacts		
Resource	**No-Action Alternative**	**Proposed Action**
Visual Resources	No impacts	The Proposed Action site is a previously disturbed industrial site. The project is unlikely to change visual landscape in a way that would be objectionable to local residents or frequent visitors.
Noise	No impacts	Temporary minor noise impacts are expected during construction and drilling. During operation, there may be minor increases in operational noise; however, noise levels in the project area are not expected to exceed ambient noise level standards as determined by the Federal, state, and/or local government.
Environmental Justice	No impacts	No disproportionately high or adverse impacts to minority or low-income communities are expected.
Human Health and Safety	No impacts, except the loss of an opportunity to reduce greenhouse gas emissions, are expected.	The project, operated in accordance with state and Federal regulations, would pose no more than a minimal risk to the health and safety of on-site workers and the local population.
Cultural Resources	No impacts	The project area is previously disturbed, and no cultural resources have been found. No substantial impacts are expected.
Waste Management	No impacts	The action is not expected to cause air, water, or soil to be contaminated with any hazardous material that poses a threat to human or ecological health and safety.

* Recovery in a reasonable time: Constant, sustainable improvement is apparent and measurable when the site is routinely observed, and full recovery is achieved over a period of no more than several years.

1.2 Purpose and Need

The DOE's National Energy Technology Laboratory (NETL) has a mission to implement a research, development, and demonstration program to resolve the environmental, supply, and reliability constraints of producing and using fossil energy sources. One aspect of that mission, the resolution of environmental constraints to producing and using fossil fuels, now requires NETL to review and, where possible, mitigate projected impacts to global climate change caused by the use of fossil fuels. One possible mitigation technique under review is the capture and long-term removal of CO_2 from the atmosphere through a process called carbon sequestration. NETL is implementing the DOE Carbon Sequestration Program, which was established in 1997 to evaluate and develop carbon sequestration technologies. The focus of this Carbon Sequestration Program involves capturing and storing CO_2 emissions prior to release into the atmosphere, as well as enhancing natural carbon uptake and storage processes. The principal goal of the Carbon Sequestration Program is to gain a scientific understanding of carbon sequestration options and to provide cost-effective, environmentally sound technology options that ultimately may lead to a reduction in greenhouse gas intensity and stabilization of atmospheric concentrations of CO_2 (DOE, 2007a). One of those options, geologic sequestration, involves the placement of CO_2 or other greenhouse gases into subsurface porous and permeable rocks in such a way that they remain permanently stored.

In 2003, DOE selected seven regional partnerships, consisting of stakeholders in geographic regions across the United States and Canada, to evaluate and pursue opportunities for carbon sequestration infrastructure development. The MGSC is one such partnership, which focuses on sequestration opportunities in the Illinois Basin and includes the states of Illinois, Kentucky, and Indiana. During the first phase, or Characterization Phase, the MGSC characterized the Illinois Basin's opportunities to store CO_2 in deep saline formations, unmineable coal seams, and depleted oilfields.

At the end of Characterization Phase in 2005, the MGSC identified promising opportunities for sequestration projects. During Phase II of the project, or Validation Phase (now underway), the MGSC is working on several small-scale carbon sequestration field projects. For example, they have completed the injection of CO_2 at the Louden Oilfield in southern Illinois to evaluate carbon sequestration with enhanced oil recovery (EOR). The partnership hopes to complete three additional EOR field projects and one coal seam sequestration project by September 2009. The lessons learned from the first two phases of the regional partnership initiative by the MGSC have enabled the partnership to select a promising location for the large-scale field test based on the regional characterization work.

The ADM Phase III Test Site is on the property of ADM on the east side of the city of Decatur, Illinois, and would use ADM's existing ethanol fermentation operation there as the source of CO_2. A detailed pre-injection site assessment and drilling of one well would enable the MGSC to characterize the site and ensure its suitability. The knowledge gained during the Phase II field projects have supported the design of a state-of-the-art large-scale storage project with a number of regional and national organizations providing field services, simulation efforts, and monitoring support that would not have been possible without the previous investment. A map of the regional carbon sequestration partnerships is on the next page.

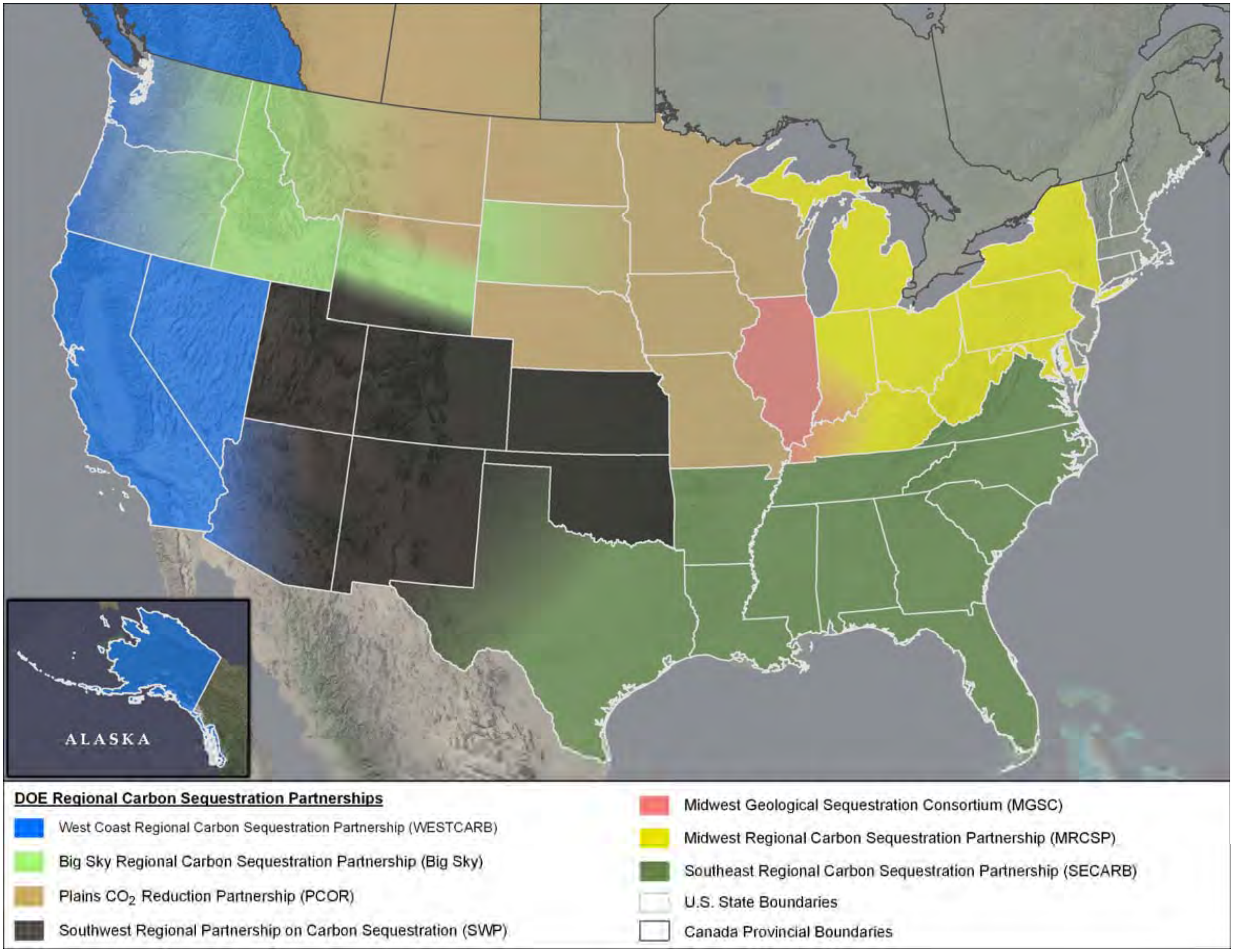


Figure 1.2. Map of Regional Carbon Sequestration Partnerships

During the Deployment Phase, or Phase III, the **purpose** of the proposed MGSC project would be to demonstrate the ability of the Mt. Simon Sandstone to accept and retain approximately 1.1 million short tons (1 million metric tons) of injected CO_2 over a three year period, thus testing large-scale sequestration sooner than might otherwise be possible. Phase III focuses on:

- Testing the acceptance of the CO_2 by the deep saline reservoir (injectivity);
- The ability of the reservoir to store CO_2 (storage capacity);
- The seal integrity of the entire site (to ensure that CO_2 does not leak to the surface or other sub-surface formations); and
- The entire process of pre-injection characterization, injection process monitoring, and post-injection monitoring to understand the CO_2 fate (monitoring, mitigation, and validation (MMV)) (MGSC, No date).

Although the processes of geologic sequestration are relatively well known, there is a **need** for additional research to fill gaps in our scientific understanding of carbon sequestration; ensure the protection of human health and the environment; reduce costs; and facilitate the full-scale deployment of this technology. Extensive laboratory investigations, modeling studies, and limited small-scale field studies assessed how CO_2 geologic sequestration would work in the subsurface. Comparing predictions from bench scale tests and numerical models with field results is necessary to validate the models and demonstrate that scientific understanding is correct (DOE, 2003).

While the oil and gas industry has years of extensive experience with CO_2 injection for EOR, this information is inadequate for validating CO_2 sequestration because the fate of the injected CO_2 has not been routinely quantified. CO_2 injected for EOR can be absorbed in the oil, held by capillary forces in pore space, trapped by buoyancy forces in stratigraphic or structural compartments, dissolved in pore water, produced and reused, or leaked from the injection zone through the soils and/or penetrations. The absence of data to account for CO_2 fate in the complex EOR system leaves a gap in scientific understanding (DOE, 2003).

Two-thirds of the United States has deep saline formations beneath landmasses and the ocean's continental shelf. These formations have an estimated CO_2 storage capacity of up to 3.5 trillion short tons. Many of these formations are located in close proximity to major point sources of CO_2 emissions, such as fossil-fuel power plants, which offer the benefit of reducing costs for transportation of CO_2 to the injection site. This proposed large-scale field project would help to answer uncertainties associated with the reactions that may occur between CO_2, brine, and minerals in the surrounding strata (DOE, 2007a).

Two key issues distinguish CO_2 sequestration in saline formations from sequestration in oil and gas fields. First, oil and gas fields result from the presence of a geologic structural or stratigraphic trap that acts as a seal, keeping oil and natural gas from leaking from the reservoir. These same types of traps are likely to retain sequestered CO_2 when injected into the depleted oil or gas reservoir. Identification of such effective traps may be more difficult in aqueous formations due to the lack of a detailed knowledge base on many of these formations and their caprocks, which may require new approaches for establishing the integrity and extent of a caprock. Second, injection of CO_2 into a saline formation is not usually accompanied by removal of water from the formation. In the case of EOR, oil and brine are simultaneously withdrawn while CO_2 is injected. Injection of CO_2 into a saline formation, on the other hand, would lead to an increase in formation pressure.

The project, under carefully controlled and monitored conditions, will determine whether, and to what extent, large-scale pressurization would affect caprock integrity, cause land surface deformation, and induce seismic hazards. Successful large-scale application of this technology demands that these potential effects, regardless of the probability of their occurrence, must be better understood to design safe and effective sequestration in saline formations. Another possible issue pertains to the acceptable leakage rate from the formation into overlying strata (DOE, 2007a).

Injection into a deep saline formation and potential leakage into overlying formations is a relevant, even if possibly unlikely concern, particularly where drinking water sources are in the vicinity. Most studies to date have been concerned with breaching the caprock; formation capacity and injectivity; and CO_2, water, and host/seal rock interaction. Less work has been done to understand the possible effects of displacing the saline water from the deeper basin into shallower outcrops, subcrops, or into freshwater regions of the same formation. This proposed large-scale field project would provide data that would contribute to the better understanding of the magnitude and probability of risks associated with brine movement caused by CO_2 injection (DOE, 2007a).

To address and better understand these experience and knowledge gaps, DOE is co-sponsoring a field experiment in a high-porosity, high-permeability formation similar to those that could eventually be used to sequester large volumes of CO_2. The Proposed Action would be closely monitored to determine whether the CO_2 remains within the injection zone and to maximize scientific understanding.

If funded, the Proposed Action would:

- Reduce greenhouse gas emissions on a local scale and contribute significantly to broader knowledge that will reduce global warming on a larger scale,
- Ensure that health and safety and environmental risks are minimized,
- Obtain results quickly so that experience can be used in moving to large pilots in other parts of the world, and
- Optimize costs preceding full scale deployment.

The test location would provide an opportunity for matching numerical model results with field observations under conditions of high volume injection at a scale similar to what would be done if CO_2 from power plants were captured and sequestered.

1.3 Legal Framework

The legal framework for this EA involves both *substantive* legal requirements (what must be done or not done) and *procedural* legal requirements (how the agency must carry out its responsibilities). DOE has prepared this EA in accordance with the Council on Environmental Quality (CEQ) "Regulations for Implementing the Procedural Provisions of the National

Environmental Policy Act," codified in Title 40 of the *Code of Federal Regulations* in Parts 1500 through 1508 (40 CFR 1500-1508). These implement the procedural requirements of the National Environmental Policy Act (NEPA), found in Title 40 of the *United States Code* in Section 4321 and following sections (42 USC § 4321 *et seq*.).

NEPA *requires* Federal agencies to consider the potential environmental consequences of a Proposed Action in their decision-making processes. NEPA *encourages* Federal agencies to protect, restore, or enhance the environment through well-informed Federal decisions. The CEQ NEPA regulations specify that an EA be prepared to:

- Provide sufficient analysis and evidence for determining whether or not to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).
- Aid in an agency's compliance with NEPA when no EIS is deemed necessary.
- Facilitate EIS preparation when one is necessary.

Further, the CEQ NEPA regulations encourage agencies to integrate NEPA requirements with other environmental review and consultation requirements. Relevant environmental requirements are contained in other Federal statutes, such as the Clean Air Act and the Clean Water Act, and their state counterparts. The following Federal and state statutes and regulations are relevant to this EA. Federal and state permits that may be required are also listed.

Clean Air Act

The Clean Air Act (CAA), 42 USC § 7401 *et seq.*, establishes the National Ambient Air Quality Standards (NAAQS) developed by the U.S. Environmental Protection Agency (USEPA) for the pervasive pollutants: sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), lead (Pb), and particulate matter (both PM_{10} and $PM_{2.5}$). The NAAQS are expressed as concentrations of the criteria pollutants in the ambient air, the outdoor air to which the general public is exposed. The CAA also contains emission control permit programs to protect the nation's air quality and establishes New Source Performance Standards that establish design standards, equipment standards, work practices, and operational standards for new or modified sources of air emissions. Where the NAAQS emphasize air quality in general, the New Source Performance Standards focus on particular industrial categories or sub-categories (e.g., fossil fuel fired generators, grain elevators, and steam generating units). Regulations implementing the CAA are found in 40 CFR Parts 50-95. Illinois has been delegated CAA authority under Chapter 415 of *Illinois Compiled Statutes* (ILCS) Section 5/3 and following sections (415 ILCS § 5/3 *et seq*.) (<u>Note</u>: Provisions dealing with Regulations (415 ILCS §5/26 *et seq*.), Enforcement (415 ILCS § 5/30 *et seq*.), Variances (451 ILCS § 5/35 *et seq*.), and Permits (415 ILCS § 5/39 *et seq*.) apply to all of the authority within Chapter 415 of ILCS that follow).

Clean Water Act

The Clean Water Act (CWA), 33 USC § 1251 *et seq.*, establishes a comprehensive framework of standards, technical tools, and financial assistance to address "point source" pollution from municipal and industrial wastewater discharges and "nonpoint source" pollution from urban and rural areas. Applicants for federal licenses or permits to conduct any activity that may result in a discharge to navigable waters must provide the Federal agency with a state CWA Section 401 certification that the discharge would comply with applicable provisions of the CWA. CWA Section 404 establishes a permit program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. CWA Section 402 establishes the National Pollutant Discharge Elimination System (NPDES), which requires point sources of pollutants to obtain permits to discharge effluents and storm water to surface waters. Regulations for implementing relevant CWA programs are found in 33 CFR Parts 320-331 and 40 CFR Parts 400-503. Illinois has been delegated CWA authority under 415 ILCS §§ 5/11 and 5/19.1 *et seq*., and 20 ILCS § 830.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), 42 USC 300 *et seq.*, gives USEPA the responsibility and authority to regulate public drinking water supplies by establishing drinking water standards, delegating authority for enforcement of drinking water standards to the states, and protecting aquifers from hazards such as injection of wastes and other materials into wells. Important for this EA are the SDWA provisions relating to injection wells. Congress passed the Safe Drinking Water Act in 1974. In part, the SDWA requires USEPA to develop minimum federal requirements for Underground Injection Control (UIC) programs and other safeguards to protect public health by preventing injection wells from contaminating underground sources of drinking water. Illinois has been delegated SDWA authority under 415 ILCS §§ 5/19.1 *et seq*. and 55/1 *et seq*. On July 31 2008, USEPA proposed draft regulations for a UIC program modification specifically developed for CO_2 geologic sequestration (73 FR 43491).

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 *et seq.*, regulates the treatment, storage, and disposal of solid and hazardous wastes. RCRA sets "cradle to grave" standards for both solid waste and hazardous waste management. Certain wastes are specifically excluded because they are regulated under other statutes. Some examples are domestic sewage and septic tank waste; agricultural wastes; industrial discharges; some nuclear wastes; and mining overburden. RCRA regulations are found in 40 CFR Parts 239-282. Illinois has been delegated RCRA authority under 415 ILCS § 5/20 *et seq*.

Comprehensive Environmental Response, Compensation, and Liability Act/Emergency Planning and Community Right-to-Know Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC § 9601 *et seq*., also known as "Superfund," established a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA also establishes requirements for closed and abandoned hazardous waste sites, provides for the liability of persons responsible for the release of hazardous substances, and established a trust fund to pay for orphan facility cleanup and closure. Regulations for implementing CERCLA are found in 40 CFR Parts 300-312.

The Emergency Planning and Community Right-to-Know Act (EPCRA), 42 USC § 1001 *et seq.*, requires Federal agencies to provide information on hazardous and toxic chemicals to state emergency response commissions, local emergency planning committees, and USEPA. EPCRA's goal is to provide this information to ensure that local emergency plans are sufficient to respond to unplanned releases of hazardous substances. Regulations implementing EPCRA are found in 40 CFR Parts 350-374. Illinois EPCRA authority is found in 415 ILCS § 5/20 *et seq*. and § 5/25b-1 *et seq*.

National Historic Preservation Act

The National Historic Preservation Act (NHPA), 16 USC § 470 *et seq.*, requires DOE to consult with the State Historic Preservation Officer (SHPO) prior to any construction to ensure that no historical properties would be adversely affected by a proposed project. DOE must also afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed project. Regulations for implementing NHPA are found in 36 CFR 800-812. Illinois historic preservation authority is found in 20 ILCS § 3420/1 *et seq*.

Archaeological Resources Protection Act

The Archaeological Resources Protection Act, 16 USC § 470aa *et seq.*, requires a permit for excavation or removal of archaeological resources from publicly held or Native American lands. The Act requires that excavations further archaeological knowledge in the public interest and that the resources removed remain the property of the United States. Regulations for implementing the Act are found in 43 CFR 7 and 36 CFR 296. Illinois archaeological protection authority is found in 20 ILCS § 3420/1 *et seq*.

American Indian Religious Freedom Act

The American Indian Religious Freedom Act, 42 USC § 1996, establishes policy to protect and preserve the inherent and Constitutional right of Native Americans to believe, express, and exercise their traditional religions. The law ensures the protection of sacred locations; access of Native Americans to those sacred locations and traditional resources that are integral to the practice of their religions; and establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by construction and operation of proposed facilities. Regulations for implementing the Act are also found in 43 CFR 7. Illinois Native American protection authority is found in 20 ILCS § 3420/1 *et seq*.

Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act, 25 USC § 3001, directs the Secretary of the Interior to guide the repatriation of federal archaeological collections and collections that are culturally affiliated with Native American tribes and held by museums that receive federal funding. DOE would follow the provisions of this Act if any excavations associated with the proposed construction led to unexpected discoveries of Native American graves or grave artifacts. Regulations for implementing the Act are found in 43 CFR 10. Illinois Native American protection authority is found in 20 ILCS § 3420/1 *et seq*.

Endangered Species Act

The Endangered Species Act (ESA), 16 USC 1531 *et seq.*, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants, as well as the preservation of the ecosystems on which they depend. ESA Section 7 requires any federal agency authorizing, funding, or carrying out any action to ensure that the action is not likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of critical habitat of such species. Regulations implementing the ESA interagency consultation process are found in 50 CFR Part 402. Illinois endangered species protection authority is found in 520 ILCS § 10/1 *et seq*.

Fish and Wildlife Conservation Act/Fish and Wildlife Coordination Act

The Fish and Wildlife Conservation Act, 16 USC § 2901 *et seq.*, encourages Federal agencies to conserve and promote conservation of non-game fish and wildlife species and their habitats. In addition, the Fish and Wildlife Coordination Act, 16 USC § 661 *et seq.*, requires Federal agencies undertaking projects affecting water resources to consult with the United States (U.S.) Fish and Wildlife Service and the state agency responsible for fish and wildlife resources. Compliance with these statutes is internalized in the DOE NEPA process. Illinois fish and wildlife authority is found in 515 ILCS § 5/5-5 *et seq*. and 520 ILCS §§ 20 and 25.

Noise Control Act

The Noise Control Act of 1972, 42 USC § 4901 *et seq.*, directs federal agencies to carry out programs in their jurisdictions to the fullest extent within their authority and in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare. This would involve complying with applicable municipal noise ordinances to the maximum extent practicable. Illinois regulates noise at the state level with authority found in 415 ILCS 5/23 *et seq*.

Farmland Protection Policy Act

The Farmland Protection Policy Act, 7 USC § 4201 *et seq.*, directs federal agencies to identify and quantify adverse impacts of Federal programs on farmlands in order to minimize the unnecessary and irreversible conversion of agricultural land to non-agricultural uses. Regulations implementing the Act are found in 7 CFR 658. Illinois farmland protection authority is contained in 505 ILCS §§ 5 and 75.

Occupational Safety and Health Act

The Occupational Safety and Health Act, 29 USC § 651 *et seq.*, requires employers to furnish employees employment and a place of employment that are free from recognized hazards that are causing or are likely to cause death or serious physical harm to the employees, and to comply with occupational safety and health standards promulgated by the Occupational Safety and Health Administration (OSHA). OSHA standards are implemented under regulations found in 29 CFR Parts 1900-2400. Illinois regulates OSHA requirements through authority found in 820 ILCS § 225 *et seq*.

Pollution Prevention Act

The Pollution Prevention Act, 42 USC § 13101 *et seq.*, establishes a national policy for waste management and pollution control that focuses first on source reduction, and then on environmentally safe waste recycling, treatment, and disposal. Three executive orders provide guidance to agencies to implement the Pollution Prevention Act: Executive Order 12873, "Federal Acquisition, Recycling, and Waste Prevention," Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition," and Executive Order 13148, "Greening the Government through Leadership in Environmental Management."

Federal Aviation Administration Act

49 USC §§ 106(f) and (g) give the Administrator of the Federal Aviation Administration (FAA) a number of powers, including the authority to regulate objects affecting navigable airspace. Regulations requiring FAA notification if any structure of more than 200 feet (60.96 m) high would be constructed are found in 14 CFR Part 77. The FAA then determines if the structures would or would not be an obstruction to air navigation. Illinois regulates navigable airspace under authority found in 620 ILCS §25 *et seq*.

Executive Orders

A number of presidential executive orders in addition to those noted above provide additional guidance to Federal agencies in developing EAs, including this EA. The most relevant of them include:

- Executive Order 11514, "Protection and Enhancement of Environmental Quality"
- Executive Order 11988, "Floodplain Management"
- Executive Order 12856, "Right to Know Laws and Pollution Prevention Requirements" Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"
- Executive Order 13112, "Invasive Species"
- Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"
- Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management"

Federal executive orders can be accessed at: http://www.archives.gov/federal-register/codification/.

Federal and State Permitting

The following are potentially applicable federal and state permitting requirements to construct and operate the proposed facilities.

- Acid Rain Permit, 40 CFR Part 72
- Airspace Obstruction Control Permit, 14 CFR Part 77
- Clean Air Act Prevention of Significant Deterioration Permit, Acid Deposition Control Permit, and Operating Permit, 40 CFR Parts 50-96
- Clean Water Act, Section 401 Certification, Section 402 NPDES Permit, Section 404 Wetlands Permit, and Pretreatment Authorization for Discharge of Wastewater to Municipal Collection System, 40 CFR Parts 104-140, 403
- Safe Drinking Water Act Underground Injection Control Permit, 40 CFR Part 144
- Rivers and Harbor Act Permit, 33 CFR Part 322
- Notice to the Federal Aviation Administration, 14 CFR Part 77
- RCRA, 40 CFR Parts 239 through 299
- Sales Tap Approval, 18 CFR 157.211, approval would be required to tap into or modify existing interstate gas pipelines.

Illinois State Permits

- Accommodation of Utilities on Right-of-Way, 92 Illinois Administrative Code (IAC) Part 530
- Air Construction Permit, 35 IAC Parts 201 and 203
- Air Operating Permit, 35 IAC Part 201, 203 and 205
- Certificate of Public Convenience and Necessity, Section 3-105 and 8-406 of the Illinois Public Utilities Act
- Interconnection Agreement from the Illinois Commerce Commission may be required.
- NPDES Permit, 35 IAC Part 309, 35 IAC, Subtitle C, Chapter 1
- Permit for Groundwater Monitoring Wells, 77 IAC 920
- Permit for Nonhazardous Onsite Waste Disposal Facility, 35 IAC Parts 812 and 813
- Potable Water Supply Connection Permits, ILCS, Chapter 415
- Prevention of Significant Deterioration (PSD) Permit, 40 CFR 52.21
- RCRA Permit Program, 35 IAC 702 and 703
- UIC Permit, 35 IAC Parts 704 and 730
- Wastewater Facility Construction Approval, ILCS, Chapter 415

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

DOE is proposing to provide cost-shared funding for an $84,274,927 project, including $66,730,912 in a federal fund cost-share, to demonstrate the ability of the Mt. Simon Sandstone, a major regional saline reservoir in the Illinois Basin, to accept and retain approximately 1.1 million short tons (1 million metric tons) of CO_2 injected over a period of three years (MGSC, 2008).

Table 2.1. MGSC Project Timeline

Activity	2008	2009	2010	2011	2012	2013	2014	2015
Site Characterization and Development								
Injection and Monitoring Operations								
Site Closure and Assessment								

The project would include the construction of a surface facility, an approximately 3,000-foot (914.4 m) long pressurized pipeline, and 2,000 feet (609.6 m) of ductwork carrying uncompressed CO_2. The facility would contain CO_2 compression and dehydration equipment necessary to capture and condition CO_2 from the ADM ethanol production plant. The pipeline would deliver the CO_2 from the compression-dehydration facility to the injection well. Installation of verification wells would result in similar operational activities as the CO_2 injection well (MGSC, 2008).

The pipeline that would transfer the CO_2 from the compression-dehydration facility to the CO_2 injection would be 4-inch to 6-inch (10.16 cm to 15.24 cm) diameter schedule 40 or 80 steel pipe designed to meet standards for the temperature and pressure of the CO_2 stream. The pipeline would be installed primarily aboveground with a small portion of undetermined length installed underground near the injection well. The pipeline would follow as much as possible the current pipeline alleys at the Decatur ADM Complex (MGSC, 2008).

Reservoir modeling would incorporate data developed during the pre-injection site assessment period, data developed from the initial well drilled on the injection site, and data collected as injection proceeds. The MGSC would initially characterize the project site using orthogonal two-dimensional (2D) seismic lines to confirm the geological structure at the site and to test for any seismically resolvable faults that may exist. A well would then be drilled through the entire Mt. Simon Sandstone to the underlying granitic basement, followed by extensive logging, core sampling, and fluid sampling to build a comprehensive site reservoir model. The model would enable understanding of injected CO_2 distribution and potential reactivity of the CO_2 and CO_2-laden brine with the reservoir and the seals. The model would be expanded using a baseline three dimensional (3D) seismic survey and would help predict where additional geophysical surveys should be taken as CO_2 is injected (MGSC, No date).

The proposed project would continue to refine previously developed MMV techniques and incorporate new technologies to understand potential leakage pathways of the larger scale test, provide post-injection monitoring, and provide assurance that health and safety requirements are fully taken into account (MGSC, No date).

2.1.1 Project Location

The ADM Phase III Test Site would be on the east side of the city of Decatur, Illinois, in Macon County (Figure 2.1.1-1). This site would be located in Section 5 of Township 16 North Range 3 East, surveyed from the 3rd Principal Meridian, and on flat terrain within the Decatur ADM Complex. The compression-dehydration facility would be located within the industrial complex to the south of the proposed injection well site (Figure 2.1.1-2). A pipeline would transport CO_2 as a supercritical fluid from the compression facility to the injection well following, as much as possible, an existing pipeline alley and overhead catwalk that allows the pipeline to cross the railroad track, and would be protected from accidental injury following ADM current construction policies (MGSC, 2008).

The ADM Phase III Test Site infrastructure would be integrated into the current footprint of the Decatur ADM Complex and would be constructed between existing structures at the Decatur ADM Complex. No space outside the existing Decatur ADM Complex footprint would be required for the compression-dehydration facility. An agricultural field and wastewater treatment facility, both owned by ADM, are located near the CO_2 injection well. A field drainage ditch is located on the northeast corner of the field. Buildings, tanks, roads, etc., associated with manufacturing operations are also on the Decatur ADM Complex (MGSC, 2008).

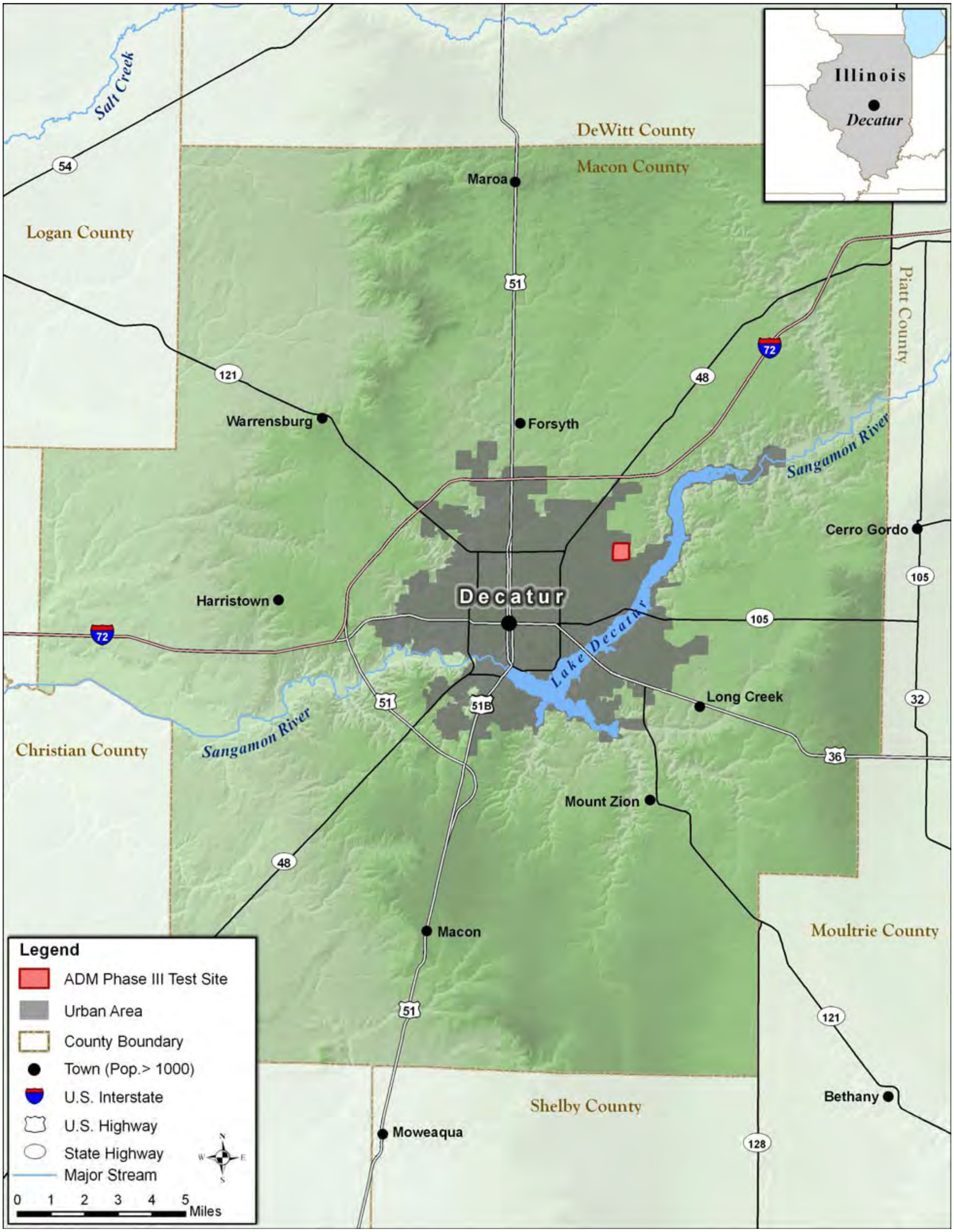


Figure 2.1.1-1. Regional Vicinity Map

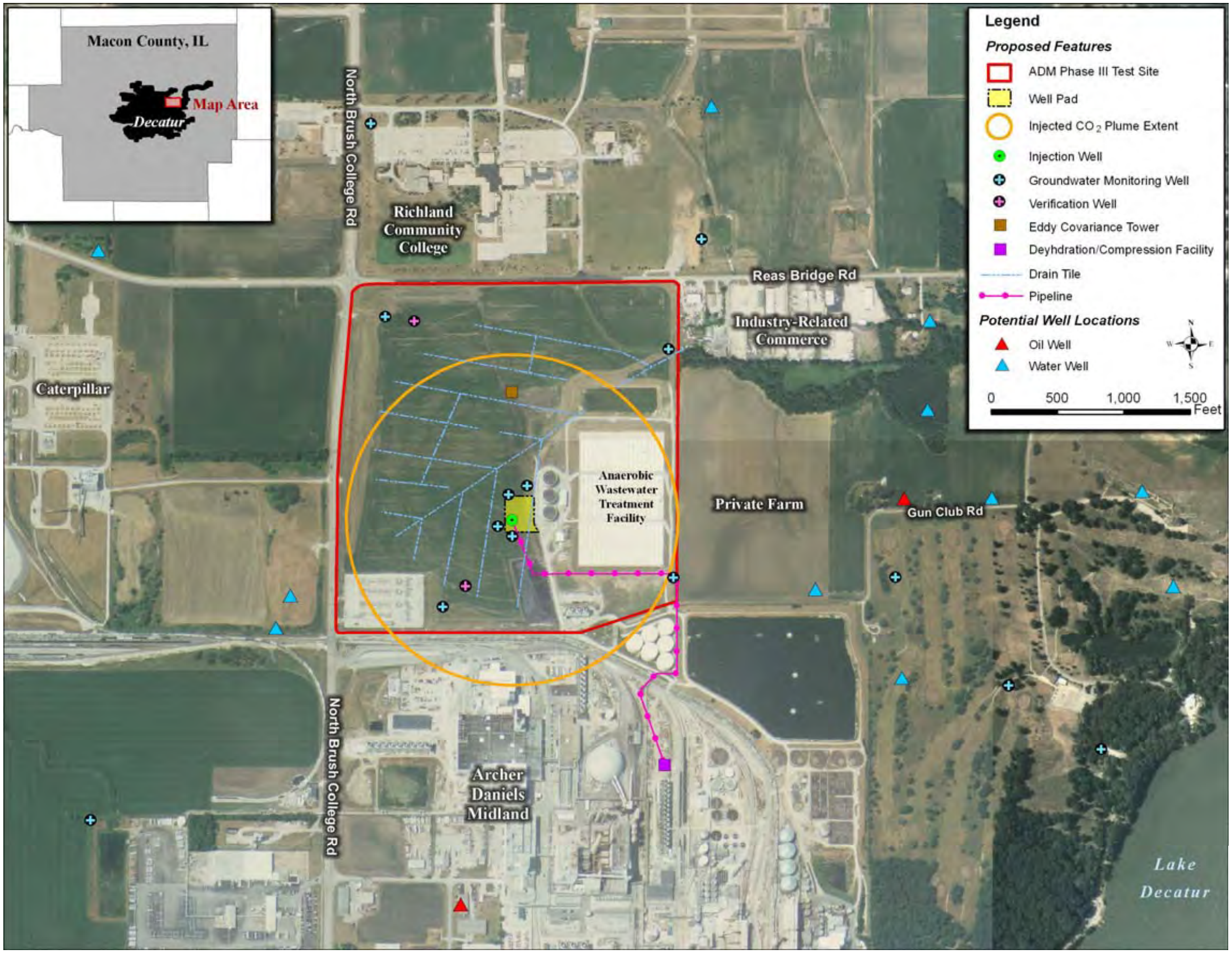


Figure 2.1.1-2. Project Area Map

2.1.2 Construction

Proposed new construction would include a surface facility, an approximately 3,000-foot (914.4 m) long pressurized pipeline, and 2,000 feet (609.6 m) of ductwork carrying uncompressed CO_2. The facility would include the CO_2 compression and dehydration equipment necessary to capture and condition the CO_2 from the ADM ethanol production plant. The facility would be capable of delivering approximately 1.1 million short tons (1 million metric tons) of CO_2 over a three-year period or approximately 367,700 short tons (365,000 metric tons) per year. The pipeline would deliver the CO_2 from the compression-dehydration facility to the injection well (MGSC, 2008).

2.1.2.1 CO_2 Supply

The source of the CO_2 for this project would be the ethanol fermentation tanks located south and slightly east of the proposed compression-dehydration facility. The outlet CO_2 stream from the ethanol fermentation facility is typically greater than 99% pure CO_2, saturated with water vapor at 80ºF and atmospheric pressure (MGSC, 2008). Collection pipes and fans/blowers would be used to pull/push the CO_2 to the compression-dehydration facility. Wet, uncompressed CO_2 would be transported in stainless steel ductwork, thereby eliminating corrosion as a potential concern. Precise pipeline length is currently unknown, but the approximate uncompressed CO_2 pipeline length would be 2,000 feet (609.6 m) (Carroll, 2008a).

2.1.2.2 Compression-dehydration Facility

The compression-dehydration facility would consist of an inlet water knockout prior to the first stage of compression. The first stage of compression would use an electrically driven screw compressor to compress the low pressure CO_2 from atmospheric pressure to approximately 300 psia (2,069 kPa). Cooling of the CO_2 after the initial compression stage would be achieved using an air-cooled exchanger or tube heat exchanger. A water knockout would be necessary before the 290 - 315 psia (2000 - 2170 kPa) CO_2 stream is routed to a once-through scrubber to remove alcohol and other impurities (MGSC, 2008).

Next, the CO_2 stream would pass through a packed-bed water scrubber to remove impurities such as acetaldehyde, methanol, and other water-soluble organic chemicals. The CO_2 stream would then be dehydrated using a TEG absorbing solution. Water-saturated CO_2 would be fed to the bottom of a packed-bed absorber tower where it would contact TEG in a countercurrent flow. The water laden TEG would leave the bottom of the absorber and would cross exchange with pure TEG in a heat exchange that cools the TEG on its way to the top of the absorber. A fuel-fired heater would heat the TEG to remove water vapor and regenerate the TEG in the stripper (MGSC, 2008).

The dehydrated CO_2 would leave the top of the absorber and go to a multi-stage reciprocating compressor. The two-stage reciprocating compressor would compress the CO_2 to the density and pressure needed for injection. Interstage cooling between compression steps would be performed using a heat exchanger. It is anticipated the outlet pressure of CO_2 would be 1,200-

1,400 psig (9,653 kPa). The critical pressure for CO_2 is 1056 psig (7,281 kPa), so the CO_2 would be at supercritical conditions prior to injection (MGSC, 2008).

2.1.2.3 Pressurized Pipeline

The pipeline that would transfer the CO_2 from the compression-dehydration facility to the CO_2 injection well would be 4-inch (10.16 cm) to 6-inch (15.24 cm) diameter schedule 40 or schedule 80 steel pipe designed to meet standards for the temperature and pressure of the CO_2 stream. The pipeline would be installed aboveground, following the current pipeline alleys at the Decatur ADM Complex as much as possible (Figure 2.1.1-2). The pipeline would be located only on Decatur ADM Complex property. The pressurized pipeline length would be approximately 3,000 feet (914 m) (MGSC, 2008).

2.1.2.4 Injection Well

The injection well and verification wells would be located in a field north of the primary industrial complex (Figure 2.1.1-2). Previously, this field was used for grain farming and laid fallow. The proposed injection rate is approximately 1,100 short tons/day (1,000 metric tons/day) of supercritical CO_2 with a cumulative amount of approximately 1.1 million short tons (1 million metric tons) over three years. If the Proposed Action is funded, it is scheduled to begin in December 2009 (NETL, 2008b).

Based on regional geology, the specific injection interval within the Mt. Simon is planned to be near the base of the Mt. Simon Sandstone and the granite basement rock. The injection interval would be identified based on well logs, core samples, and drill stem tests from the initial well drilled on the site during Phase II (NETL, 2008b).

For the anticipated Mt. Simon net thickness and permeability, reservoir modeling and nodal analyses suggest that a single injection well with $9^5/_8$ inch (24.45 cm) diameter injection casing and 4.5-inch (11.43 cm) diameter injection tubing would be adequate to meet the 1,100 short tons/per day (approximately 1,000 metric tons/day) injection rate into the injection tubing. Pre-drilling modeling would be revised once well logs and core samples are recovered from the Phase II well. The proposed project timeline calls for a 12-15 month period between completing the Phase II well (drilling and casing) and CO_2 injection during Phase III. Perforating the well casing would occur in the Mt. Simon formation shortly before CO_2 injection beings, assuming identification of a highly permeability zone. If the potential injectivity of this interval is not large enough or the interval is not found, the well could be perforated at different depths and permeability tests conducted so that an appropriate injection interval could be determined (NETL, 2008b).

The installation, operation, and eventual closure of this injection well are carefully governed by a regulatory program administered by USEPA, and delegated to qualified states such as the state of Illinois, known as the Underground Injection Control (UIC) permit program. MGSC has applied for a UIC permit for the establishment of this injection well as a Class 1 well, a designation of wells that inject industrial non-hazardous liquids, municipal wastewaters or hazardous wastes beneath the lowermost Underground Source of Drinking Water (USDW).

USEPA's UIC regulations prohibit injection wells from causing "the movement of fluid containing any contaminant into an underground source of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation...or may otherwise adversely affect the health of persons" (40 CFR 144.12(a)). The federal UIC Program has been implemented since 1980 and has responsibility for managing over 800,000 injection wells. The programmatic components of the UIC Program are designed to prevent fluid movement into USDWs by addressing the potential pathways through which injected fluids can migrate into USDWs. These programmatic components are described in general below (USEPA, 2008a):

- *Siting*: Injection wells are to be sited to inject into a zone capable of storing the fluid, and to inject below a confining system that is free of known open faults or fractures.
- *Area of Review (AOR) and Corrective Action*: Examination required of the vertical and horizontal extent of the area potentially influenced by injection and storage activities; and identification of all artificial penetrations in the area that may act as conduits for fluid movement into USDWs (e.g., active and abandoned wells) and, as needed, perform corrective action to these open wells (i.e., artificial penetrations).
- *Well Construction*: USEPA requires injection wells to be constructed using well materials and cements that can withstand injection of fluids over the anticipated life span of the project.
- *Operation*: Injection pressures must be monitored so that fractures that could serve as fluid movement conduits are neither propagated into the layers in which fluids are injected or initiated in the confining systems above.
- *Mechanical Integrity Testing*: The integrity of the injection well system must be monitored at an appropriate frequency to provide assurance that the injection well is operating as intended and is free of significant leaks and fluid movement in the well bore.
- *Monitoring*: Owners or operators must monitor the injection activity using available technologies to verify the location of the injected fluid, the pressure front, and demonstrate that injected fluids are confined to intended storage zones (and, therefore, injection activities are protective of USDWs).
- *Well Plugging and Post-Injection Site Care*: At the end of the injection project, USEPA requires injection wells to be plugged in a manner that ensures that these wells will not serve as conduits for future fluid movement into USDWs. Additionally, owners or operators must monitor injection wells to ensure fluids in the storage zone do not pose an endangerment to USDWs.

2.1.2.5 Verification Wells

There are plans to drill and complete up to two verification wells within the Mt. Simon. Because of the research aspects of this project, these wells would be drilled to verify the location of the CO_2 within the Mt. Simon. The placement of these verification wells would be based on the location of the CO_2 plume as inferred from other techniques such as a seismic survey (ADM, 2008a).

The verification wells would be drilled and cased. As the verification wells are drilled, completed, and tested, the monitoring program would expand to include these additional wells. The verification wells would be drilled between years two and four of the project to provide information to confirm geophysical and modeling estimates of plume location and geochemical/geomechanical effects of the CO_2 on the injection reservoir and caprock (NETL, 2008b).

The verification wells would use a state-of-the-art system designed by Schlumberger Oilfield Services to monitor and collect fluid samples and take pressure measurements in the target formation and a number of other formations overlying the Mount Simon Sandstone. The WestBay System^{TM} consists of series of sampling ports situated at different intervals along the casing and separated by hydraulic packers, which can be used to isolate each sampling location to reduce the number of required monitoring wells (Schlumberger, 2008a).

2.1.2.6 Groundwater Monitoring Wells

UIC programs help protect underground sources of drinking water from contamination by injection wells (See Section 1.3). ADM submitted a permit application for a Class I Non-hazardous Permit (ADM, 2008a). The Proposed Action would comply with the stipulations of the permit.

Four shallow, groundwater monitoring wells would be drilled around the injection well to the bedrock (200-300 feet (60.96 – 91.44 m) deep) to serve as a regulatory basis to monitor groundwater quality. Up to twelve additional wells would be drilled at the edges of the ADM Phase III Test Site to establish the general direction of groundwater movement prior to CO_2 injection (ADM, 2008a). The precise location of these wells will be determined after initial geological data is gathered and analyzed from the injection well site.

Using this information, groundwater modeling would be used to determine locations and necessity of additional groundwater monitoring wells. Wells would likely be spaced at different increments from the injection well (e.g., 25-150 feet (7.62 – 45.72 m)) once the modeling is completed. Additional work would be done to identify existing groundwater wells in the immediate area of the injection well that can be used for monitoring (ADM, 2008a).

At this time, there is one existing shallow groundwater well, completed under Phase II, relatively close to the proposed injection site. The area of review has a 2.5-mile (4.02 kilometers (km)) radius. However, during the 3 years of active injection of this proposed project, the CO_2 would be expected to move no more than 1,250 feet (381 m) laterally in the deepest part of the Mt. Simon, and much less than that as it would migrated towards the top of the injection formation. Monitoring of all of the identified existing groundwater wells in the 2.5 mile (4.02 km) radius in the UIC area of review (AOR) would be unnecessary because of the planned number and location of new shallow groundwater monitoring wells within the immediate injection well area and the extensive monitoring planned for the injection zone (ADM, 2008a).

All groundwater monitoring wells would be installed and eventually abandoned according to Illinois Department of Public Health regulations. During drilling, continuous cores would be collected from selected monitoring well locations and archived at the Illinois State Geological Survey. Field descriptions of the cores would be recorded and the potential monitoring interval identified (ADM, 2008a).

Monitoring wells would be constructed with 2-inch (5.08 cm) polyvinyl chloride (PVC) pipe with threaded connections. Well screens, slotted screen with 0.010-inch (0.254 millimeter (mm)) slots, would be used for groundwater monitoring wells. The screened interval would have a sand pack of appropriate thickness based on the monitoring interval identified from core samples. Bentonite would be placed above the sand pack to near surface. Concrete pad and a well protector would be placed around each well at the surface. The elevations of the monitoring wells would be determined by level surveying, based on the known elevation of a local benchmark. Prior to implementing the sampling schedule, all wells would be developed. Dedicated bladder pumps and pressure transducers would be installed in each well (ADM, 2008a).

It is anticipated that background samples would be collected until approximately November 2009, allowing a minimum of one year of background monitoring. Groundwater samples would be collected monthly to determine background water quality near the CO_2 injection site. Up to sixteen monitoring wells would be installed at or near the injection site. After collecting baseline data on water chemistry, temperatures, pH, and pressure, the groundwater would be collected on a quarterly basis. Data from the four wells closest to the injection well would fulfill the regulatory requirements of the UIC permit and the remaining wells would be used for research purposes only (ADM, 2008a).

2.1.2.7 Vadose Zone Soil Vapor Monitoring Stations

Vadose zone samplers would be installed to provide soil gas samples. The samplers would monitor CO_2 concentrations to validate integrity of seal formation, injection well, and other potential migration pathways to the biosphere (MGSC, No date). Vadose zone samples located at varying depths using field tile drains and drive point samplers may be used to provide soil gas samples that would be collected on a periodic basis (NETL, 2008b).

Indirect strategies include geophysical monitoring of the deep and shallow bedrock, aerial or satellite imagery, and multi-phase/multi-component flow models for simulating gas and liquid-phase flow in the injection formation (in-zone) and the near-surface environment (out-of-zone) (MGSC, No date).

2.1.2.8 Atmospheric Modeling Data Collection Stations

Direct measurement of CO_2 concentrations in the air is an integral part of the MMV program to ensure the health and safety of the public and to curtail environmental impacts. Because of the natural variations in CO_2 concentrations and fluxes in the near surface environment that arise from soil, plant, and subsurface processes, several monitoring techniques would be employed (MGSC, No date).

Eddy covariance is a technique using an Infrared Gas Analyzer (IRGA) and numerous micrometeorological variables including wind velocity, relative humidity, and temperature to determine CO_2 fluxes over a large area. This technique would be employed with the Proposed Action because it could be a cost-effective technique to monitor CO_2 fluxes. The complexity of the Decatur ADM Complex with respect to potential CO_2 sources (industrial, residential, vehicular) and temporal releases may make data interpretation difficult. This technique would require a minimum of one year of background data and would be deployed early in the MMV program. Based on predominant wind directions and area to be monitored, two eddy covariance systems may be constructed (MGSC, No date).

2.1.2.9 Injection Well Surface Facilities

Facilities and improvements would be constructed or placed at the ground surface within a 300 feet (91.44 m) by 300 feet (91.44) area in the immediate vicinity of the injection well (see Figure 2.1.1-2). These facilities, many of which are temporary to the drilling activity, would support well construction, operation, and project monitoring. In addition to the wellhead itself, these would include:

- Pipe tubs (to hold drill pipe and casing),
- Tubs, Catwalk (ramp at the side of the drill rig where pipe is laid out be lifted to the derrick floor),
- Catwalk water tank,
- Fuel trailer,
- Frac tanks (tanks to hold fluid for stimulating the well),
- Pumps (used to pump drilling mud during drilling operations),
- Drill rig, pumps,
- Trip tank (a small mud tank used to ascertain the amount of mud necessary to keep the wellbore full with the exact amount of mud that is displaced by drill pipe),
- Steel pits (a temporary steel containment for holding wellbore fluids,
- Mudlogger (a person who records information derived from examination and analysis of formation cuttings made by the bit and of mud circulated out of the hole to determine the presence of natural gas or oil),
- Pits, Mudlogger, 50,000 gallon (189.27 kiloliter) reserve pit (an earthen, plastic-lined pit to clean out the mud pump and store excess drilling mud),
- 150,000 gallon (567.81 kiloliter) reserve pit (settling or shaker an earthen, plastic-lined pit adjacent to the shale shaker where the drill cuttings are separated from the mud,
- Manifold rack (a pipe fitting with several side outlets to connect it with other pipes),
- Flare pit (usually a water-filled, plastic-lined, earthen pit over which, a flare is lit to burn off an produced natural gas during drilling operations),
- pit, 20 parking stalls,
- Three operations trailers,
- An office/conference room facility, and
- A communications shack.

2.1.3 Operations and Maintenance

2.1.3.1 General

The proposed injection of approximately 1.1 million short tons (1 million metric tons) of supercritical CO_2, at the rate of 25.5 pounds (lbs)/second (sec) (1,000 metric tons/day) would utilize the Mt. Simon formation as a target storage zone. Injection would be by a single well at the Decatur ADM Complex, an ethanol producer at Decatur, Illinois. There is one operating hydrocarbon well site on the Decatur ADM Complex, and the closest known penetration of the Mt. Simon formation is approximately 17 miles away (27.36 km) (NETL, 2008b). This is expected to be far beyond the radius of influence (1,250 feet (381 m)) of the proposed injection well (ADM, 2008a).

Prior to injection, the CO_2 stream from the ADM ethanol fermentor would need to be dewatered and compressed. The minimum compression is to the critical point of CO_2, which is 88°F (31.1°C) and 73 atmospheres pressure (7,395 kPa). In practice, a higher pressure would be required, given that the Mt. Simon formation pressure may be between 2,165 psig (14,928 kPa) and 2,598 psig (17, 910 kPa) (NETL, 2008b).

Compression of the gas stream and cooling would cause the water vapor in the CO_2 to condense, but a condensate of almost pure water and CO_2 is a highly corrosive mixture, which could not be tolerated in view of the high pressure of the system proposed. The alternative is dehydration with a glycol, such as TEG prior to compression or during compression stages. The TEG systems, though well known in the oil and gas industry, usually operate at high pressure. Engineering experience with low-pressure dehydration is much more limited, although it should in principle be workable.

The current concept is for multiple stages of compression, accompanied by cooling and water knock-out, with a TEG system in the final stage. The intent is to avoid the corrosion that would occur. This final design is still under consideration for the aboveground facilities, primarily because the pressures to be encountered are yet determined from the data collected from the injection well. The compression system and final design are yet to be chosen, because the pressure of the Mt. Simon formation must await the drilling program for the injection and production wells (NETL, 2008b). It is anticipated, however, that the compressors would be electrical, since an electrical power supply at the Decatur ADM Complex already exists.

Non-potable saline water would be produced during drill stem testing and on-going sampling from verification wells (ADM, 2008a). In addition, water by-product of the CO_2 conditioning process prior to injection would be condensation water from the dehydration, which would consist of essentially distilled water with a small mole fraction of TEG and perhaps traces of ethanol. This fluid would be handled through the existing ADM wastewater system for treatment, testing, and disposal.

Noise control would be maintained by housing the compressors in a dedicated process building.

2.1.3.2 Target Zone and Operational Integrity

ADM (2008a) has recognized that the successful operation of the Proposed Action would primarily be an issue of the integrity of the test site and would require a number of monitoring processes. In principle, compression and dehydration are straightforward matters in petroleum engineering. They would be complicated in this instance by issues of corrosion control that in part would have to be answered by design considerations of the compression-dehydration system. Corrosion monitoring would be an integral part of the operations of the aboveground facilities. Once operational without significant corrosion, the compression-dehydration system would be a simple operation with little environmental impact.

Target Zone

The target zone chosen by the MGSC is the Mt. Simon formation. The top of the Mt. Simon formation is thought to be between 5, 000 and 6,000 feet (1.52 – 1.83 km) at the Decatur ADM Complex (NETL, 2008b). It is described as very thick sandstone, overlain by the highly impermeable Eau Claire formation. The Eau Claire is expected to be 300-500 feet (91.44 – 152.40 m) thick in the injection area. Further, impermeable confining formations are the Maquoketa shale (about 2,500 feet (762 m) below grade) and at lesser depth still the New Albany shale (1,800 feet (548.64 m) below land surface).

For the Proposed Action, the MGSC has set aside 10-12 months between drilling of the injection well during Phase II operations and CO_2 injection during Phase III for the evaluation of the target zone, selection of the injection zone within the Mt. Simon formation, and the construction of infrastructure and facilities. While some information from the distant wells suggests that the Mt. Simon may show the highest permeability at depth, and show adequate permeability in the top 200 feet (60.96 m), the MGSC plans to evaluate the full Mt. Simon interval in order to attain the target injection rate at a depth as low in the Mt. Simon formation as possible (NETL, 2008b).

Since CO_2 would likely rise within the sandstone, it could do the following (ADM, 2008a).

- First, the CO_2 could dissolve in the saline formation water; this would be expected to be an important process at the high pressures involved, and should acidify the water;
- Second, the acidic water could attack the carbonaceous cements that are sometimes present in sandstone, but are limited at this site; this could be a favorable effect in that it would improve the permeability to fluid flow. However, initial computer simulations of geochemistry suggest that this effect would not be a major one.
- The Eau Claire formation, being dolomitic, is subject to attack by any residual CO_2 that had not been consumed by reactions in the target zone. However, it is highly unlikely that approximately 1.1 million short tons (1 million metric tons) of CO_2 would cause sufficient breakdown of the Eau Claire to allow penetration to a higher zone; if that were to happen, the CO_2 could not penetrate the overlying shale layers, as these would be mostly inert to CO_2.

Cement Integrity

The well would be cemented according to Illinois regulations. There would be a period of 10-12 months between drilling and perforating, and initial use of the injection well. This is, in part, intended to allow for core material to be studied such that the best injection depth interval can be chosen and perforated. During this period, the MGSC would run casing logs (cement bond logs) to check cement integrity prior to deployment.

The initial cementing of well casing strings would be performed according to requirements of the Illinois EPA Underground Injection Control Regulations and defined in the permit application (ADM, 2008a).

Tests of the Mt. Simon Formation

The closest well penetrating the Mt. Simon formation is over 17 miles (27.36 km) from the ADM Phase III Test Site. It follows that little site-specific geologic information exists, and projections have been made from existing geological trends. The evaluation of data collected during drilling of the CO_2 injection well would be used to determine final depths of injection and operational conditions. Geologic, geomechanical, and operational information collected during well installation includes:

- The formation pressure,
- The formation fracture pressure,
- The fracture gradient of the confining Eau Claire formation,
- Porosity,
- Permeabilities, horizontal and vertical (if possible), to CO_2 and water,
- Radius of influence,
- Injectivity, and
- Drill stem tests.

The results of the above would determine the injection pressure, which would not exceed the fracture pressure plus some built-in margin of safety. This in turn would determine the pipe size required for the planned injection rate and the duty of the compression system.

Integrity of the Pipeline

System pressure would be monitored closely, as a loss of pressure is indicative of loss of the CO_2 supercritical fluid (ADM, 2008a).

Since CO_2 is neither toxic nor explosive, the worst case would be a sudden complete failure of pipe. This would release all the CO_2 in the pipe. The result would be dry ice formation at the break due to the sudden expansion, plus release of a large gas cloud as the supercritical fluid is converted to CO_2 gas. The gas is non-toxic, but a sudden, large release from the pipeline might displace air for the workers at the Decatur ADM Complex, or perhaps at the outskirts of Decatur if the release was into a confined area (NETL, 2008b).

This scenario, though highly unlikely, would be modeled, taking into account the sudden release and its atmospheric dispersion. If, after the final design is chosen, the modeling suggests a possibility of health effects or even fatalities due to air displacement, it would be necessary to install automatic low-pressure shut-downs at intervals along the pipe. The effect of this would be to limit the amount of CO_2 that could escape in a sudden, complete failure of the pipe (See Section 4.9).

ADM (2008a) has presented a contingency plan for system failure that includes the proposed high-pressure compression facility.

Summary

The integrity of the system against CO_2 release would be dependent on the following:

- Continuous corrosion testing,
- Frequent moisture testing of the dehydrated gas, and
- Continuous pressure monitoring of the pipeline, with automatic shut-down systems.

Prior to injection, the wells would be logged to determine the casing integrity over the cemented intervals (cement bond log) as per ADM UIC Injection Control Permit (ADM, 2008a).

2.1.3.3 Monitoring, Mitigation, and Validation (MMV) Programs

A number of intermittent studies or continuous programs would be undertaken:

Air Dispersion

USEPA models for atmospheric dispersion of gases would be run to estimate dispersion of off-gases from the compressor, as well as the issue of sudden CO_2 release referred to above. The outcomes would be used to assist and direct pilot operation decisions, and to some extent design of the facility. In addition, the models would be run to ensure public safety should a complete pipe rupture occur (NETL, 2008b).

Fluid Flow Modeling

A variety of models would be run to gain insight into the nature of fluid flows in the project area, including injection zone fluid flow modeling (reservoir simulation), geochemical and mechanical modeling, basin wide modeling, groundwater modeling, and near-surface modeling (NETL, 2008b). The intent of these programs would be to utilize observation well and system pressure data for the purpose of understanding the physical processes that would be encountered as a consequence of the sequestration. The purpose of this type of modeling is mainly for research. History matching of observation well results and wellhead pressures at given flow rates would require a number of assumptions to be made due to reservoir and injection rate unknowns. These assumptions will be verified or modified as a result of this project and will provide information about subsurface processes important to future operations.

Groundwater Monitoring

Standard groundwater monitoring programs would be used to detect any changes in groundwater. Such changes are considered unlikely in the potable groundwater zone due to the depth of the targeted Mt. Simon sandstone and the presence of numerous shale gas migration barrier formations between the Mt. Simon and the deepest potable groundwater zone.

The water changes in the injection zone would be monitored by chemical analysis of fluids recovered from observation wells. In these wells, it is conceivable that pH changes and hardness, as well as alkalinity changes may be observed. Trace element concentration changes may also take place.

Injection Fluid Sampling

The injected fluids would be sampled prior to injection in accordance with the UIC permit to test for the presence of non-condensable gases and certain organic components that may arise from the ethanol fermentor (ADM, 2008a).

Operations Monitoring

The MGSC would utilize automated devices to measure injection volumes, well pressures, annulus pressures, and formation temperatures. These would be used to determine the smooth functioning of the operation, absence of leaks, and absence of flow behind the injection pipe. Continuous pressure readings in pipelines, at the wellhead, and in the wellbore annulus that are outside the permit limits would lead to automatic shutdown of the injection system, if necessary, per the injection control permit.

After some months of operation, it would likely be found that some monitoring techniques would provide more useful information than others. The frequency of the less helpful measurements would then be decreased (ADM, 2008a).

2.1.4 Decommissioning

ADM would have several choices available to them:

First, they may decide to continue the sequestration program as part of their ongoing operations. In that case, regulatory approval would be obtained as necessary (ADM, 2008a).

Second, if they do not choose to continue or if the pilot has not shown unequivocally favorable results, the plant site does not require decommissioning immediately. However, the wells would have to be abandoned, and the pipeline could be abandoned in place or the aboveground sections removed. Well abandonment would be according to IEPA UIC regulations. All decommissioning would be done in compliance with applicable laws and regulations.

2.2 No-Action

DOE's provision of cost sharing in the Proposed Action is the Federal action that brings the Proposed Action under NEPA regulations. Under the No-Action alternative, DOE would not provide partial funding for the proposed project. In the absence of DOE funding, project proponents would not proceed with the proposed project tasks. Thus, the components of the Proposed Action (including injection of CO_2 and building of compression-dehydration facility) would not occur under the No-Action alternative.

2.3 Alternatives Considered but Eliminated from Detailed Analysis

It is important to remember that the decision under review in this EA is for DOE to either fund or not fund the Proposed Action. Two additional alternatives were available for satisfying DOE's need for developing information on potential technological solutions for geological carbon sequestration in this region.

Alternatives to the Proposed Action include:

- Conducting the experiment at another field site in the same sedimentary basin and
- Conducting the experiment in another geographic area (different sedimentary basin).

The Proposed Action site was selected based on an optimum and advantageous combination of site characteristics, including:

- Regional geologic characteristics (depth and thickness of Mt. Simon, lack of faulting, and caprock's presence and thickness);
- Local availability of large volumes of $CO_{2,}$; and
- Willingness of the industrial partner to cooperate in this effort.

Other sites that were investigated by the MGSC lacked the strength of the ADM Phase III Test Site in one or more of these characteristics. Alternative sites typically would have required significantly longer pipelines for transporting CO_2 and had less information regarding the geologic character of the injection formation and overlying caprocks. Therefore, these other sites were eliminated.

2.4 Issues Considered and Dismissed

The Purpose and Need section above highlighted the importance of the overall program of evaluating carbon capture and storage (CCS) as one tool among many to address global climate change while providing this nation with a secure energy future. Many potential impact issues associated with EAs were reviewed to compile this EA for DOE. Because of the lack of potential impact to certain issues due to the specific characteristics of the Proposed Action, the following issues were considered but dismissed from detailed analysis:

Right-of-Way Acquisition	There was no need for additional right-of-way.
Wild & Scenic Rivers	There are no designated Wild & Scenic Rivers within a 75-mile (120 km) distance from the project site.
Increase Local Government Expenditures	The expected population dynamics of the temporary workforce are not expected to impose additional local government expenditures through need for new roads, schools, etc.
Impact Property Values	This is a minor expansion within an existing industrial facility.
Alter Local Hydrology Patterns	None of the proposed construction would impact drainage in the local watershed.

Harm Tribal Lands	No lands affiliated with Native American tribes would be impacted by the Proposed Action.

3.0 THE ENVIRONMENTAL ANALYSIS APPROACH

This chapter describes how the environmental review team analyzed the potential impacts of this Proposed Action (i.e., injection and analysis of potential for geologic storage of CO_2). Chapter 4 provides a description of the affected environment and the potential environmental effects of the Proposed Action along with an analysis of environmental effects if the Proposed Action was not implemented.

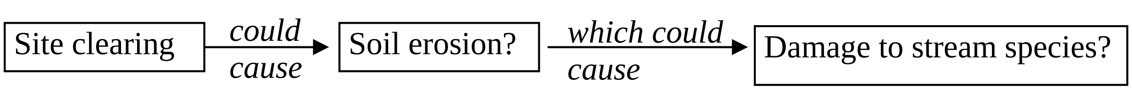
3.1 Approach to the Analysis

An EA is intended to be a clear, focused analysis of impacts. It is not intended to be merely a compilation of encyclopedic information about the project or about the environment. Accordingly, the environmental review team used a systematic approach to identifying, and then answering the relevant impact questions.

The initial step was to develop a detailed description of the components of the CO_2 storage process to be used at this test site to study the potential of geologic sequestration of CO_2. This description was presented in Chapter 2.

For each project component (e.g., underground injection of CO_2), the team sought to identify all the types of direct effects which that activity could cause on any environmental resource. For example, clearing a site of vegetation could cause soil erosion. In doing this preliminary identification of the types of impacts that potentially could occur, the team drew upon their experience with previous projects.

For each potential direct effect, the team then sought to identify the potential indirect effects on other environmental resources. For example, soil erosion could cause sedimentation in nearby streams, which could in turn harm the fish and other species in the stream.



In some cases, the team identified multiple effects on the same resource, which are shown in diagrams (Figure 3-1). Figure 3-1 is the overall Cause-Effect-Question diagram for the entire project. This served as the framework of the analysis of impacts. That is, the team focused their efforts on answering these questions as to whether these effects would in fact occur, and if so, how extensive, how severe, and how long-lasting they would be.

Note that Figure 3.1 (next pages) contains references to the specific section of the document where each impact is addressed.

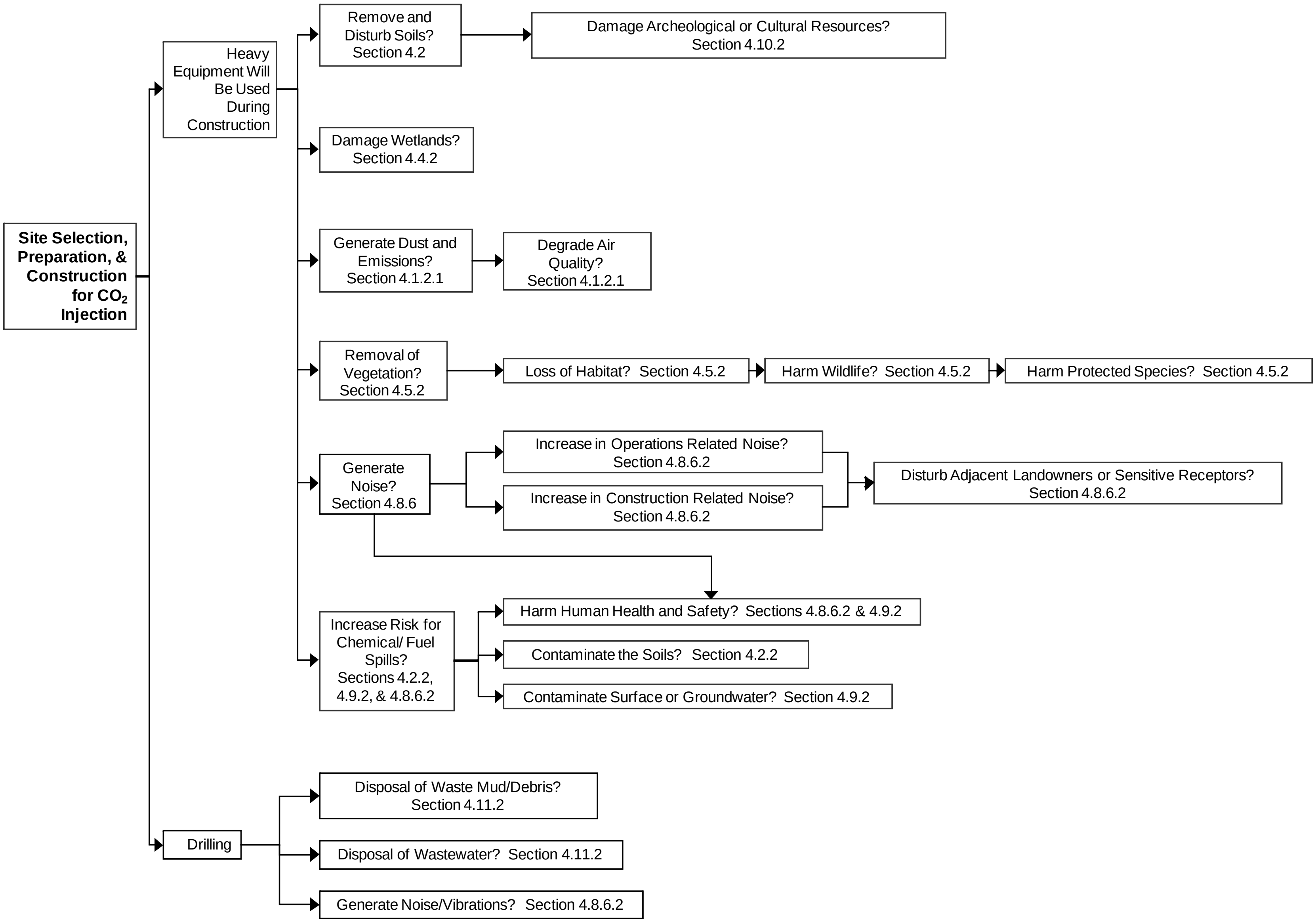


Figure 3.1-1. Cause-Effect-Questions Page 1

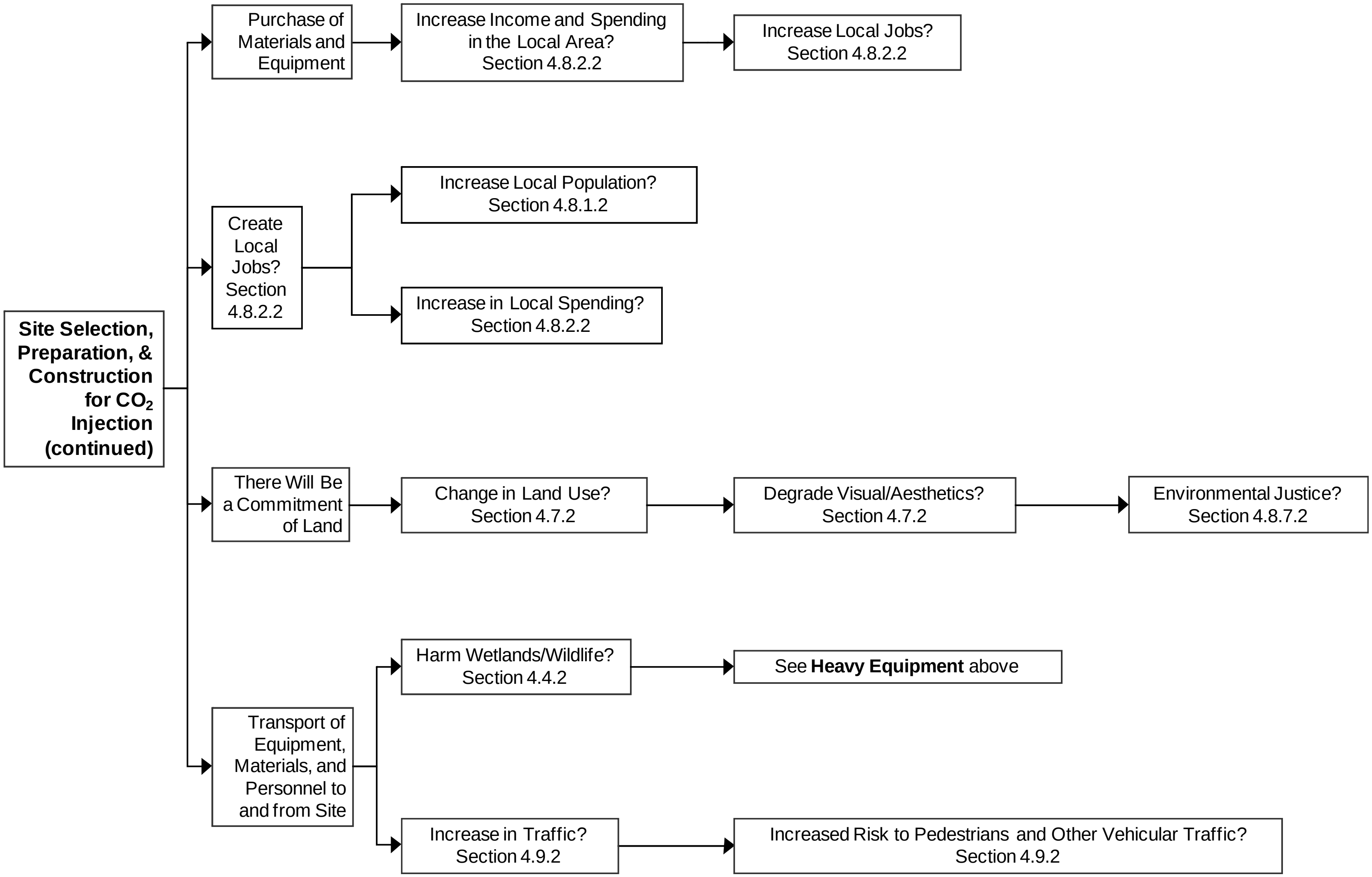


Figure 3.1-2. Cause-Effect-Questions Page 2

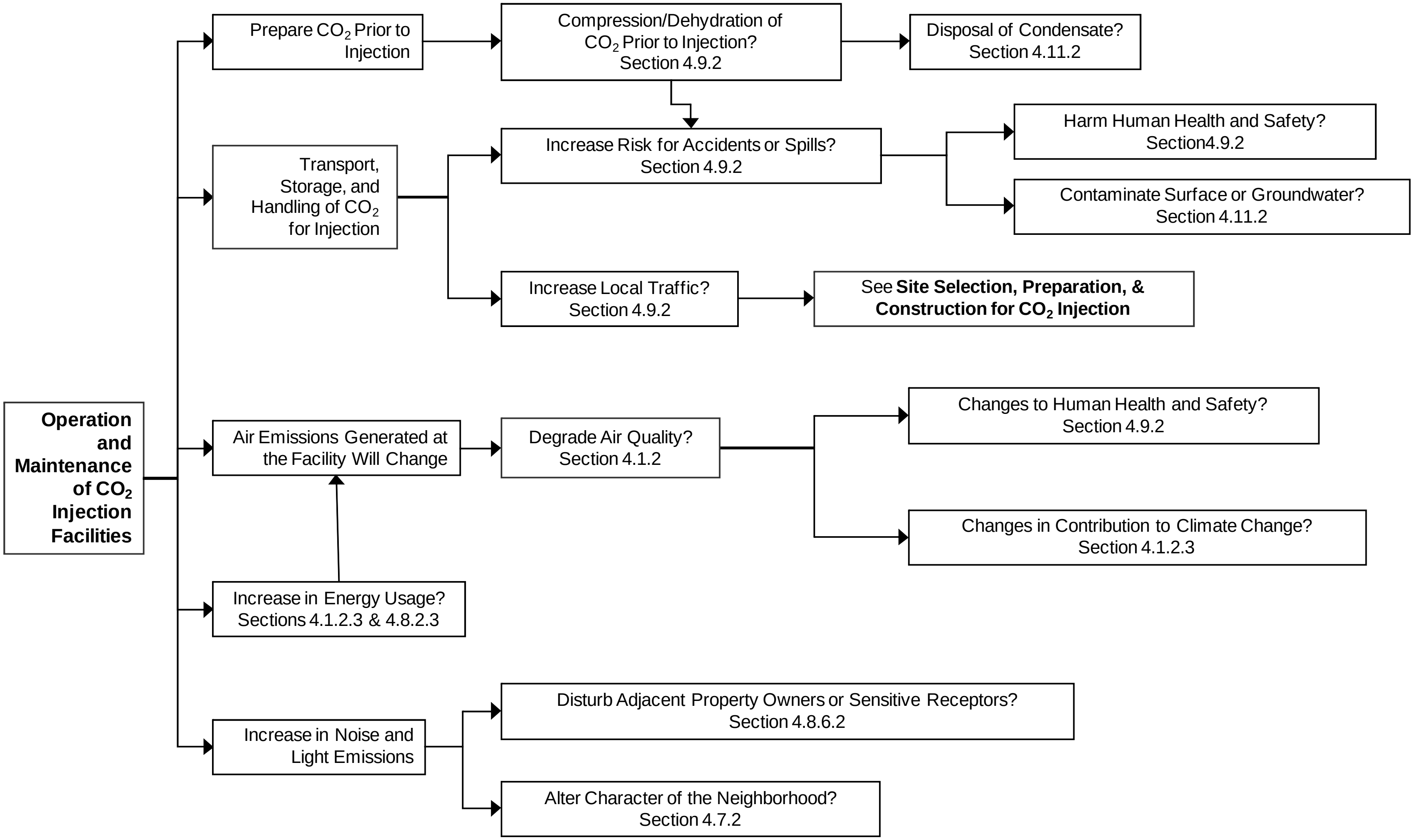


Figure 3.1-3. Cause-Effect-Questions Page 3

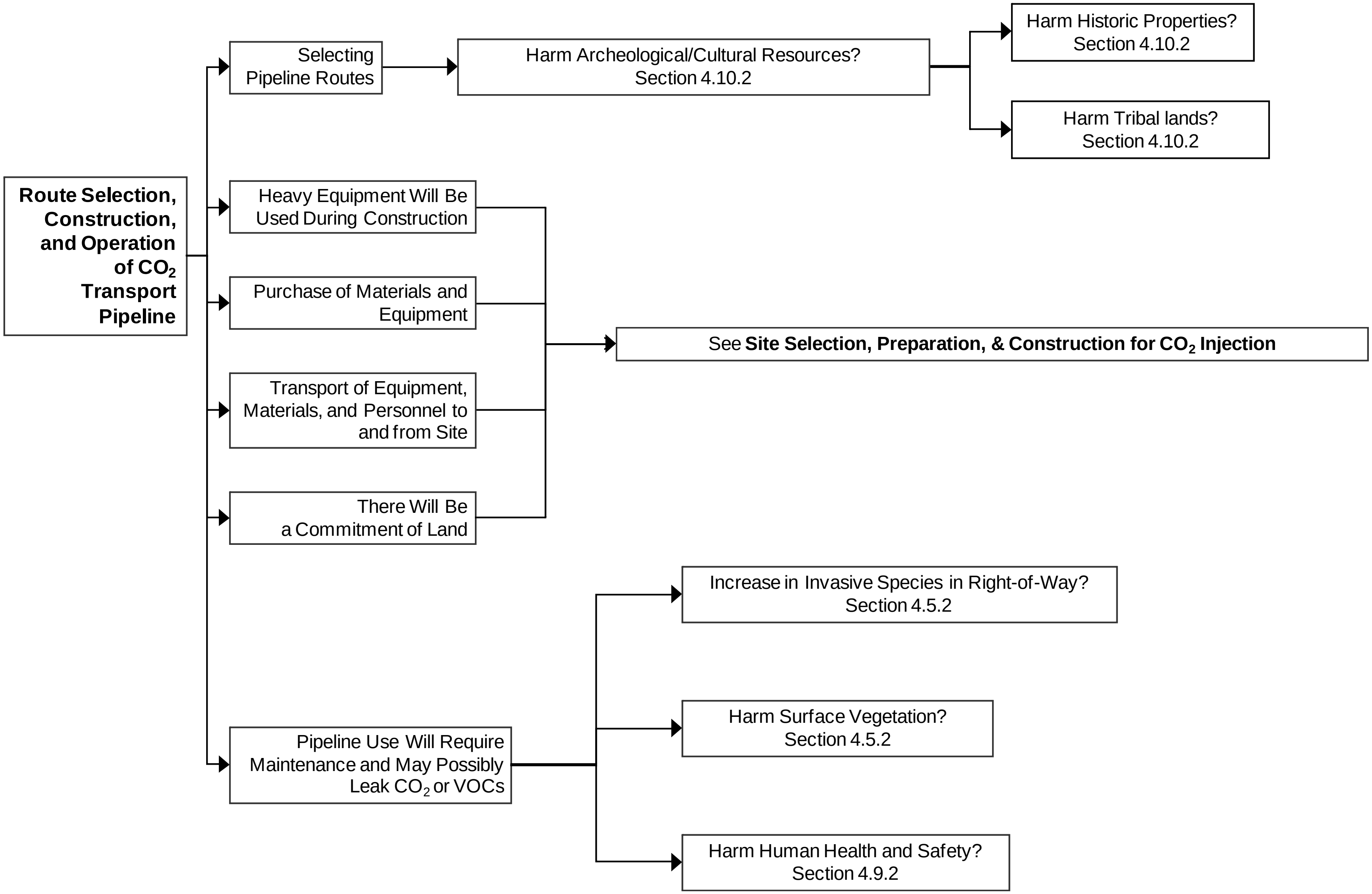


Figure 3.1-4. Cause-Effect-Questions Page 4

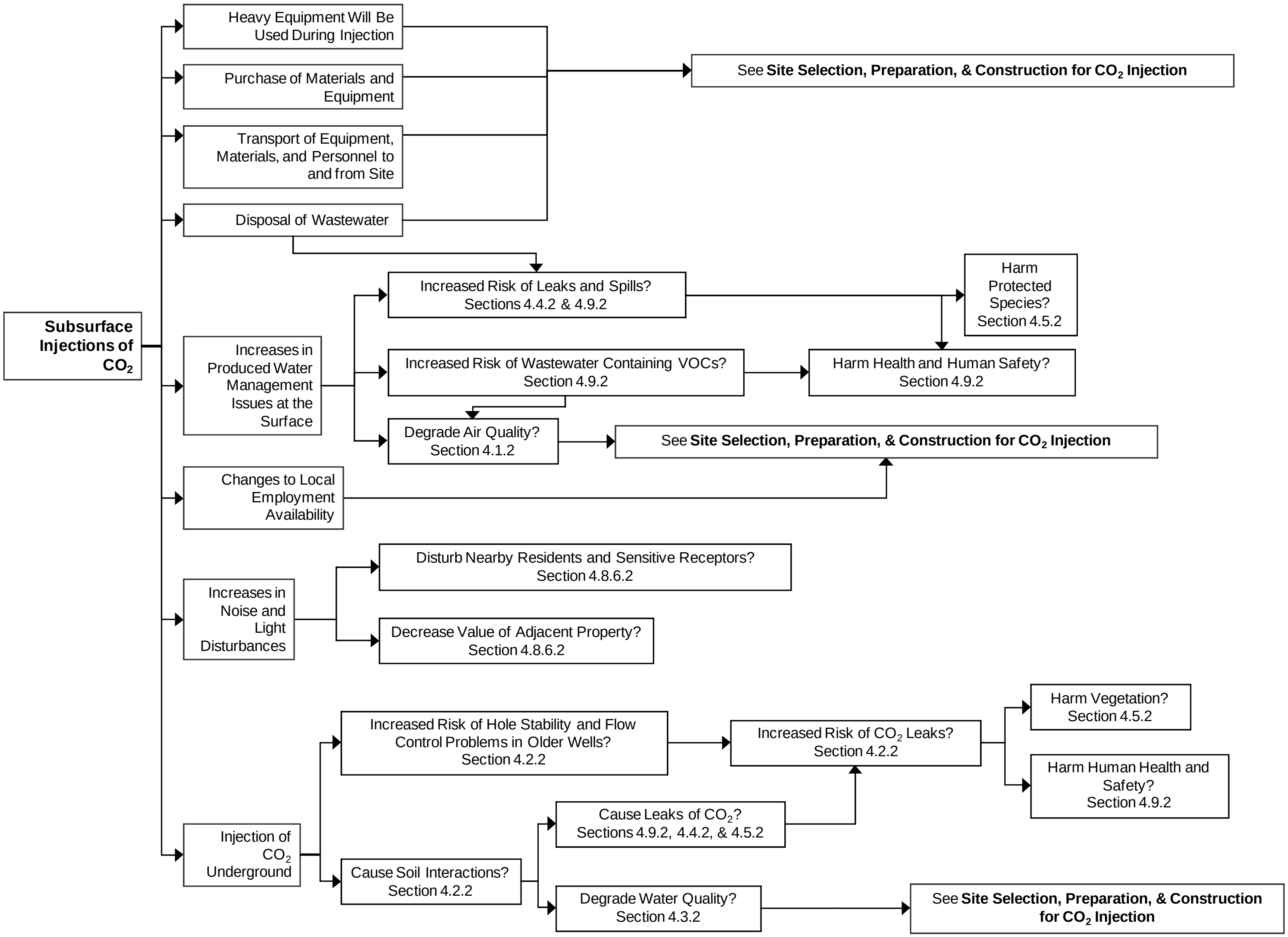


Figure 3.1-5. Cause-Effect-Questions Page 5

3.2 Analysis of Significance

The review team used a systematic process to evaluate the importance, or significance, of the predicted impacts. This process involved comparing the predictions to the significance criteria established by the team and set out below in Table 3.2. These significance criteria were based on legal and regulatory constraints and on team members' professional technical judgment.

Table 3.2. Impact Significance Thresholds

Resource Area	Impact Significance Thresholds An impact would be significant if it EXCEEDS the following conditions.
Air Quality	The project would not produce emissions that would impede the area's conformity with the State Implementation Plan under the Clean Air Act.
Geologic Formations	The Proposed Action would cause no measurable leakage of CO_2 from the storage formation to the surface or into another area in the subsurface, and there is no more than an imperceptible risk of inducing seismic events due to increased reservoir pressure.
Soils	Any changes in soil stability, permeability, or productivity would be limited in extent. Full recovery would occur in a reasonable time*, considering the size of the project. Mitigation, if needed, would be simple to implement and proven to be effective in previous applications.
Surface Water	Any changes to surface water quality or hydrology would be confined to the immediate project area. Full recovery would occur in a reasonable time, considering the size of the project and the affected area's natural state.
Groundwater	Any changes to groundwater quality and quantity would be at the lowest detectable levels. Full recovery would occur in a reasonable time. Mitigation, if needed, would be proven to be effective in previous applications.
Wetlands	Any impacts to wetlands would be confined to the immediate project area and would not cause any regional impacts. Planned mitigation measures would fully compensate for lost wetland values in a reasonable time.
Terrestrial Vegetation	Any changes to native vegetation would be limited to a small area and would not affect the viability of the resources. Full recovery would occur in a reasonable time, considering the size of the project and the affected resource's natural state. Mitigation, if needed, would be proven to be effective in previous applications.
Wildlife	Any changes to wildlife would be limited to a small portion of the population and would not affect the viability of the resource. Full recovery would occur in a reasonable time, considering the size of the project and the affected species' natural state.
Threatened or Endangered Species	Any effect to a federally listed species or its critical habitat would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population. This negligible effect would equate to a "no effect" determination in U.S. Fish and Wildlife Service terms.

Land Use	Any change in land use would be limited to a small area and would not noticeably alter any particular land use at the ADM Phase III Test Site or in adjacent areas. The affected areas would fully recover in a reasonable time once the project is completed.
Population and Employment	Changes to the normal or routine functions of the affected community are short-term or do not alter existing social or economic conditions in a way that is disruptive or costly to the community.
Infrastructure	The project would not noticeably affect or disrupt the normal or routine functions of public institutions, roads, electricity, and other public utilities and services in the project area.
Parks and Recreation	Any disturbance would be minor, temporary in duration, and in character with existing uses of the project area.
Visual Resources	The action, along with planned mitigation, would not permanently change the visual landscape in a way that is objectionable to a number of local residents or frequent visitors. (or) The action, along with planned mitigation, would not change the visual resource classification of the affected area.
Noise	Noise levels in the project area would not exceed ambient noise level standards as determined by the Federal, state, and/or local government.
Environmental Justice	Neither minority nor low-income groups within the affected community would experience proportionately greater adverse effects than other members of the community would.
Human Health and Safety	The project, with current and planned mitigation measures, would pose no more than a minimal risk to the health and safety of on-site workers and the local population.
Cultural Resources	The action would not affect the context or integrity features (including visual features) of a site listed or eligible for listing on the National Register of Historic Places or of other cultural significance. Following consultations with the SHPO/Tribal Historic Preservation Office(r) (THPO) and any other potentially affected groups including Indian Tribes, local governments, and the National Park Service (NPS), the determination of effect under Section 106 of the NHPA would be *no adverse effect*.
Waste Management	The action, along with planned mitigation measures, would not cause air, water, or soil to be contaminated with hazardous material that poses a threat to human or ecological health and safety.

* Recovery in a reasonable time: Constant, sustainable improvement is apparent and measurable when the site is routinely observed, and full recovery is achieved over a period of no more than several years.

4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

4.1 Air Quality

4.1.1 Description

This is a description of regional climate, ambient air quality with respect to attainment of National Ambient Air Quality Standards (NAAQS), and identification of applicable air quality regulations.

4.1.1.1 Climate and Weather

Decatur, Illinois, average winter temperature is 25.7°F. The average summer temperature is 74.6°F. The total annual precipitation is 39 inches (99.06 cm) with 58% of this falling in April through September. The growing season for most crops also falls within the April through September period. The average seasonal snowfall is 21.5 inches (54.61 cm) (MGSC, 2008).

4.1.1.2 National Ambient Air Quality Standards and Attainment Status

USEPA Region 5 and the Illinois Environmental Protection Agency (IEPA) regulate air quality in Illinois. The CAA (42 USC 7401-7671q), as amended, gives the USEPA the responsibility to establish the primary and secondary NAAQS (40 CFR Part 50) that set acceptable concentration levels for seven criteria pollutants: fine particulate matter (PM_{10}),very fine particulate matter ($PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrous oxides (NO_x), ozone (O_3), and lead. Short-term standards (1-, 8-, and 24-hour periods) have been established for pollutants contributing to acute health effects, while long-term standards (annual averages) have been established for pollutants contributing to chronic health effects. Based on the severity of the pollution problem, nonattainment areas are categorized as marginal, moderate, serious, severe, or extreme. Each state has the authority to adopt standards stricter than those established under the federal program. However, the State of Illinois accepts the federal standards.

Federal regulations designate Air-Quality Control Regions (AQCRs) in violation of the NAAQS as “nonattainment” areas. Federal regulations designate AQCRs with levels below the NAAQS as “attainment” areas. “Maintenance” AQCRs are areas that have previously been designated “nonattainment” and have been redesignated to “attainment” for a probationary period through implementation of maintenance plans. The ADM Phase III Test Site is completely within the West Central Illinois Intrastate AQCR (AQCR 075) (40 CFR 81.264). Federal regulations designate AQCR 075 as an attainment area for all criteria pollutants (40 CFR 81.314). Because the study area is in an attainment region, the air conformity regulations do not apply. However, the project’s emissions of criteria pollutants and the applicability thresholds under the general conformity rules were carried forward for more detailed analysis to determine the level of impact under NEPA.

4.1.1.3 Local Ambient Air Quality

Existing ambient air quality conditions can be estimated from measurements conducted at air quality monitoring stations close to the study area (Table 4.1.1.3). With the exception of the eight-hour O_3 and $PM_{2.5}$ standards, air-quality measurements are below the NAAQS (USEPA, 2008b). The reported maximum of 0.091 parts per million (ppm) for the eight-hour level exceeds the standard of 0.08 ppm within the region. However, the 3-year average of the fourth highest daily maximum 8-hour average O_3 concentrations over each year has not exceeded 0.08 ppm; hence, the attainment status. The reported maximum of 37 micrograms per cubic meter ($\mu g/m^3$) for the 24-hour $PM_{2.5}$ level exceed the standards of 35 $\mu g/m^3$. However, it was only exceeded once; hence, the attainment status.

Table 4.1.1.3. NAAQS and Monitored Air Quality Concentrations

Pollutant and Averaging Time	Primary NAAQS[1]	Secondary NAAQS[1]	Monitored Data[2]	Location of Station
CO				
8-Hour Maximum[3] (ppm)	9	(None)	2	Sangamon County
1-Hour Maximum[3] (ppm)	35	(None)	3	
NO_2				
Annual Arithmetic Mean (ppm)	0.053	0.053	*(no data available)*	-
Ozone				
8-Hour Maximum[4] (ppm)	0.08	0.12	0.091	Macoupin County
$PM_{2.5}$				
Annual Arithmetic Mean[5] ($\mu g/m^3$)	15	15	14	Macon County
24-Hour Maximum[6] ($\mu g/m^3$)	35	35	37	
PM_{10}				
Annual Arithmetic Mean[7] ($\mu g/m^3$)	50	50	24	Macoupin County
24-Hour Maximum[3] ($\mu g/m^3$)	150	150	54	
SO_2				
Annual Arithmetic Mean (ppm)	0.03	(None)	0.003	Sangamon County
24-Hour Maximum[3] (ppm)	0.14	(None)	0.05	
3-Hour Maximum[3] (ppm)	-	0.5	0.198	

1 - Source: 40 CFR 50.1-50.12.
2 - Source: (USEPA, 2008b).
3 - Not to be exceeded more than once per year
4 - The 3-year average of the fourth highest daily maximum 8-hour average O_3 concentrations over each year must not exceed 0.08 ppm.
5 - The 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from must not exceed 15.0 $\mu g/m^3$.
6 - The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor must not exceed 65 $\mu g/m^3$.
7 - The 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 $\mu g/m^3$.
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
NO_2 = Nitrogen dioxide

4.1.1.4 Existing Facility Emissions

The Decatur ADM Complex operates a variety of grain processing activities, including milling, oil refining, alcohol, and ethanol production. It has many stationary sources of air emissions. Significant sources of emissions include storage tanks, dryers, boilers, evaporators, and conveyers. Insignificant sources include small boilers, storage tanks, and internal combustion engines. Based on the facility's potential to emit, Decatur ADM Complex is a major source of volatile organic compounds (VOC), PM, CO, hazardous air pollutants (HAPs), NO_x, and SO_2. A facility-wide Title V permit (permit number 115015AAE) was issued on August 18, 2004 (IEPA, 2004). As part of the permit requirements, the facility must comply with emission limits and operational hours for individual pieces of equipment, and submit an annual facility-wide emission statement. Table 4.1.1.4 lists the overall annual emissions for the Decatur ADM Complex. Notably, because CO_2 is not currently regulated, CO_2 emissions are not tracked at the facility.

Table 4.1.1.4. Existing (2007) Air Emissions for Decatur ADM Complex

Criteria Pollutants	Decatur ADM Complex Annual Emissions (Short Tons per Year)
CO	3000
NO_x	2665
PM_{10}	1476
$PM_{2.5}$	439
SO_2	9206
VOC	3881

Source: (ADM, 2008b).

4.1.1.5 Greenhouse Gasses and Global Warming

Greenhouse gases (GHG) are components of the atmosphere that contribute to the greenhouse effect and global warming. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities such as the burning of fossil fuels. Federal agencies, states, and local communities address global warming by preparing GHG inventories and adopting policies that will result in a decrease of GHG emissions. According to the Kyoto Protocol and California Climate Action Registry (CCAR), there are six GHGs: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (UNFCCC, 2007; CARB, 2007a). Although the direct GHG (CO_2, CH_4, and N_2O) occur naturally in the atmosphere, human activities have increased their atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2004, concentrations of CO_2 have increased globally by 35 percent. Within the United States, fossil fuel combustion accounted for 94 percent of all CO_2 emissions released in 2005. On a global scale, fossil fuel combustion added approximately 30 $x10^9$ short tons (27 $x10^9$ metric tons) of CO_2 to the atmosphere in 2004, of which the United States accounted for about 22 percent (USEPA, 2007a). DOE's Energy Information Administration (EIA) report indicates that United States' CO_2 emissions have grown by an average of 1.2 percent annually since 1990 and energy-related CO_2 emissions constitute as much as 83 percent of the total annual CO_2 emissions (DOE, 2007b).

Since 1900, the Earth's average surface air temperature has increased by about 1.2 to 1.4ºF. The warmest global average temperatures on record have all occurred within the past 10 years, with the warmest year being 2005 (USEPA, 2007b). With this in mind, DOE, while preserving their core operations, is poised to support climate-changing initiatives to reduce GHG emissions.

4.1.2 Effects of Proposed Action

Short-term minor impacts to air quality would be expected with the implementation of the Proposed Action. Direct and indirect air emission would not exceed applicability thresholds, be "regionally significant," or contribute to a violation of any federal, state, or local air regulation. Air emissions would be limited to temporary diesel emissions from drilling equipment during well development and drilling of the observation and groundwater monitoring wells. A dehydration reboiler, which could generate limited air emissions, is the only expected source of air emissions during injection or monitoring operations. In summary, the project would not produce emissions that would impede the area's conformity with the State Implementation Plan under the Clean Air Act.

4.1.2.1 Estimated Emissions and General Conformity

The general conformity rules require Federal agencies to determine whether their action(s) would increase emissions of criteria pollutants above preset threshold levels (40 CFR 93.153(b)). These *de minimis* (of minimal importance) rates vary depending on the severity of the nonattainment and geographic location. Because AQCR 075 is in attainment, the air conformity regulations do not apply. However, all direct and indirect emissions of criteria pollutants were estimated and compared to applicability threshold levels of 100 short tons per year (tpy) to determine whether implementation of the Proposed Action would cause significant environmental impacts. The total direct and indirect emissions associated with the following activities were accounted for (Table 4.1.2.1).

- Site preparation & construction,
- Construction and operation of transport pipeline,
- Operation and maintenance of injection facilities, and
- Subsurface injections of CO_2.

Construction emissions would primarily be due to the use of diesel drilling rigs, mud pumps, diesel generators and motors, heavy construction equipment, deliveries to the site, the application of architectural coatings, and fugitive dust. Drill rig operations during well construction are anticipated to occur 24 hours per day and 7 days per week for no more than three months. The operational emissions would primarily be due to vehicle operation, and the proposed propane-fired dehydration reboiler at the new facilities. There are no planned operational activities along the proposed pipeline or at the well sites that would generate emissions of criteria pollutants.

The total direct and indirect emissions associated with the Proposed Action would not exceed applicability threshold levels. Because AQCR 075 is an attainment area, there is no existing emission budget. However, due to the limited size and scope of the Proposed Action, it is not anticipated that the estimated emissions would make up 10 percent or more of regional emissions for any criteria pollutant and not be regionally significant. A detailed breakdown of drilling, construction, and operation emissions is located in Appendix A.

Table 4.1.2.1. Proposed Action Emissions Compared to Applicability Thresholds

	Annual emissions (Short Tons Per Year)						*De minimis* threshold (Short Tons Per Year)	Would emissions exceed applicability thresholds? [Yes/No]
Activity (Year)	**CO**	**NO_x**	**VOC**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**		
Drilling and Construction (2008)	4.8	8.7	1.2	0.01	0.4	0.4	100	No
Operational Emissions	0.0	0.1	0.0	0.0	0.0	0.0	100	No

Note: SO_x is sulfur oxides.

4.1.2.2 Regulatory Review

New stationary sources of emissions may be subject to both federal and state permitting requirements. These requirements include, but are not limited to, New Source Review (NSR), Prevention of Significant Deterioration (PSD), and New Source Performance Standards (NSPS) for selected categories of industrial sources. In addition, under the National Emission Standards for Hazardous Air Pollutants (NESHAP), new and modified stationary sources of air emissions may be subject to Maximum Achievable Control Technology (MACT) requirements if their potential to emit HAPs exceeds either 10 short tons per year of a single HAP, or 25 short tons per year of all regulated HAPs. These regulations are outlined in Title 35 of the Illinois Administrative Code Subpart B, Air Emission Regulations (IPCB, 2008).

The Decatur ADM Complex is in an attainment area and would introduce only one new insignificant stationary source of air emissions; the dehydration reboiler. However, since it would be located at an existing major source, it is possible that the reboiler would need a permit to construct, and be added to the list of insignificant sources outlined in the facility's Title V permit. At the final design stages, the reboiler would be chosen and permitting requirements correspondingly determined.

The construction and drilling activities would be accomplished in full compliance with Illinois regulatory requirements through the use of compliant practices and/or products. Some applicable sections may include:

- Subchapter C: Part 212: Visible and Particulate Matter Emissions,
- Subchapter C: Part 215: Organic Material Emissions Standards and Limitations, and
- Subchapter I: Part 237: Open Burning.

Construction and drilling activities would be expected to cause some localized dust. Standard mitigation techniques such as watering, erecting wind breaks, and using covers where practicable would be employed to minimize its effects.

4.1.2.3 Greenhouse Gasses and Global Warming

Direct and Indirect CO_2 Emissions. Carbon emissions from the Decatur ADM Complex would be captured and sequestered in the Mt. Simon deep saline reservoir. It is anticipated that approximately 1.1 million short tons (1 million metric tons) of CO_2 would be sequestered during the project three year injection period. However, the overall amount of CO_2 generated would increase due to the burning of diesel fuel during drilling, the additional electrical demand (5-6 megawatt (MW)), and worker commutes. The net CO_2 emissions for the project were estimated (Table 4.1.2.3). A net decrease of approximately 988,000 short tons of CO_2 emission would be realized over the life of the project. These 988,000 short tons of CO_2 are currently vented to the atmosphere and would not be if the sequestration project is successful. This is less than 0.0001% of the global CO_2 emissions. The additional 115,000 short tons of that would be generated would not be generated at all without the implementation of the Proposed Action.

Table 4.1.2.3. Net CO_2 Emissions for the Proposed Action

Activity/Source	**Emissions (Short Tons)**
Drilling and Construction	494
Electricity Usage	113120
Worker Commutes	722
Sequestration	(1102300)
Total Emissions	(987964)

Fugitive CO_2 Emissions and Compressor Blowdown. Because sequestration of CO_2 is an integral part of research and development activities for the Proposed Action, fugitive air emissions of CO_2 would occur during routine operations. Sources of emissions during sequestration operations could include injection and monitoring wells; and aboveground valves, piping, and wellheads that comprise the transmission pipeline. In addition, compressors are often equipped with automatic blowdown valves that depressurize compressors, bottles, separators, and interconnecting lines in the event of a shutdown.

It is expected that emissions from these sources would be very small. The majority of the CO_2 stream that would feed the system would otherwise be vented to the atmosphere without the Proposed Action. Therefore, CO_2 that is vented from the unit during this project are emissions that would otherwise have occurred if the compression unit, pipeline, and wells were not in place. Therefore, these sources of fugitive emissions would not increase overall CO_2 emissions.

Atmospheric monitoring and modeling for CO_2. Direct measurement of CO_2 concentrations in the air would be an integral part of the MMV Program to ensure the health and safety of the public and to curtail environmental impacts. Because of the natural variations in CO_2 concentrations and fluxes in the near surface environment that arise from soil, plant, and subsurface processes several monitoring techniques would be employed. In addition, to track potential leaks the Hybrid Single-Particle Lagrangian Integrated Trajectory Model (HYSPLIT), developed by the National Oceanic and Atmospheric Administration (NOAA) and Australia's Bureau of Meteorology, would be used to simulate the atmospheric dispersion and the concentration distribution of CO_2 from multiple-source emissions of CO_2, and/or other potential pollutants associated with a CO_2 release.

4.1.3 Effects of No-Action

Selecting the No-Action alternative would result in no direct impact to ambient air-quality conditions. No drilling or construction would be undertaken and no changes in facility operations would be expected. Ambient air-quality conditions would remain as described in Section 4.1.1.3.

Selecting the No-Action alternative could have minor indirect impacts to air quality. No-Action, meaning that this project is not carried out in any setting, would delay planned larger-scale sequestration projects by perhaps several years. The increased understanding of subsurface behavior of CO_2 would not be gained. Additionally, an example of successful and safe sequestration, on any scale, could not be offered to the public in support of a larger, more expensive project. The complexities of a larger pilot might translate to long delays in public and regulatory approval, thereby jeopardizing goals of rapid action on climate change issues. A 3-year delay in initiating large-scale sequestration efforts would lead to an increase CO_2 emissions by approximately 5% and atmospheric concentrations of CO_2 would increase by as much as 6 ppm before any stabilization effort would be started.

4.1.4 Cumulative Effects

The State of Illinois takes into account the effects of all past, present, and reasonably foreseeable emissions during the development of the State Implementation Plan (SIP). The State of Illinois accounts for all significant stationary, area, and mobile emission sources in the development of this plan. Estimated emissions generated by the Proposed Action would be *de minimis* and would not be regionally significant. Therefore, it is not anticipated that the Proposed Action would contribute substantially to adverse cumulative effects to air quality.

4.2 Geology and Soils

4.2.1 Description

The ADM Phase III Test Site is located on the east side of the city of Decatur, Illinois, which lies in Macon County (Section 5 of Township 16 North Range 3 East). The site is located on the existing Decatur ADM Complex. Project activities are planned immediately north of the main ADM plant in an open field owned by ADM. The land use of the Decatur ADM Complex is characterized as industrial, although the test site has been previously leased for agricultural uses (MGSC, 2008). Water bodies in the vicinity include Lake Decatur, which was formed in 1920s by the damming of the Sangamon River, a principal tributary of the Illinois River (Decatur, 2008a; IDNR, 2003). This river and reservoir provide surface drainage for the surrounding land and water supply for the city of Decatur (Decatur, 2008a). The site is located on essentially flat topography with slopes less than 5% as determined from topographic maps covering the area. There is no evidence of karst topography (such as sinkholes) in the area (MGSC, 2008).

Subsurface. The subsurface geology of the Illinois Basin (Figure 4.2.1-1) in the project area consists of a thick sedimentary sequence of Cambrian to Pennsylvanian geologic formations overlain by unconsolidated moraine deposits of the Quaternary-age Wedron Group (ISGS, 1996). The thickest and most widespread brine reservoir in the Illinois Basin is the basal Cambrian-age Mt. Simon Sandstone. It is overlain by the Cambrian Eau Claire Formation, a regionally extensive very low-permeability shale, and underlain by Precambrian granitic basement. The deposition of the Mt. Simon Sandstone is commonly interpreted to be a shallow, subtidal marine environment. In general, the paleogeography of Illinois at the time of uppermost Mt. Simon deposition was one of a low-relief coastal setting in a subsiding basin that was open to the ocean to the south. In the northern half of Illinois, the Mt. Simon is used extensively for natural gas storage. Detailed reservoir data are available from these projects. Data from ten Mt. Simon gas storage projects shows that the upper 200 feet (60.96 m) has porosity and permeability high enough to be a good sequestration target. The closest Mt. Simon penetration to the test site is the Harrison #1 well about 17 miles (27.36 km) to the southeast (ADM, 2008a).

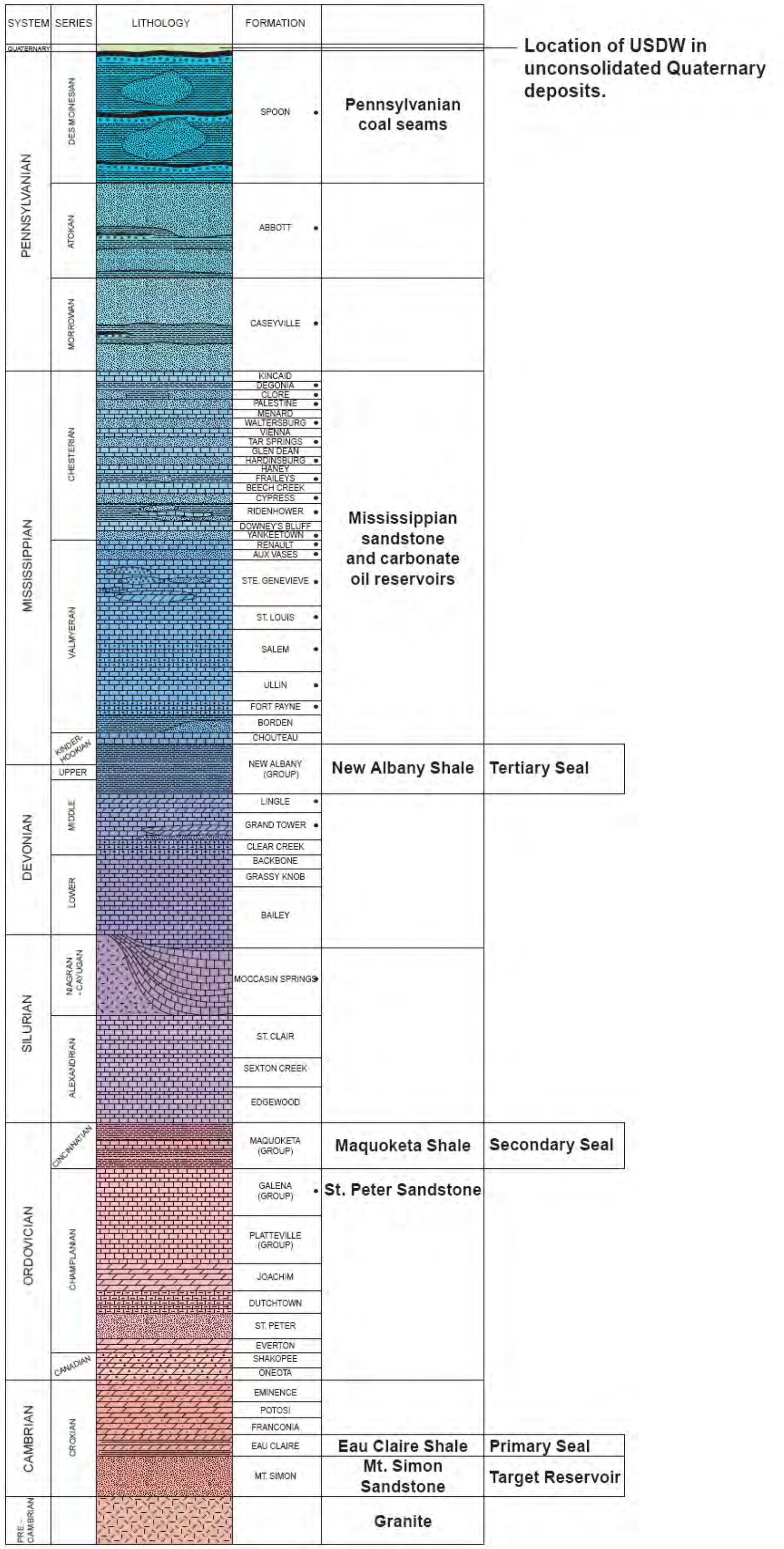


Figure 4.2.1-1. Illinois Basin's Stratigraphic Column of Key Formations for CO_2 Injection
Source: (NETL, 2008b).

Mapping from regional data suggests that the gross thickness of the Mt. Simon is 1,000 to 1,600 feet (304.8 – 487.68 m) at the test site. The nearest well with a porosity log for the entire thickness of the Mt. Simon, the Humble Oil Weaber-Horn #1 well, was drilled on the Loudon Field anticline in Fayette County, a major oilfield 51 miles (82.08 km) south of the project area. The Weaber-Horn #1 drilled through 1,300 feet (396.24 m) of Mt. Simon before drilling into the Precambrian granite (ADM, 2008a).

The top of the Mt. Simon at the Weaber-Horn #1 well was at 7,000 feet (2.14 km) and the gross thickness had an average porosity, calculated from wireline logs, of about 12 percent. The Weaber-Horn #1 well log porosity data are similar to those found in the Hinton #7, the deepest well at the Manlove Field in Champaign County, approximately 37 miles (59.55 km) northeast of the project area. The Manlove Field is the deepest Mt. Simon natural gas storage field in the Illinois Basin (NETL, 2008b).

A regional Mt. Simon structure map suggests that the top of the Mt. Simon is between 5,000 and 6,000 feet (1.52 and 1.83 km) measured depth at the test site. For the CO_2 injection portion of this research project, the injection interval would not be the entire thickness of the Mt. Simon; rather it would be a subinterval within the gross thickness of this massive sandstone geologic unit that has acceptable permeability properties (NETL, 2008b).

Within the Illinois Basin, three thick shale units function as major regional seals. These are, from shallowest to deepest, the Devonian-age New Albany Shale, Ordovician-age Maquoketa Formation, and the Cambrian-age Eau Claire Formation. There are also many minor, thinner Mississippian- and Pennsylvanian-age shale beds that form seals for known hydrocarbon traps within the Basin. The lowermost seal, the Eau Claire, has no known penetrations within a 17-mile (27.36 km) radius surrounding the test site; therefore, there are no existing wellbores whose integrity would be of concern. All three major seals are laterally extensive and appear, from subsurface wireline correlations, to be continuous within a 100-mile (160.93 km) radius of the test site (NETL, 2008b).

The primary confining zone (seal) at the test site is the Cambrian age Eau Claire Formation. An isopach map based on regional well control suggests that the Eau Claire should be 300–500 feet (91.44 – 152.40 m) thick at the proposed test site. The estimated top of the Eau Claire Formation would occur between 4,500 to 5,500 feet. The Eau Claire Formation is composed primarily of a silty, argillaceous dolomitic sandstone or sandy dolomite in northern Illinois and becomes a siltstone or shale in the central part of the Illinois Basin. Regionally, the Eau Claire is a persistent shale interval above the Mt. Simon that is expected to provide a good seal.

The database of UIC and gas storage wells with cores from the Eau Claire was also used to derive seal qualities. Data show that the Eau Claire's median permeability is 0.000026 millidarcies (mD) and median porosity is 4.7%. At the Ancona Gas Storage Field, located 80 miles (128.75 km) to the north of the proposed test site, cores were obtained through 414 feet (126.19 m) of the Eau Claire, and 110 analyses were performed on a foot-by-foot basis on the recovered core. Most vertical permeability analyses showed values of less than 0.001 mD up to 0.001 mD. Only five analyses were in the range of 0.100–0.871 mD, the latter being the maximum value in the data set. Thus, even the more permeable beds in the Eau Claire

Formation are expected to be relatively tight and would tend to act as sealing lithologies (NETL, 2008b).

There are two secondary seals expected at the test site. The Ordovician-age Maquoketa Shale is laterally continuous across the test site and is estimated to be over 200 feet (60.96 m) thick at the test site at an estimated depth of between 2,500 to 2,600 feet (762 to 792.48 m) measured depth. This shale is a regional seal for oil reservoirs from the Ordovician Galena (Trenton) Limestone. The Devonian-Mississippian-age New Albany Shale at a depth of approximately 1,800 feet (548.64 m) is about 140 feet (42.67 m) thick in the project area. Extensive well control from oilfields shows that this shale is a good seal for oil accumulations. Thus, it should also be a good secondary seal against the vertical migration of CO_2 (NETL, 2008b).

There are no mapped regional faults and fractures within a 25-mile (40.23 km) radius of the proposed site. A preliminary 2-D seismic survey has been completed during Phase II of the project. Additional 2-D, 3-D, and vertical seismic profile (VSP) data are planned to further characterize the site geology and monitor the fate of the CO_2 (ADM, 2008a).

Soils. Soils in the area were mapped by the U.S. Department of Agriculture (USDA) in 1990 (Figure 4.2.1-2). Five silt loam soil units have been mapped within the project site: the Drummer silty clay loam (152), Flanagan silt loam (154A), Proctor silt loam (148B), Catlin silt loam (171B) and Dana silt loam (56B). The most common soil type is the Drummer, which is characterized by a nearly level poorly drained soil that occurs in broad, flat areas on outwash or till plains. This soil is not highly susceptible to erosion due to the flat topography. The Flanagan silt loam is a nearly level, somewhat poorly drained soil located on broad ridges on till plains and moraines. The soil is not highly susceptible to erosion due to the flat topography. The land capability classification, or the suitability of a soil type for a particular field crop, for the Flanagan and Drummer soil types are moderately limited in the selection of species and require moderate conservation measures (NRCS, 2008). Specifically for these soil types, the land capability class of IIw denote that excess water (ponding/flooding) can interfere with crop productivity.

Figure 4.2.1-2. Map of Soil Types over the ADM Phase III Test Site
Source: (NRCS, 2008).

Table 4.2.1. Map Legend to NRCS-derived Soils Map for ADM Phase III Test Site

Map Unit Symbol	Map Unit Name	Acres (m^2) in Area of Interest	Percent of Area of Interest
56B	Dana silt loam, 2 to 5 percent slopes	9.3 (37,635)	6.1%
148B	Proctor silt loam, 2 to 5 percent slopes	5.9 (23,876)	3.9%
152A	Drummer silty clay loam, 0 to 2 percent slopes	64.9 (262,641)	42.9%
154A	Flanagan silt loam, 0 to 2 percent slopes	62.1 (251,310)	41.1%
171B	Catlin silt loam, 2 to 5 percent slopes	4.3 (17,401)	2.8%
198A	Elburn silt loam, 0 to 2 percent slopes	4.0 (16,187)	2.7%
679B	Blackberry silt loam, 2 to 5 percent slopes	0.6 (2,428)	0.4%
802B	Orthents loamy, undulating	0.1 (404)	0.0%
Totals for Area of Interest		151.2 (611,885)	100.0%

Source: (NRCS, 2008).

The Proctor, Catlin, and Dana soils are generally well drained to moderately well drained and have moderate rates of air and water movement. These soils have medium surface runoff, high water capacity, and moderate organic matter content. They have a land capability classification of IIe suggesting the soils have moderate limitations due to their susceptibility to erosion or prior damage due to erosion. The maintenance of adequate plant cover can mitigate their vulnerability to erosion (NRCS, 2008).

At the test site, the low topographic relief suggests that there is essentially no potential for landslides, and negligible risk of subsidence (ADM, 2008a).

4.2.2 Effects of Proposed Action

The main potential negative effects of the Proposed Action (injection of approximately 1.1 million short tons (1 million metric tons) of CO_2 over three years) are identified in the following paragraphs with accompanying notations regarding their likelihood of occurrence.

A sudden release of CO_2 to the surface would be considered unlikely because of the well technology to be used and the expertise of the technology providers. If it was to occur, such an event is unlikely to have a large impact on the soil resources surrounded the well. Effects would be very localized and readily remediated. The main risk to the soils would be if a sudden release occurred late in the project after substantial injection had occurred (in Year 3 for example).

Under these circumstances, the injected CO_2 would have had time to interact with organic and mineral matter in the reservoir and potentially have dissolved organic compounds and other contaminates. In related CO_2-EOR experience when sudden releases have occurred, the main adverse outcome to soils around the wellhead has been well blowout of dry ice contaminated with crude oil. There is no expectation of any crude oil in the reservoir at the ADM site. This has been readily cleaned up by removal and replacement with new soil.

Relatively slow leakage from the well bore due to casing and/or cement problems are likely to be detected ahead of time by the Mechanical Integrity Testing proposed in the UIC Permit application (ADM, 2008a).

Relatively slow or extremely slow leakage from the injection zone through the seal and ultimately into the soils is an extremely unlikely event even on a time scale of hundreds of years.

Due to the highly unlikely nature of the above-described effects, the conclusion is that there would be no measurable leakage of CO_2 from the storage formation to the surface or into another area in the subsurface.

4.2.3 Effects of No-Action

If the No-Action alternative is implemented, the construction and injection activities of the Proposed Action do not take place. Thus, no impacts to soils and geology would occur.

4.2.4 Cumulative Effects

ADM has no other projects planned for the area (Carroll, 2008b). Since there are no substantial impacts to geological and soil resources, the Proposed Action and the No-Action alternative do not substantially contribute to the cumulative impacts to these resources in the project area or its vicinity.

4.3 Water Resources

4.3.1 Description

The only significant source of surface water in the immediate vicinity is Lake Decatur, which is located approximately 1 mile (1.61 km) to the east of the ADM Phase III Test Site. Lake Decatur is a 3,090 acre reservoir formed by the damming of the Sangamon River, a major tributary to the Illinois River. Lake Decatur is the source of drinking water for the City of Decatur (Decatur, 2008a).

Water flows in the Sangamon River are monitored by the United States Geological Survey (USGS) downstream of the test site (05573540: Sangamon River at Route 48) and the Sangamon Dam. Hydrometric records from 1983-2007 indicate an annual mean flow of 693 cubic feet (ft^3)/sec (211.23 cubic meter (m^3)/sec) and achieved a maximum peak flow of 31,800 ft^3/sec (9692.64 m^3/sec) in May of 2002 (USGS, 2007).

Surface water quality was assessed on the Sangamon River in Decatur, Illinois, between the years 1978-1997. Specific conductance was measured between 300-1010 microsiemens per centimeter (µS/cm) with a mean value of 586.6 µS/cm. The pH of surface water samples had a field test range between 6.4 and 8.8 over the 1978-1997 sampling period (USGS, 2008).

Lake Decatur and the upstream reaches of the Sangamon River were identified on the IEPA's 2006 Section 303(d) (of the Clean Water Act) list of impaired waters (waters in which at least one applicable use is not fully supported). Uses not supported for Lake Decatur on the 2006 list were aquatic life, fish consumption, public and food processing water supplies, and aesthetic quality. The use not supported by upstream segments of the Sangamon River on the 2006 list was primary contact. Although still impaired, these waters have been removed from the 2008 list because a Total Maximum Daily Load (TMDL) has been established by IEPA. The exception is that Lake Decatur is on the 2008 303(d) list for not supporting aquatic life and fish consumption (IEPA, 2008; IEPA, 2006).

The City of Decatur also relies on ten groundwater wells to supplement its water supply in times of drought. The source of groundwater is the Mahomet Aquifer, located 6 miles to the north of the ADM test site, where water is pumped into the Sangamon River to supplement water levels in Lake Decatur (Roadcap and Wilson, 2001). The Mahomet aquifer is a major aquifer at 150 – 300 foot depth capable of yielding significant amounts of water (usually greater than 1,000 gallons per minute or approximately greater than 3,800 liters per minute). Other shallower aquifers are found in the Banner Formation, the Glasford Formation, and more recent sediments (ADM, 2008a).

Sand and gravel aquifers are likely to be thin or absent in the Banner Formation, the lower portion of the Glasford Formation, and the more recent sediments. Sand and gravel aquifers are likely to be 5 to 20 feet thick in the upper portion of the Glasford Formation and are likely found within 100 feet of the ground surface (ADM, 2008a).

4.3.2 Effects of Proposed Action

As summarized in Section 2.1.2.4, the current regulatory framework for USEPA's UIC permitting program includes multiple provisions for safeguarding and preventing injected fluid movement into USDWs. The permitted Class I injection well on the ADM test site would employ accepted industry standards in meeting the specified permit provisions and conditions. The findings of this section are valid only if the UIC permit application is successful and a Class I permit is issued for the ADM test site injection well.

The sequestration of CO_2 in deep brine reservoirs involves possible drilling through USDWs and a slow upward migration of sequestered CO_2 that has the potential to impact groundwater quality if not adequately trapped by confining layers. CO_2 interacts with the host brine to generate a low pH solution (on the order of 2.8 to 3.0). This acid water is known to mobilize metals adsorbed to mineral grains. Injection of CO_2 could also cause pressure gradients that can result in displacement of brine into overlying aquifers. These outcomes are of relatively low risk for the ADM Phase III Test because of the:

- Depth of the proposed injection zone,

- Multiple sequences of shale seals between the injection zone and USDW,
- Absence of seismic activity in the local area, and
- Relatively low injection rates of CO_2 compared to proposed commercial projects or the FutureGen project.

The main potential negative effects of the Proposed Action (injection of approximately 1.1 million short tons (1 million metric tons) of CO_2 over three years) are identified in the following paragraphs with accompanying notations regarding their likelihood of occurrence.

A sudden release of CO_2 to the surface involves extreme volume expansion of CO_2 from supercritical liquid state to gas and the large adiabatic decompression that occurs in such events are explosive in nature and result in high velocity ejection of dry ice and frozen formation water. Some of this material would be injected into the shallow aquifers around the wellhead. This type of event is considered unlikely for the Proposed Action because of the well technology to be used and the expertise of the technology providers. If it does occur, such an event is unlikely to have a large impact on the water resources surrounding the well. Effects would be very localized and readily remediated (Skinner, 2003).

The main risk to water resources would be if a blowout occurred late in the project after substantial injection had occurred (in Year 3 for example). Under these circumstances, the injected CO_2 would have had time to interact with organic and mineral matter in the reservoir and potentially have dissolved organic compounds and other contaminates. In CO_2-EOR experiences when blowouts have occurred, the main adverse outcome to shallow groundwater, immediately around the wellhead, has been well blowout of dry ice contaminated with crude oil (Skinner, 2003). This has been readily cleaned up by standard groundwater remediation methods.

Relatively slow leakage from the well bore due to casing and/or cement problems are highly likely to be detected ahead of time by the Mechanical Integrity Testing proposed in the UIC Permit application.

With regard to relatively slow or extremely slow leakage from the injection zone through the seal into USDW, data in the specific test location is not yet available, but proxy information from other similar wells in the region may be used to infer such values by analogy and the proposed 12 to 15 month pre-injection data monitoring and modeling period for the ADM Phase III Test Program will confirm and modify that proxy information as necessary. Potential impacts to groundwater will also be anticipated and minimized by implementation of a monitoring and mitigation plan that focuses on potential leakage pathways. For this test, there are four geological factors to consider when assessing the possibility that upward migration of the injected and sequestered CO_2 into USDWs. They are the number of intervening confining layers that occur between the injection zone and USDWs, thickness of those confining layers, the permeability and porosity of the confining layers, and the potential for fracture to occur in the confining layers.

Section 4.2.1 indicated that there are three thick shale units that function as major regional seals. There are also many minor, thinner Mississippian- and Pennsylvanian-age shale beds that form seals for known hydrocarbon traps within the basin (ADM, 2008a). Just as important, the lowermost Eau Claire seal has no known penetrations within a 17-mile (27.36 km) radius surrounding the site; therefore, integrity of existing wellbores is not as significant an issue as in some shallower formations. All three major seals are laterally extensive and appear, from subsurface wireline correlations, to be continuous within a 100-mile (160.93 km) radius of the test site (ADM, 2008a).

Section 4.2.1 also states that the expected thicknesses of the confining layers at the test site are substantial, likely measuring 300-500 feet (91.44 – 152.40 m) for the primary Eau Claire formation, over 200 feet (60.96 m) for the Maquoketa formation, and 140 feet (42.67 m) for the New Albany Shale formation. The shallower secondary formations have already demonstrated their effectiveness as regional seals for oilfields (NETL, 2008b).

Section 4.2.1 summarizes porosity and permeability values from nearby gas storage wells, concluding that even the more permeable beds in the Eau Claire formation, with permeability values as high as 0.871 mD are expected to be relatively tight and tend to act as sealing lithologies (NET, 2008b).

The main faults and or fracture zones of concern are ones that may penetrate through the seals into the reservoir (that is ones that penetrate the containment zone). Based on information presented in the UIC permit (ADM, 2008a) application, no faults have been documented within 25 miles (40.23 km) of the test site. Section 4.2.1 indicates that a preliminary 2-D seismic survey has been completed during Phase II of the project. Additional 2-D, 3-D, and VSP data are planned to further characterize the site geology and monitor the fate of the CO_2. There is no specific data available on the fracture pressure of the Eau Claire Formation, but there are indications of successful storage of gas in the Mt. Simon without fracturing the overlying Eau Claire for 10 underground natural gas storage reservoirs in Illinois operating in the Mt. Simon at depths ranging from 1,420 to 3,950 feet (432.82 to 1,203 m) (ADM, 2008a).

The injection process does not utilize substantial volumes of water. Therefore, there should not be a direct impact on the supply of water resources of the area.

The surface water resources primarily represented by Lake Decatur are subject to the same subsurface effects described above for USDWs. The difference is the potential effects are reduced by the greater vertical separation from the saline reservoir as well as horizontal separation from the lake, which is approximately 1 mile (1.61 km) to the east of the ADM Phase III Test Site. As described earlier, a sudden CO_2 release to the surface causes formation of dry ice and frozen formation water, and the effects are very localized.

The soils are not highly erodible (See Section 4.2), so water contamination from increased run-off is not a major issue. Further, the facility has received a construction permit under the General NPDES permit for construction storm water discharges (Keller, 2008).

For reasons presented above, the project has limited potential to have negative effects on the availability and current uses of water resources and the potential to cause impairment of water resources through construction and operation of the sequestration project.

4.3.3 Effects of No-Action

If the No-Action alternative is implemented, the construction and injection activities of the Proposed Action do not take place. Thus, no impacts to water resources are expected to occur.

4.3.4 Cumulative Effects

ADM has no other projects planned for the area (Carroll, 2008b). Since there are no substantial impacts to water resources, the Proposed Action and the No-Action alternative do not substantially contribute to the cumulative impacts to these resources in the project area or its vicinity.

4.4 Wetlands and Floodplains

4.4.1 Description

There are no wetlands designated within the project area boundaries according to the National Wetlands Inventory (USFWS, 1987). The facility would be built within the existing industrial setting of the Decatur ADM Complex, and the pipeline would not be located near any wetland area. The nearest wetland is located adjacent to the western boundary of the ADM Phase III Test Site with a road separating it from the test site (Figure 4.4.1-1). Additionally, there is a man-made settling pond at the test site that collects surface runoff and/or drain tile water.

The National Wetlands Inventory map unit outside of the northwest site boundary is classified as PEMAf (USFWS, 1987). The PEMAf unit is an emergent wetland classified as palustrine emergent temporarily or semi-permanently flooded (USFWS, 2008a). Palustrine system designations include all non-tidal wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens.

There are no floodplains in the ADM Phase III Test Site area. The nearest floodplain is associated with an unnamed tributary off the Sangamon River and Lake Decatur to the east of the test site approximately 0.36 miles (0.58 km) (Illinois State Water Survey, 1996). Figure 4.4.1-2 (second page) shows the location of the floodplains to the test site.

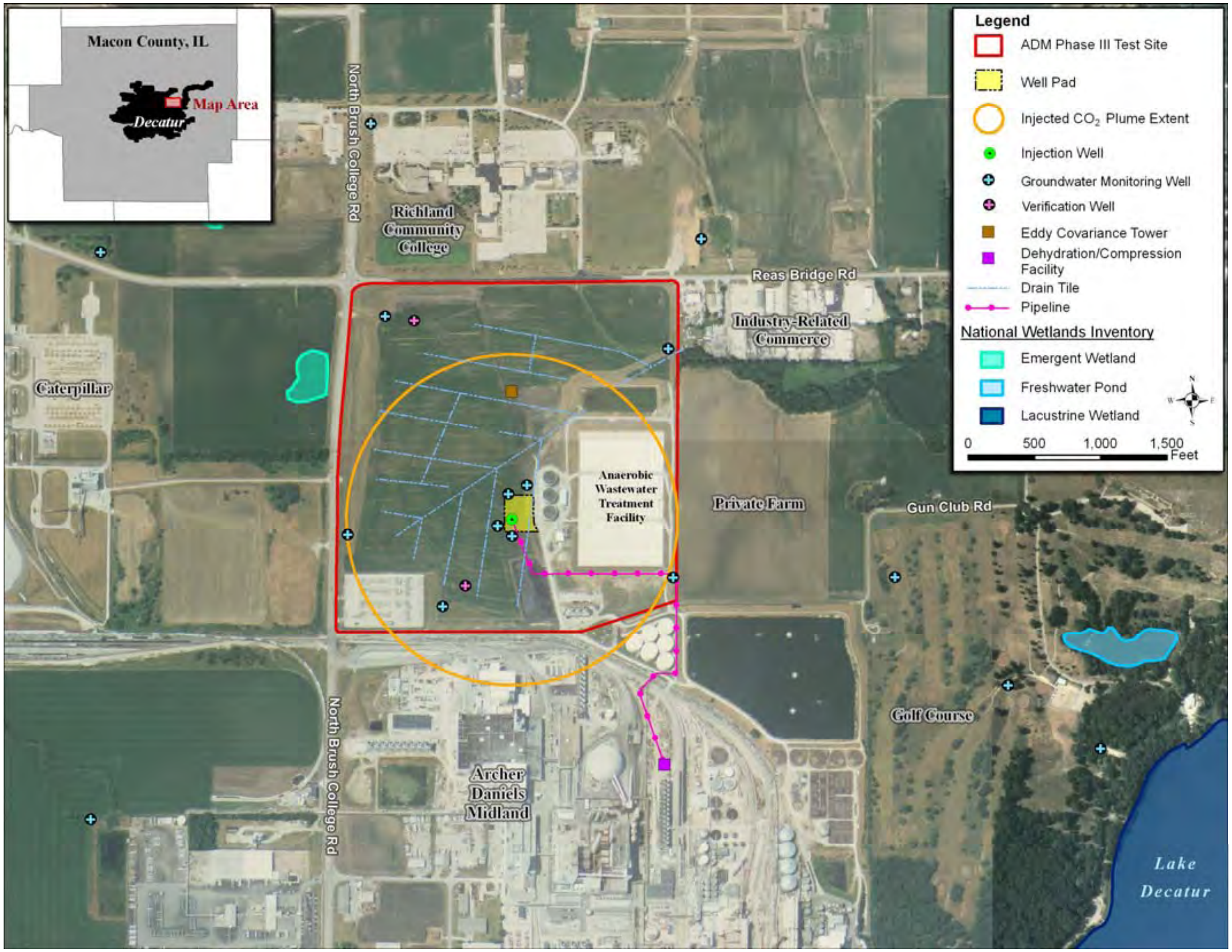


Figure 4.4.1-1. Water Bodies and Wetlands near the Test Site

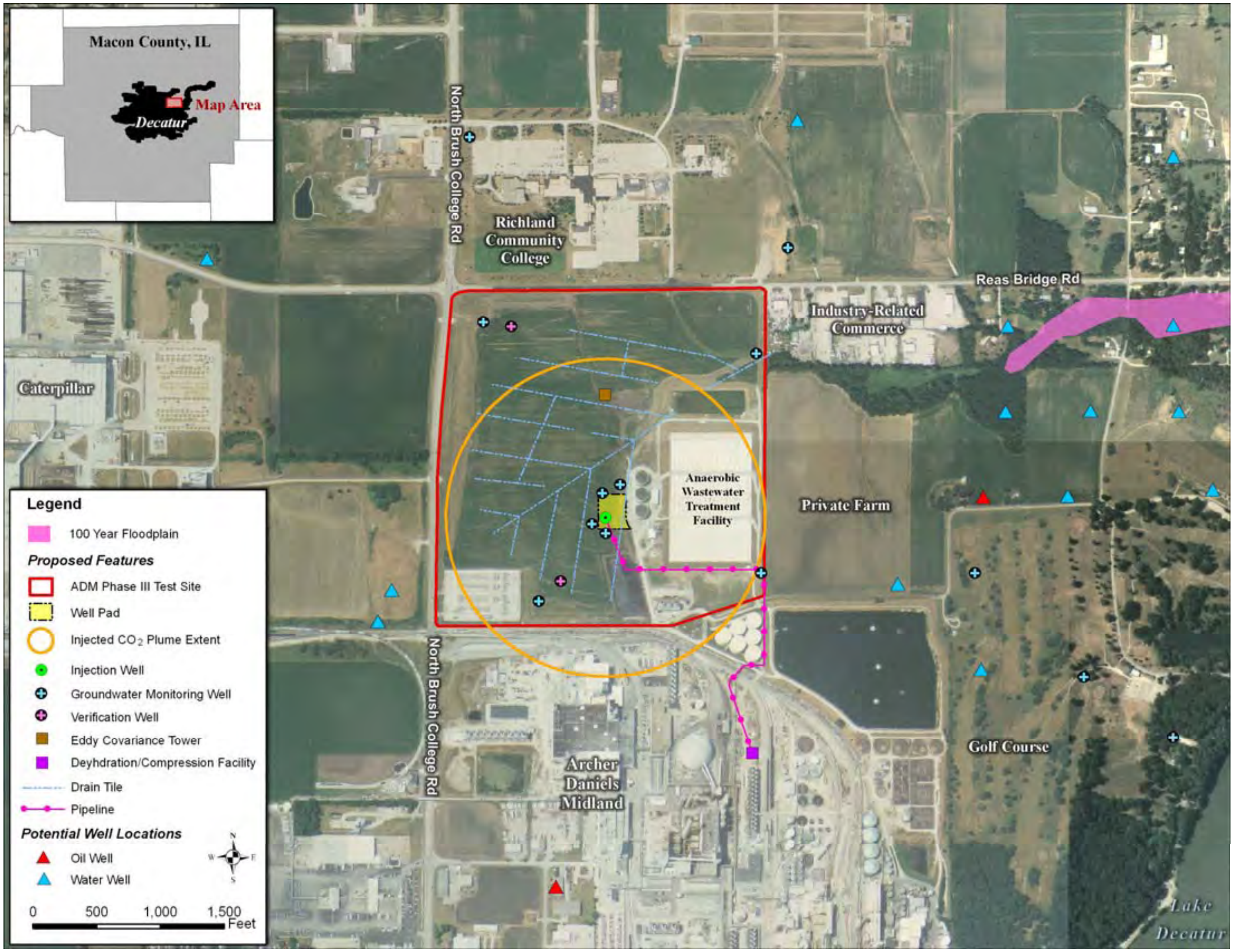


Figure 4.4.1-2. Floodplains near the ADM Phase III Test Site

4.4.2 Effects of Proposed Action

As there are no wetlands or floodplains in the test site, wetland resources and floodplains would not be impacted by construction of the Proposed Action. Although three wells would be drilled along the western boundary of the test site, they would be far enough away so that there would be no impacts to the wetland located across the road outside the study area. Furthermore, it is not likely that wetlands would be impacted by the discharge of wastewater from project activities. Similarly, the wells drilled on the eastern boundary of the test site should be far enough away so that there would be no impacts to floodplains.

The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on wetlands and floodplains near or at some distance from the test site. Wetland vegetation and water quality could be impacted by increased concentrations of CO_2, possibly resulting in changes in species composition, plant death, changes in pH, and water quality (International Energy Agency, 2007).

Although leakage of CO_2 to the surface affecting wetlands and floodplains in a widespread area is possible, it is more likely that any impacts to wetlands and floodplains would be confined to the immediate project area and would not cause any regional impacts. Thus, impacts on wetlands and floodplains by the Proposed Action would not be expected to exceed the significance threshold.

4.4.3 Effects of No-Action

Under the No-Action alternative, the ADM Phase III Test Site work by the MGSC would not be implemented. No impacts to wetlands or floodplains would occur as a result of this alternative.

4.4.4 Cumulative Effects

Previous industrial development of the project area by ADM and recent agricultural practices may have resulted in impacts to any wetlands that may have occurred onsite at one time. Wetlands in the project area vicinity are subject to adverse effects from ongoing agricultural, residential, and industrial activities; these activities are likely to continue in the future. The proposed project would not pose any threats to wetlands or floodplains in the project area, aside from the unlikely leakage of CO_2 to the surface, which would have widespread consequences on wetlands and floodplains. However, given the larger impacts to wetlands and floodplains from past, present, and future activities, cumulative impacts contributed by the proposed project would be minimally adverse and are not expected to exceed the threshold of significance.

4.5 Terrestrial Vegetation

4.5.1 Description

The proposed new CO_2 injection wells and observation wells would be located in an area characterized by the Bailey Ecoregion classification as the Prairie Parkland (Temperate)

Province of the Prairie Division (National Atlas, 2008). This ecoregion covers an extensive area from Canada to Oklahoma, with alternating prairie and deciduous forest. Vegetation in this province is forest-steppe, characterized by intermingled prairie, groves, and strips of deciduous trees (Bailey, 1995). Trees often cover the highest hills. Grasses are the dominant prairie vegetation. The most prevalent type of grassland is bluestem prairie, dominated by such plants as big bluestem, little bluestem, switchgrass, and Indian grass, along with many species of wildflowers and legumes. In many places where grazing and fire are controlled, deciduous forest is encroaching on the prairies. Due to generally favorable conditions of climate and soil, most of the area is cultivated, and little of the original vegetation remains. The upland forest in this province is dominated by oak and hickory.

The Proposed Action site consists of land within the Decatur ADM Complex that has been disturbed from its natural state. Surrounding land is industrial, residential, or agricultural. An adjacent fallow agricultural field owned by ADM comprises most of the test site. Low growing grasses occur on the area surrounding the Anaerobic Wastewater Treatment Facility, which has been previously disturbed.

The Illinois Department of Natural Resources has compiled an inventory of resource rich areas (RRA) in Illinois (MGSC, 2008). The Proposed Action site does not lie within a designated natural area. The Sangamon River RRA, approximately seven miles (11.27 km) to the northeast of the Proposed Action site, is the closest RRA.

No critical habitats or federally listed plant species exist in the vicinity of the test site. Two federally listed plant species, Eastern prairie fringed orchid (*Platanthera leucophaea*) and prairie bush clover (*Lespedeza leptostachya*) – both threatened, and one Illinois state listed endangered plant species, wild hyacinth (*Camassia angusta*), occur in Macon County (USFWS, 2007; IDNR, 2008), but are not likely to be found in the project area. A review of the U.S. Fish and Wildlife technical assistance website (USFWS, 2008b) on June 10, 2008, for federally listed threatened and endangered species resulted in a conclusion that the Proposed Action would have "no effect" on listed species, their habitats, or proposed or designated critical habitat. An official consultation request and documentation memo are included in Appendix B.

4.5.2 Effects of Proposed Action

Construction activities associated with the Proposed Action would occur in the fallow field north of the main ADM plant where there is no native vegetation growing, or in the complex itself. Some of the new proposed wells and pipeline may be placed in the areas of low growing grasses, which may be disturbed or removed for well and pipeline installation. The majority of disturbance would occur in previously disturbed areas, minimizing adverse impacts on vegetation. The CO_2 compression-dehydration surface facility and part of the pipeline would be in the industrial complex part of the Decatur ADM Complex, which mainly consists of paved surfaces.

Approximately a 100-foot (30.48 m) radius around the injection well would be disturbed during installation. The injection well pad and the surrounding operations area would disturb less than one acre, on which there would be very little, if any, vegetation. Installation of the two verification wells, four onsite groundwater monitoring wells, and up to 12 additional groundwater monitoring wells (outside of the project boundary) would disturb a very small area around each well, probably less than 0.5 acre (2023 m^2) total, on which there would be very little, if any, vegetation. Construction of the 3000-foot (914.4 m) pressurized pipeline would disturb ground for less than half its length as much of the pipeline follows paved surfaces, likely not more than 0.5 acre (2023 m^2) on which there would be very little, if any, vegetation. There could also be localized vegetation disturbance from foot traffic during installation, injection, and monitoring; however, this area would likely be minimal and limited to the areas immediately surrounding the equipment.

Exotic plants or seeds could be brought to the site with fill material or on equipment. New introductions could allow for exotic plants to become established and spread, especially in areas where the ground is newly disturbed by construction activities. Exotic plants currently growing in the area can also become established and spread on newly disturbed substrates. However, mitigation to ensure that imported material does not contain exotic plant material would be implemented.

As no critical habitats or federally listed plant species exist in the vicinity of the project area, there would be no impacts on threatened or endangered species.

The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on vegetation near or at some distance from the project area. Although atmospheric CO_2 promotes plant growth, increased concentrations in the soil could lead to root asphyxiation and plant death (International Energy Agency, 2007). Impacts of seepage on on-shore ecosystems could also include altered biological diversity and changes to the composition and numbers of species in the local environment. The range of effects on terrestrial ecosystems could extend to entire ecosystems and could be chronic, acute, or lethal depending on species affected and concentrations of CO_2. However, aerial imaging of the injection site would monitor vegetative conditions to validate integrity of seal formation, injection well, and other potential migration pathways to the biosphere. Any irregularities, such as dieback, that are detected would trigger remediation measures.

Any changes to native vegetation would be limited to a small area and would not affect the viability of the resources. Full recovery would occur in a reasonable time, considering the size of the project and the affected resource’s natural state. Therefore, impacts on terrestrial vegetation would not be expected to exceed the significance threshold.

4.5.3 Effects of No-Action

Under the No-Action alternative, the ADM Phase III Test Site work by the MGSC would not be implemented. No impacts to terrestrial vegetation would occur as a result of this alternative.

4.5.4 Cumulative Effects

Vegetation in the ADM Phase III Test Site has been previously cleared for ADM industrial development and agricultural practices. These activities have involved removal, trampling, or destruction of vegetation and disturbance of ground cover. Any vegetation disturbance associated with the Proposed Action would occur in previously disturbed areas or areas devoid of any vegetation. It is also possible that an unlikely leakage of CO_2 to the surface would have wider spread consequences on vegetation. Overall, cumulative impacts from the proposed project when added to other past, present, and reasonably foreseeable future actions would be minimally adverse and are not expected to exceed the threshold of significance.

4.6 Wildlife

4.6.1 Description

Common mammals that occur in rural areas in the vicinity of Decatur, Illinois, include white-tail deer, groundhog, skunk, mink, red and gray fox, and river otter. Common birds include Canada goose, owls, hawks, turkey vulture, and mourning dove. Reptiles include snapping turtle, spotted turtle, timber rattlesnake, western fox snake, eastern milk snake, and bull snake.

No critical habitat exists in the vicinity of the test site or in Macon County. One federally listed wildlife species, Indiana bat (*Myotis sodalis*) - endangered, and two Illinois state listed endangered species, upland sandpiper (*Bartramia longicauda*) and Bewick's wren (*Thryomanes bewickii*), occur in Macon County (IDNR, 2008). Of these species, only the Bewick's wren has been documented as occurring approximately one mile (1.61 km) south of the test site. A review of the U.S. Fish and Wildlife Service (USFWS) technical assistance website (USFWS, 2008b) on June 10, 2008, for federally listed threatened and endangered species resulted in a conclusion that the Proposed Action would have "no effect" on listed species, their habitats, or proposed or designated critical habitat. An official consultation request and a documentation memo are included in Appendix B.

4.6.2 Effects of Proposed Action

Activities for construction of the CO_2 compression-dehydration facility, installation of wells and pipeline, vehicle traffic, lighting during night work, and human presence would cause temporary displacement and disturbance of resident wildlife for the two year duration of construction and installation and three year injection period. Species are expected to return to the area after construction and injection is completed, although there may still be some minimal disturbance during the additional two years of post injection monitoring (MMV would take place concurrently with the three year injection period). These impacts would be localized and limited to the immediate area of the project area.

It is estimated that very minimal (less than one acre (4,047 m^2)) of wildlife habitat would be disturbed by installation of wells and pipeline. Approximately a 100-foot (30.48 m) radius around the injection well would be disturbed during installation. The injection well pad and the surrounding operations area would disturb less than one acre (4,047 m^2), on which there would be very little, if any, wildlife habitat. Installation of the two verification wells, four onsite groundwater monitoring wells, and up to 12 additional groundwater monitoring wells (outside of the project boundary) would disturb a very small area around each well, probably less than 0.5 acre (2,023 m^2) total, on which there would be very little, if any, wildlife habitat. Construction of the 3,000-foot (914.4 m) pressurized pipeline would disturb ground for less than half its length as much of the pipeline follows paved surfaces, likely not more than 0.5 acre (2,023 m^2) on which there would be very little, if any, wildlife habitat.

As no critical habitats or federally listed animal species exist in the vicinity of the project area, there would be no impacts on threatened or endangered species.

The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on wildlife near or at some distance from the project area. Effects of a leak would decrease in severity in a series of concentric rings, with those organisms closest to the leak suffering from acute or even lethal concentrations of CO_2 (International Energy Agency, 2007). Changes in subsurface biogeochemical processes could lead to changes in soil pH with associated negative effects on microbial populations, leading to a change in nutrients present which would progress up the food chain. Changes in the quality of groundwater would have serious consequences on water resources. Both food chain and water resource impacts would likely have detrimental effects on animal health. Additionally, prolonged exposure to high CO_2 concentrations may result in increased risk of asphyxiation for some wildlife (International Energy Agency, 2007).

Any impacts on wildlife from the Proposed Action would be limited to a small portion of the population and would not affect the viability of the resource. Full recovery would occur in a reasonable time, considering the size of the project and the affected species' natural state. Therefore, impacts on wildlife would not be expected to exceed the significance threshold.

4.6.3 Effects of No-Action

Under the No-Action alternative, the ADM Phase III Test Site work by the MGSC would not be implemented. No impacts to wildlife would occur as a result of this alternative.

4.6.4 Cumulative Effects

Wildlife and habitat in the project area have been, and continue to be, subject to disturbance and damage by ADM industrial development and activities, and agricultural practices. Habitat disturbance associated with new infrastructure as part of the Proposed Action would be limited, and wildlife displacement and disturbance would be temporary lasting only for the duration of the construction, injection, and monitoring period. It is also possible that an unlikely leakage of CO_2 to the surface would have wider spread consequences on wildlife and habitat. Cumulative impacts from the proposed project when added to other past, present, and reasonably foreseeable future actions would be minimally adverse and are not expected to exceed the threshold of significance.

4.7 Land Use

4.7.1 Description

The ADM Phase III Test Site would be located near Decatur, Illinois, within Macon County and entirely within the large Decatur ADM Complex that is owned and managed by ADM, one of the consortium partners of the MGSC. ADM is one of the world's largest processors of soybeans, corn, wheat, and cocoa. ADM is a leading manufacturer of biodiesel, ethanol, soybean oil and meal, corn sweeteners, flour, and other value-added food and feed ingredients (ADM, 2008a).

The Decatur ADM complex consists of various processing facilities including a corn wet milling plant with ethanol production, which would be the source of CO_2 for this project. Additional primary facilities include cogeneration, bio-products, oilseed processing, and vegetable oil refining.

Nearby properties and/or land uses include Richland Community College; Caterpillar, Inc.; industry-related commercial businesses; and private farm (Figure 2.1.1-2). Macon County has a comprehensive plan under development that will establish existing and future land use plans, but these plans were not available for this analysis.

Land utilized for the proposed CO_2 compression-dehydration facility and much of the pipeline construction are visibly industrial in nature, which is in concert with their industrial designation as part of the Decatur ADM Complex. The injection well area and the remainder of the pipeline are would also be within the Decatur ADM Complex. The Decatur ADM Complex is a secured and fenced area that would also include the injection well area once this project commences.

The Drummer silty clay loam (152), Flanagan silt loam (154A), Proctor silt loam (148B), Catlin silt loam (171B) and Dana silt loam (56B) have all been identified at the test site based on the Soil Survey of Macon County (Figure 4.2.1-2)(MGSC, 2008). All of these soils are considered characteristic of prime farmland.

An alfalfa ground cover is planned for the vacant field where the injection well would be located beginning in the summer of 2008.

4.7.2 Effects of Proposed Action

The proposed project would slightly expand the visual and physical industrial character of the very large Decatur ADM Complex while remaining entirely within existing ADM property. The current Decatur ADM Complex developed property size is 300 acres (1,214,057 m^2) while the proposed project would be four acres (Carroll, 2008c). Current industrial land use designations would be unaffected by this project. Though the proposed injection well site is industrial property, there have been past uses there that were agricultural. With the exception of a 300 foot by 300 foot (91.44 m by 91.44 m) area for injection well surface improvements, the injection well area would be planted in alfalfa, retaining much of the agricultural appearance of this area of the project and minimizing any effects on identified prime farmland resources.

New elevated pipelines required by the project are planned to follow existing elevated pipe corridors on Decatur ADM Complex property, except for the portion immediately preceding the injection well area, which would be placed underground.

The compression-dehydration facility would be set among other heavy industrial uses featuring cooling towers and other plant facilities and equipment that are typical of this type of industrial facility. The appearance and operation of this part of the project would be compatible with its immediately surrounding land uses.

The compression and pipeline facility will be built fully within the Decatur ADM Complex and will be integrated with the control of ADM's processing facilities. ADM may, therefore, choose to continue operation of the compression-dehydration facility, pipeline, and injection well after the project is complete. That decision will be based on value of that operation with respect to greenhouse gas mitigation laws that may come into effect between now and 2014 at the conclusion of the project. Should requirements for emissions reductions applicable to companies like ADM be adopted, then ADM may continue operations consistent with permitting requirements for geological sequestration that may be in effect at that time and considering the relative value of the facility with respect to other options available to the company.

Should ADM choose not to operate the facility, the disposition of the equipment will be made in accordance with regulatory requirements and project closeout options available to ADM and to DOE in view of DOE's role in supporting the ADM Phase III Test Site. Equipment that may be readily moved may be salvaged and other installed components, such a concrete foundation slabs and buried pipeline segments, may be put to other uses within the Decatur ADM Complex. The injection well would be plugged in accordance with the UIC permit issued at the time of its initial operation (Finley, 2008; ADM, 2008a).

The effects of the Proposed Action are that land use impacts would be limited to a small area and would not noticeably alter any particular land use at the test site or in adjacent areas. The affected areas would fully recover in a reasonable time once the project is completed. Therefore, the impacts to land use from implementing the Proposed Action are not expected to exceed the significance threshold.

4.7.3 Effects of No-Action

Under the No-Action alternative, the ADM Phase III Test Site work by the MGSC would not be implemented. No impacts to land use would occur as a result of this alternative.

4.7.4 Cumulative Effects

No additional land use development is currently planned in the vicinity of the project outside of Decatur ADM Complex property (Carroll, 2008b; Chamber, 2008; Decatur, 2008b). ADM has no major development planned beyond routine expansion of current plant facilities (Carroll, 2008b). This project would expand industrial development in a predominately industrial land use area, so cumulative impacts would be negligible with regard to most unplanned development that may occur in this area and should be considered compatible with the current industrial character of the project area.

4.8 Socioeconomic Resources

The socioeconomic assessment considers those elements of the human social environment that may be sensitive to changes resulting from implementation of the Proposed Action. Specifically, the assessment is concerned with how the Proposed Action would affect people, institutions, communities, and the local economy, as well as larger infrastructure, social, and economic systems. This section describes the socioeconomic conditions that may be affected by implementation of Proposed Action and addresses the potential impact that may result from actions undertaken as a part of the Proposed Action.

4.8.1 Population

4.8.1.1 Description

The project area would be located on the east side of the metropolitan area of Decatur, Illinois, and is entirely contained by the existing ADM industrial complex. Within the corporate limits of the City of Decatur, the project area would be surrounded by a mixture of industrial and agricultural land with some residential and commercial properties located in the area, but substantially removed from the site proper. With a 2006 estimated population of 77,047 residents (Census, 2007a), Decatur is the county seat and also the largest city in Macon County.

The city is part of the larger Decatur Metropolitan Statistical Area, which had an estimated population of 109,061 in 2007 (Census, 2008). Incorporated communities within a 15 mile (24.14 km) radius of Decatur include: Argenta – population 841, Forsyth - population 2,871, Harristown - population 1,252, Long Creek - population 1,317, Macon - population 1,146, Mount Zion - population 5,061, Oreana - population 941, and Warrensburg - population 1,193 (Census, 2007a) Block data (Census, 2000a) for the area immediately surrounding the test site indicate a total of 51 residents living in 19 housing units, with an occupancy rate of 100 percent. Despite the predominately urban character of the Decatur region, 46.3 percent, or nine of the residential units in the areas neighboring the test site are classified by the U.S. Census as rural.

The estimated population for the city of Decatur shows a 5.9 percent decline from the 2000 population of 81,860, continuing a trend from the previous decade in which the city declined from its 1990 population of 83,885 (Census, No date). In 2000, Decatur supported a total of 37,239 housing units with a median value of $63,200. The occupancy rate for all units in the city was 91.5 percent. The average population density for the metropolitan area of Decatur is 1,923 persons per square mile (2,589,988 m^2), with a housing density of 855.1 units per square mile (2,589,988 m^2) (Census, 2000b). The median age of Decatur residents, 37.2 years, is slightly lower than that for the surrounding county, 39.3 years. Approximately 76.0 percent of the population is 18 years or older, with 6.7 percent under the age of five and 16.4 percent aged 65 and over (Census, 2000a).

The estimated population of Macon County in 2006 was 109,309 residents; a slight decrease from the 2000 total of 114,706 (Census, 2007b). In 2000, there were a total of 51,738 housing units in the county, with an occupancy rate of 90.3 percent and an average density of 86.5 units per square mile (2,589,988 m^2). Population density for this year was 86.5 persons per square mile (2,589,988 m^2) (Census, 2000b). Residents aged 18 years and older represented 75.4 percent of the total population. Children five years of age and younger account for 6.4 percent of the county's population and persons 65 years of age and older make up 15.2 percent (Census, 2000a).

4.8.1.2 Effects of Proposed Action

Implementation of the Proposed Action would have only a minor, if not negligible, effect on the size and demographic characteristics of the local population. No additional, permanent full-time employment would be generated as a result of this alternative. Any increased labor requirement would be temporary and limited to the construction of the well, pipeline, and compressor facilities. Estimates for the additional workforce required at the site range from 9 to 39 personnel, depending on the particular stage of the process (Schlumberger, 2008b). This temporary increase would be easily accommodated by existing local resources.

The Proposed Action would be in keeping with the industrial character existing in the project area and would not introduce any new or incompatible uses. The proposed well, compression-dehydration plant, and the associated pipeline would be located entirely within the existing Decatur ADM Complex boundaries. No additional land outside the existing footprint would be needed. As a result, no substantial impact would be associated with the potential to change the community character and setting, demographic composition, or housing availability beyond that already existing under ADM's current operation. Therefore, the impacts from implementing the Proposed Action are expected to be below the significance threshold.

4.8.1.3 Effects of No-Action

Continuation of the No-Action alternative would mean that DOE funds would not be used to support the proposed drilling, construction, and monitoring and data collection activities on the test site. Correspondingly, no change would occur in the existing condition, and the current management of the site would continue. No changes to local demographic composition or community setting and character would be anticipated under this alternative. Any future changes in the use or infrastructure of the site would be dependent on ADM short and longer-term corporate planning and any specific future use determinations for the test site that may derive from that process. Therefore, the impacts from implementing the No-Action alternative are expected to be below the significance threshold.

4.8.1.4 Cumulative Impacts

As noted under the Proposed Action, the introduction of the Proposed Action would not be expected to account for any noticeable changes in the size or demographic characteristics of the local population and would not contribute to any substantial changes in local community character and setting. When considered in combination with ADM's current and proposed management of the existing site and the future site condition, the cumulative effects would be expected to be minor and are not expected to exceed the threshold of significance.

4.8.2 Employment and Income

4.8.2.1 Description

The local economy of the City of Decatur is characterized by a combination of heavy and light industries along with large-scale agricultural production and services. Farming and farm-related occupations continue to be a major source of employment in the Macon County area. Per capita personal income for the city of Decatur in 2006 was $19,761. Employment statistics for the year indicate that the city supported a total civilian labor force of 36,551 workers, with an unemployment rate of 6.8 percent or 2,489 workers. The largest occupational categories included: management, professional, and related occupations, with 10,843 workers, or 31.8 percent of the workforce; sales and office occupations, with 7,954 workers or 23.4 percent of the workforce; and service occupations with 7,107 workers, or 20.9 percent of the total. Median household income in 2006 was $34,877 (Census, 2006a).

The leading employment sectors for Macon County in 2006 were manufacturing, with 24.46 percent of total employment; health care and social assistance, with 15.05 percent; and retail trade, with 12.75 percent of the total (BLS, 2006). Employment statistics for March 2008 indicate that the county supported a total labor force of 55,183 workers, with an unemployment rate of 6.1 percent, or 3,356 workers. This represents an increase of 0.3 percent from the 2007 annual average unemployment (BLS, 2008). The per capita personal income of $34,133 for that year was 89 percent of the state average, $38,409. Total personal income for the county was $3.7 billion (BEA, 2006). Median household income for 2006 was $41,009 (Census, 2006b). A summary of income distribution by household is presented in Table 4.8.2.1.

Table 4.8.2.1. Household Income for 2006

	Number	**Percent**
Less than $10,000	4,859	10.39
$10,000 to $14,999	3,710	7.93
$15,000 to $24,999	5,739	12.27
$25,000 to $34,999	6,179	13.21
$35,000 to $49,999	6,473	13.84
$50,000 to $74,999	8,321	17.79
$75,000 to $99,999	5,782	12.37
$100,000 to $149,999	4,040	8.64
$150,000 to $199,999	890	1.90
$200,000 or more	768	1.64
Total Households	**46,761**	**100**

Source: (Census, 2006b).

4.8.2.2 Effects of Proposed Action

Implementation of the Proposed Action would be expected to have only minimal effect on the local economy, labor conditions, and the availability of production or consumer resources in the surrounding community. Permanent, longer term labor requirements for operation, monitoring, and maintenance of the proposed facility would not be expected to be substantial and could easily be accommodated by ADM's existing labor force.

Labor requirements for the construction of the well, pipeline, and compressor facilities would be temporary and of short duration. Workforce estimates for the well drilling operations include from 24 to 39 personnel working 24 hours per day seven days per week for from four to seven days during initial set up of the drill rig. After drilling begins, the rig-based workforce would decline to approximately 9 to 18 personnel. At peak times, such as during logging or cementing operations, this number could potentially double (Schlumberger, 2008b). These requirements represent skill areas that could be accommodated by ADM's existing workforce or from the larger Decatur and Macon County workforce without major impact or stress to existing labor availability in the area. As a result, no change in regional employment would be anticipated.

The planning, construction, operation, monitoring, and post injection activities proposed under Proposed Action would result in a total project spending of $84,274,927, including $66,730,912 in federal funds. The local economy of the City of Decatur and surrounding Macon County is sufficient to capture much of this additional spending. This represents a potential beneficial impact to the local economy in the form of wages and salaries paid to local workers and income to local commercial entities providing goods and services. Assuming that all expenditures were captured by the local economy, the Proposed Action spending over three years would be equal to approximately 2.4 percent of the annual total income for Macon County. However, it is likely that at least a portion of project expenditures might be spent outside the local economy for labor goods or services not locally available, so that the actual benefit would probably be somewhat less.

Resource requirements for the project would not be expected to result in substantial changes in the provision of infrastructure and other services to local residents. The compression-dehydration facility is estimated to require an increased electrical demand of 5 to 6 MW over the three-year injection period. Since the ADM plant produces its own electricity, this increase would not impact industrial or residential users in the local area. Similarly, water and wastewater treatment requirements would not have a local impact. The proposed requirement for 220 barrels (9,240 gallons or approximately 35 kiloliters) of water is within existing capacity, and wastewater would be directed to the wastewater treatment facility or the water-reuse system that currently exists for the Decatur ADM Complex. No additional impact on supply or rate structure would be anticipated for local users in the surrounding community. Therefore, the impacts from implementing the Proposed Action are expected to be below the significance threshold.

4.8.2.3 Effects of No-Action

In the absence of federal funding, the Proposed Action would likely not proceed. ADM's current management and operations at the test site would be expected to continue unchanged. As a result, no change would be expected to occur in the existing condition or uses of the test site. Current trends in employment, production, and commercial activity would be expected to continue in their present pattern with no additional direct or indirect impact to the local economy. Therefore, the impacts from implementing the No-Action alternative are expected to be below the significance threshold.

4.8.2.4 Cumulative Impacts

The introduction of the Proposed Action to other planned or reasonably foreseeable actions at the study site or in the surrounding area would be expected to have only a minor effect on the local economy. As noted under the Proposed Action, the project would have minimal or no adverse impact on local employment or the availability and cost of local resources and services in the Decatur or larger Macon County economy. Therefore, it would not be expected to contribute to any cumulative effect. Some potential benefit would be derived from the small, but potential additional labor requirement and from additional expenditures in the local economy associated with the Proposed Action. These benefits could be experienced without adverse consequences and would not alter the existing condition or contribute substantially to the cumulative effect.

4.8.3 Infrastructure

Characterization of the current transportation and other infrastructural elements of the project area focuses on the ability of these elements to serve existing demand as well as any increase that may result from implementation of the Proposed Action.

4.8.3.1 Description

The ADM Phase III Test Site would be located in an industrial area adjacent to the urbanized area of Decatur. The road system in the surrounding region is a combination of intra-urban and rural roads. To the north, the test site is bounded by Reas Bridge Road (Rd.) (Illinois (IL)- 24). North Brush College Rd. (IL-1) forms the western boundary of the test site. To the east and somewhat removed from the test site boundary, Gun Club Road joins Christmas Tree Road to intersect with Reas Bridge road approximately one-half mile (805 m) from the northeastern corner of the test site. To the south, the Decatur ADM Complex supports a network of service roads of varying capacity.

Traffic volume studies for the segment of North College Brush Road running north from the intersection at Faries Parkway indicate an average daily volume of 11,300 vehicles, increasing to 20,700 vehicles by 2025 (Blank et al., 2004). The current daily truck traffic into and out of the Decatur ADM Complex is estimated at approximately 1,750 trips (Litynski, 2008a).

There are no utility transmission lines within the boundaries of the project area, apart from those servicing ADM facilities. A pipeline right-of way crosses the southeastern corner of the test site and continues south along the site border to the Decatur ADM Complex. A freight rail line of the Illinois Central Railroad crosses east to west in the area between the compression-dehydration facility and the injection well. A spur connects this line to the Decatur ADM Complex.

4.8.3.2 Effects of Proposed Action

The Proposed Action would not substantially alter existing traffic patterns, level of congestion, or road conditions in the immediate and surrounding area of the project area. Temporary increases in traffic resulting from the proposed action are presented in Table 4.8.3.2 below.

Table 4.8.3.2. Well Construction Transport Estimate		
Description of Transport	**Number***	**Type of vehicle**
Movement of rig & components to site	39-56 loads	flatbeds
Normal delivery of mud chemicals, bits,	4	flatbed
Visits by ADM, Illinois State Geological Survey (ISGS), etc.	10	cars/trucks
Cementing trucks	4	pump trucks & cement bins
Logging trucks & tools	2	logging trucks w/tools
Drill pipe, jars, drill collars, etc.	3	flat beds
20 inch casing	3	flat beds
13 3/8 inch casing	7-9	flat beds
9 5/8 inch casing	11-13	flat beds
Crew changes, daily for rig personnel	3	cars or vans
Vacuum trucks, waste disposal trucks, etc.	2	vacuum trucks
Casing running, lay down machines	5	2 Short Ton + 4 flatbeds
Other miscellaneous trucks, vehicles	4	F150's, cars, vans
* Number of vehicles per week or number of loads		
Note: Traffic will peak during set-up, mobilization & demobilization, cementing & logging runs as well as when running pipe		

Adapted from: (Schlumberger, 2008c).

Any temporary increases in traffic during the construction phase would not be sufficient to cause a substantial change in conditions during these periods. No activities occurring at the test site would be likely to disturb power or other utility transmission lines in the area. Therefore, the impacts from implementing the Proposed Action are expected to be below the significance threshold.

4.8.3.3 Effects of No-Action

Operations at the existing Decatur ADM Complex are ongoing. In the event that the Proposed Action is not implemented, any subsequent effect on traffic flow and patterns would be considered part of the current traffic conditions in the area. No additional impact would be anticipated. There are no public utilities at the site which might be disturbed either under current conditions. Therefore, the impacts from implementing the No-Action alternative are expected to be below the significance threshold.

4.8.3.4 Cumulative Impacts

Cumulative impacts would not be anticipated in association with the Proposed Action. There are no planned or reasonably foreseeable actions for the project area which when added to the effect of the Proposed Action would substantially change local road use or traffic patterns. There would be limited potential to alter or disturb power or other infrastructure services to the area as a result of the Proposed Action, but these potential impacts are not expected to exceed the threshold of significance.

4.8.4 Parks and Recreation

4.8.4.1 Description

Major facilities in the surrounding area include:

- Faries Park – a 7 acre (28,328 m^2) picnic and recreational area located approximately 1.8 miles (2.9 km) from the test site to the southeast (Moore, 2008; Carroll, 2008d; Litynski, 2008b).
- Nelson Golf Course and Park – a 45 acre (182,109 m^2) facility with picnic playground and sports facilities, located approximately three miles (4.83 km) to the southeast of the test site;
- Lions Park – a 2.5 acre (10,117 m^2) site that serves as a neighborhood park with picnic and court facilities, located approximately two miles (3.22 km) to the northwest of the test site; and
- Chandler Park – a 17.5 acre (70,820 m^2) lakefront park with picnic facilities, located approximately 2 miles (3 km) to the southwest of the test site (Decatur Park District, No date).

4.8.4.2 Effects of Proposed Action

The addition of the well, pipeline, and compression-dehydration facility to the existing Decatur ADM Complex would generate negligible impact to recreational activities in the immediately surrounding area. No facilities exist in the immediate vicinity of the test site that might be disturbed by site activities. The Proposed Action would be in keeping with the existing industrial character of test site and does not alter the existing setting or interfere with the user experience of more remotely located facilities. Therefore, the impacts from implementing the Proposed Action are expected to be below the significance threshold.

4.8.4.3 Effects of No-Action

Parks and recreational opportunities both nearby and in the larger Decatur area have historically existed along with ADM operations at the Decatur ADM Complex. No additional impact would be anticipated from continuing management practices or site activities. Therefore, the impacts from implementing the No-Action alternative are expected to be below the significance threshold.

4.8.4.4 Cumulative Impacts

The addition of the Proposed Action to ongoing activities at the Decatur ADM Complex would have no substantial impact to the character, setting, or visitor experience associated with parks or other recreational opportunities in the immediately surrounding and larger Decatur communities.

4.8.5 Visual Resources

4.8.5.1 Description

There are no scenic vistas or aesthetic landscapes in the vicinity of the Proposed Action. The test site would be on the east side of Decatur, Illinois, and within the Decatur ADM Complex. The compression-dehydration facility would be located within the industrial complex to the south of the proposed injection well site. The pipeline would travel from the compression-dehydration facility to the injection well following, as much as possible, an existing pipeline alley and overhead catwalk to allow the pipeline to cross the railroad track.

4.8.5.2 Effects of Proposed Action

Under the Proposed Action, construction of a CO_2 compression-dehydration facility (which is outside of the ADM Phase III Test Site but on ADM property), one injection well, monitoring wells, and pipeline would minimally alter the visual elements of the project area much of which is currently a fallow agricultural field. However, facilities constructed under the Proposed Action would not contrast with the present landscape as industrial features are common in the vicinity of the test site.

The unlikely event of leakage of injected CO_2 to the surface could pose detrimental effects on terrestrial ecosystems, having impacts on visual resources if areas of vegetation are altered. Changes in species composition, frequency and density of plants, or vegetation dieback could alter visual elements in the landscape and viewsheds.

Overall, it is not likely that the Proposed Action would change the visual landscape in a way that would be objectionable to local residents or frequent visitors. Thus, impacts on visual resources would not be expected to exceed the significance threshold.

4.8.5.3 Effects of No-Action

Under the No-Action alternative, the ADM Phase III Test Site work by the MGSC would not be implemented. No impacts to visual resources would occur as a result of this alternative.

4.8.5.4 Cumulative Impacts

Visual quality at the test site has been predominantly altered by the past ADM industrial development. Agriculture, residential, and other ongoing industrial activities have also affected the visual quality of the surrounding area. Given the larger impacts to visual resources from past, present, and future activities, cumulative impacts added from the proposed project would be minimally adverse and are not expected to exceed the threshold of significance.

4.8.6 Noise

Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise intrusive. Human response to noise varies depending on the type and characteristics of the noise, distance between the noise source and the receptor, receptor sensitivity, and time of day. Noise is often generated by activities part of everyday life, such as construction or vehicular traffic.

Sound varies by both intensity and frequency. Sound pressure level, measured in decibels (dB), is used to quantify sound intensity. The dB is a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level. Hertz (Hz) are used to quantify sound frequency. The human ear responds differently to different frequencies. A-weighting, described in a-weighted decibels (dBA), approximates this frequency response to express accurately the perception of sound by humans. Sounds encountered in daily life and their approximate level in dBA are provided in Table 4.8.6-1.

Table 4.8.6-1. Common Sounds and Their Levels

Outdoor	Sound level (dBA)	Indoor
Snowmobile	100	Subway train
Tractor	90	Garbage disposal
Noisy restaurant	85	Blender
Downtown (large city)	80	Ringing telephone
Freeway traffic	70	TV audio
Normal conversation	60	Sewing machine
Rainfall	50	Refrigerator
Quiet residential area	40	Library

Source: (Harris, 1998).

The dBA noise metric describes steady noise levels. However, very few noises are, in fact, constant; therefore, a noise metric, Day-night Sound Level (DNL) has been developed. DNL is defined as the average sound energy in a 24-hour period with a 10-dB penalty added to the nighttime levels (10 P.M. to 7 A.M.). DNL is a useful descriptor for noise because it averages ongoing yet intermittent noise, and it measures total sound energy over a 24-hour period. In addition, Equivalent Sound Level (Leq) is often used to describe the overall noise environment. Leq is the average sound level in dB.

The Noise Control Act of 1972 (Public Law 92-574) directs Federal agencies to comply with applicable federal, state, interstate, and local noise control regulations. In 1974, the USEPA provided information suggesting that continuous and long-term noise levels in excess of DNL 65 dBA are normally unacceptable for noise-sensitive land uses such as residences, schools, churches, and hospitals.

The State of Illinois's Environmental Protection Act of 1985 limits noise to levels that protect the health, general welfare, and property. The State of Illinois limits the noises in individual frequency ranges at noise sensitive land uses (Table 4.8.6-2) (35 IAC H.901.101) (IL, 2008). There are no maximum overall levels outlined in the regulation. In addition, Decatur has a local noise regulation as part of the zoning code that states it is unlawful to generate sound louder than 80 dBA at the property line (Decatur Zoning Code Section XVII Subpart D) (Decatur, 2008c).

Sounds generated from construction activities are exempt from both the state and local regulations.

Table 4.8.6-2. State of Illinois Environmental Noise Standards			
Octave Band Center Frequency (Hz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to Noise Sensitive Land Uses		
	Industrial Source	Commercial Source	Residential Source
31.5	75	72	72
63	74	71	71
125	69	65	65
250	64	57	57
500	58	51	51
1000	52	45	45
2000	47	39	39
4000	43	34	34
8000	40	32	32

Sources: (IL, 2008; Decatur, 2008c).

4.8.6.1 Description

The Decatur ADM Complex and adjacent areas are primarily mixed use industrial and recreational with Faries Park recreational complex to the east, and a community college to the north, and a rail station to the south of the project area. The nearest noise sensitive area (NSA) is a community college north of the Decatur ADM Complex. Existing sources of noise at NSAs near the Decatur ADM Complex, compressor location, and drilling site include rail traffic traveling east of the Wabash Rail Station, local road traffic, high-altitude aircraft overflights, and natural noises such as leaves rustling, and bird vocalizations. It is also possible that industrial noise contributes to overall noise environment outside of the facilities property boundary. For analysis purposes, the NSAs surrounding the facility have been categorized as quiet suburban residential areas. This would constitute the worst case existing noise conditions. The noise environment consists of light traffic conditions where no mass transportation vehicles and relatively few automobiles and trucks pass. The background sound either is distant traffic or is difficult to identify by residents.

Table 4.8.6.1. Estimated Existing Noise Levels at Nearby Noise Sensitive Areas							
	Closest Noise Sensitive Area (NSA)				Estimated Existing Sound Levels (dBA)		
Site	Distance	Direction	Type	Land Use Category	DNL	Leq (Daytime)	Leq (Nighttime)
Drilling Site	1,800 feet 549 m	North	School	Quiet Suburban Residential	55	53	47
Compressor Site	4,100 feet 1,250 m	North	School				

Source: (ANSI, 2003).

4.8.6.2 Effects of Proposed Action

Short-term and long-term minor adverse effects to the noise environment would be expected with the implementation of the Proposed Action. The effects would be primarily due to heavy equipment noise during construction and drilling, and the operation of the proposed compressor. This evaluation considers significant sound sources that could affect NSAs.

Construction Noise. There would be some form of moderate to heavy construction at the Decatur ADM Complex and the well locations. Individual pieces of construction equipment typically generate noise levels of 80 to 90 dBA at a distance of 50 feet (15.24 m). Table 4.8.6.2-1 presents typical noise levels (dBA at 50 feet (15.24 m)) that USEPA has estimated for the main phases of outdoor construction.

Table 4.8.6.2-1. Noise Levels Associated with Outdoor Construction

Construction Phase	Leq (dBA) at 50 feet (15.24 m) from Source
Ground Clearing	84
Excavation, Grading	89
Foundations	78
Structural	85
Finishing	89

Source: (USEPA, 1974).

With multiple items of equipment operating concurrently, noise levels can be relatively high during daytime periods at locations within several hundred feet of an active construction sites. The zone of relatively high construction noise levels typically extends to distances of 400 to 800 feet (121.92 to 243.84 m) from the site of major equipment operations. Locations within 1,000 feet (304.8 m) would experience substantial levels (greater than 62 dBA) of construction noise. However, there are no NSAs within 1,000 feet (304.8 m) of the construction sites. Therefore, affects due to construction noise would be considered minor. Construction activities are exempt from both the state and local regulations.

These effects would be temporary and would be considered minor. The following best management practices (BMPs) would be used to reduce these already limited effects:

- Construction would predominately occur during normal weekday business hours in areas adjacent to noise-sensitive land uses such as residential areas; and
- Construction equipment mufflers would be properly maintained and in good working order.

Drilling Noise. The Proposed Action would involve drilling operations for the injection and monitoring wells. Components of the drilling equipment include the drill rig, mud pumps, and diesel generators. Drilling equipment is expected to operate twenty-four hours per day, seven days per week, for up to three months. The nearest NSA is 1,800 feet (549 m) north of the injection well location. A DNL of 54 dBA and a Leq of 48 dBA were estimated for the drilling operations at the nearest NSA. These levels are below the USEPA threshold of 65 dBA (DNL), are temporary, and would have only a minor effect on the noise environment. Detailed noise calculations are located in Appendix C.

The generator and combined diesel driven systems would have the standard exhaust muffles. Barriers can be installed around the noisy components to diminish the noise but would not likely be necessary given the distance to the nearest NSA. Drilling noise would be expected to dominate the soundscape for all on-site personnel. Personnel, and particularly equipment operators, would utilize adequate personal hearing protection to limit exposure and ensure compliance with federal health and safety regulations.

Operational Noise. The compressor facility is in the preliminary design stages. Therefore, a complete equipment list and associated manufacturers specifications is not finalized. However, the only major noise-producing equipment expected is a 6000 horsepower (hp) [4474 kilowatt (kW)] reciprocating compressor. This compressor would operate 24 hours per day 7 days per week. Noise levels that would be generated by operation of the compressor at the nearest NSA have been compared to the levels outlined in the state and local noise regulation (Table 4.8.6.2-2).

Table 4.8.6.2-2. Compressor Noise Levels at Nearest NSA Compared to Noise Standards

Octave Band Center Frequency (Hz)	Allowable Sound Pressure Levels (dB)	Predicted Compressor Noise Levels	Exceeds Standard (Yes/No)
31.5	75	55	No
63	74	52	No
125	69	51	No
250	64	47	No
500	58	44	No
1000	52	44	No
2000	47	40	No
4000	43	27	No
8000	40	9	No
Leq (dBA)	80	48	No

Sources: (IL, 2008; Decatur, 2008c).

Because of the limited amount of noise and the distance to the nearest NSA, violations of neither the state nor the local noise regulations are expected. Special variances to the state or local noise ordinance, mitigation measures, or both would not likely be required. Overall, these effects would be considered minor. Therefore, the impacts from implementing the Proposed Action are expected to be below the significance threshold.

4.8.6.3 Effects of No-Action

The No-Action alternative would have no impacts to noise because no drilling would occur, and no additional equipment would be installed. Noise levels would remain at their existing levels.

4.8.6.4 Cumulative Impacts

The Proposed Action would introduce long-term incremental increases the noise environment. However, these increases would be relatively small when compared to the existing conditions and would be considered minor.

4.8.7 Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (The White House, February 11, 1994), requires that Federal agencies consider as a part of their action any disproportionately high and adverse human health or environmental effects to minority and low income populations. Agencies are required to ensure that these potential effects are identified and addressed.

The USEPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." For purposes of assessing environmental justice under NEPA, the CEQ defines a minority population as one in which the percentage of minorities exceeds 50 percent or is substantially higher than the percentage of minorities in the general population or other appropriate unit of geographic analysis (CEQ, 1997).

Consideration of the potential consequences of the Proposed Action for environmental justice requires three main components:

- A demographic assessment of the affected community to identify the presence of minority or low income populations that may be potentially affected;
- An assessment of all potential impacts identified to determine if any result in significant adverse impact to the affected environment; and
- An integrated assessment to determine whether any disproportionately high and adverse impacts exist for minority and low-income groups present in the study area.

4.8.7.1 Description

For the environmental justice analysis, the immediate site vicinity is defined as those census blocks that contain a portion of the project area or immediately adjacent to the project area. In 2000, minority populations accounted for 17.5 percent of the total population of immediate site vicinity or a total of 9 residents (Census, 2000a). This is substantially lower than the minority percentage for the population of the City of Decatur as a whole. In 2000, minority population accounted for 22.3 percent of the city's total population or 18,331 individuals. Hispanic or Latino populations (of any race) represented 1.2 percent of the total, or 978 individuals. Socioeconomically disadvantaged individuals, those living at or below the poverty line, constituted 16.5 percent of the population or 12,999 individuals in 2000 (Census, 2006c).

Minority populations made up approximately 15.2 percent of the total population of Macon County. Hispanic or Latino residents (of any race) constitute approximately one percent of the total population or 1,120 individuals. In 2000, there were 14,316 individuals living at or below the poverty level, or 12.9 percent of the population (Census, 2006c).

4.8.7.2 Effects of Proposed Action

Minority and lower income groups are generally not present in the study area in significantly greater proportions than for the Decatur community as a whole and the larger Macon County area. Additionally, both direct and indirect effects to local populations, resources, and the character and setting of the local community would be anticipated to be minimal for all populations in the immediate study area and for the surrounding communities. Therefore, no disproportionately high or adverse impacts to minority or low-income communities would be expected.

4.8.7.3 Effects of No-Action

The present management of the test site by ADM would be expected to continue with no appreciable change to the existing activities at the Decatur ADM Complex. No disproportionate impact to minorities or low-income populations would be anticipated under the No-Action alternative.

4.8.7.4 Cumulative Impacts

The Proposed Action considered by this EA would add only minimally to existing conditions in the project area and surrounding communities. As a result, any incremental impact would not be expected to be sufficient to exceed the significance threshold and would most likely be experienced evenly across all populations.

4.9 Human Health and Safety

4.9.1 Description

Air pollution causes human health problems. Air pollution can cause breathing problems; throat and eye irritation; cancer; birth defects; and damage to immune, neurological, reproductive, and respiratory systems (USEPA, 2007c). National and state ambient air quality standards represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare with a reasonable margin of safety (See Section 4.1). In addition, OSHA regulations specify appropriate protective measures for all employees.

Spills from the construction of the Proposed Action and its operation could also a source of possible impacts to human health and safety. Spills can introduce soil contamination and allow exposure pathways to workers and the public. The risks and effects of a spill depend on its composition. A common material used in construction and operation that can be spilled is gasoline. Gasoline irritates the lungs and is a skin irritant. Enough gasoline exposure can cause death or nervous system damage (ATSDR, 2007). Similarly, waste management also is a source of possible human health and safety risks from exposure to contaminants (See Section 4.11).

A primary concern to human health and safety within the project area would be CO_2 leaks. CO_2 is heavier than ambient air, colorless, and odorless, which makes it an invisible hazard (DOE, 2007a). Since it is denser than ambient air, leaked CO_2 will typically pool in hollows and confined spaces until dispersed by wind or other ventilation methods (DOE, 2007a; IPCC, 2005). CO_2 under pressure or at high concentration levels can cause suffocation and permanent brain injury from lack of air (DOE, 2007a). Headache, impaired vision, labored breathing, and mental confusion also can occur from exposure to CO_2. The pressure drop from CO_2 leaks from vessels (pipes) creates a cold hazard, and even the vapor can cause frostbite (IPCC, 2005). Generally, the pooling and large, rapid releases of the CO_2 are the situations of concern for human health and safety instead of small gradual leaks due to concentration level differences (IPCC, 2005; DOE, 2007a).

No general CO_2 exposure standards exist yet for the general public (DOE, 2007a). The immediately dangerous to life and health level of exposure for CO_2 is 5% or 40,000 ppm. For up to several hours, exposure to 0.5 to 1.5% CO_2 in the air typically is not harmful for people with normal health. However, people with impaired health (such as cerebral disease), children, and people involved in complex tasks are more susceptible to the effects of CO_2 exposure. CO_2 exposure impedes people's performance of complex tasks by causing labored breathing, headache, and mental confusion. The occupational standard of maximum allowable concentration of CO_2 in air for eight hours of continuous exposure is 0.5%, and for a short period, it is 3.0% (IPCC, 2005).

CO_2 once leaked can cause human health issues in the water as well as air. CO_2 underground injection can contaminate groundwater if the CO_2 migrates to underground aquifers (See Section 4.3). This contamination can occur by the CO_2 causing the mobilization of chemicals such as metals in the soil into the aquifers. Despite monitoring and permitting requirements (USEPA's UIC program), the risk to human health from potable water contamination still exists from underground injection. Similar to air emissions of CO_2, gradual releases of CO_2 into water sources typically do not cause substantial harm to human health, but rapid releases could (DOE, 2007a).

Between 1994 and 2006, there were 31 CO_2 pipeline accidents reported, but there were no injuries or fatalities from these incidents in the United States (DOE, 2007c). Some historical causes of CO_2 pipeline incidences are relief valve failure (4 failures), weld/gasket/valve packing failure (3 failures), corrosion (2 failures), and outside force (1 failure). The incident rate from 1990 to 2002 for CO_2 pipelines in the United States was 0.0002 $mile^{-1}$ yr^{-1} (0.00032 km^{-1} yr^{-1}) (IPCC, 2005). This rate of failure is comparatively small. For comparison with natural gas pipelines, see Table 4.9.1.

Table 4.9.1. Comparison of Natural Gas Pipelines to CO_2 Pipelines from 1995 to 2005

Category	Natural Gas	CO_2
Miles (km) of Pipeline	304,001 (489,242) (in 2003)	3,300 (5,311)
Number of Incidents	960	12
Property Damage per Incident	$484,000	$42,000
Injuries from Incidents	82	0

Table 4.9.1. Comparison of Natural Gas Pipelines to CO_2 Pipelines from 1995 to 2005		
Category	**Natural Gas**	**CO_2**
Fatalities	29	0

Source: (DOE, 2007a).

The workers on the project would be subject to the same types of health risks that are generally associated with their professions (DOE, 2007a). There is a rate of 15.2 deaths per 100,000 for construction workers, which is the third highest rate of death from injury (NIOSH, No date). The construction incident rate of total recordable cases of nonfatal occupational injuries and illnesses in 2006 was 5.9 per 100 full-time workers (BLS, 2007).

4.9.2 Effects of Proposed Action

The Proposed Action would include pipe installation; construction and operation of a compression-dehydration facility; collection and transportation of CO_2; drilling of injection and observation wells; and injection of supercritical CO_2 (See Section 2.1). These could all present risks to human health and safety. The materials and equipment used for construction and operation would meet prescribed standards (MGSC, 2008).

The equipment that would be used for the implementation of the Proposed Action represents only minimal risks to human health and safety under normal operating conditions (DOE, 2007a). Thus, if BMPs, maintenance, and regulations are followed, the equipment should pose little impact to human health and safety. Drilling into pressurized formations could release flammable gases like methane. Preventative measures to minimize well blowouts or venting of dangerous gases should be implemented. Measures to avoid the equipment failure caused by high pressure would be executed (DOE, 2007a). ADM's safety plans would be updated to include the new risks from handling the pressurized CO_2 (MGSC, 2008; MGSC, No date).

Since all of the construction and operation of the Proposed Action is on ADM property, the increase in traffic from workers and delivery of equipment and materials should be partially limited to onsite, which reduces risk to pedestrians and the general public. However, the Proposed Action would still represent an increase in traffic, which increases the potential for accidents. The current truck traffic in and out of the Decatur ADM Complex is approximately 1,750 trucks per day (Litynski, 2008a). The expected increase in the number of trips due to the Proposed Action from the current level of vehicle activity is minor. Thus, the impact to human health and safety from the increase in transportation is not expected to exceed the level of significance threshold (See Sections 4.8.1 and 4.8.3).

Air emissions from the Proposed Action are not anticipated to be regionally significant (See Section 4.1). Thus, the impacts to human health from air emissions would not be expected to exceed the significance threshold. Following mitigation measures and BMPs would reduce any impacts to human health from air quality. Further, workers would follow OSHA procedures, which would further reduce the impact to human health. The propane burning from the dehydration reboiler would produce some limited air pollutants, such as formaldehyde, which can cause shortness of breath and blurred vision (ILO, 2004; MGSC, 2008). However, the Proposed Action only produces a very small amount of these air pollutants, and these are the same types and quantities as with any burning of propane. Thus, there would be a minimal risk to human health and safety. A risk assessment is in process for the compression-dehydration facility.

The soils are not highly erodible (See Section 4.2), so water contamination from increased run-off, which could lead to human health and safety risks, is not a major issue (See Section 4.3). Further, the facility has received a construction permit under the General NPDES permit for the construction storm water discharges (Keller, 2008). Further, wastewater would be collected and pretreated. The pretreated water is subsequently sent to the City of Decatur Publicly Owned Treatment Works (MGSC, 2008). Therefore, the overall effect of the Proposed Action to surface water quality is expected to not exceed the significance threshold.

The only hazardous or toxic material used in the Proposed Action is CO_2 (MGSC, 2008). Thus, if safety procedures and BMPs are followed, spills and leaks from equipment and processes (other than CO_2) would be of low concentrations as well as nonhazardous and not toxic. This would represent a low risk to human health and safety (DOE, 2007c). Under normal conditions, hazardous and toxic materials can be used safely when appropriate safety precautions are followed (DOE, 2007a). Thus, the minimal concentrations of VOCs in the collected CO_2 should be a minimal risk to human health and safety. A risk assessment is in process for compression-dehydration facility.

The design of the Proposed Action's MMV plan would be to avoid, detect, and correct any unintended CO_2 emissions (MGSC, No date). The Eau Claire Formation, the Mt. Simon Sandstone, and the thick shale units present at the proposed injection site make groundwater contamination highly unlikely (ADM, 2008a). However, groundwater monitoring would still occur to detect problems and initiate corrective action if necessary (ADM, 2008a; MGSC, No date). The groundwater monitoring would include testing for metals, ammonia, CO_2, pH, dissolved oxygen, and other possible contaminants (MGSC, No date) (See Section 4.3). This would allow for early detection and appropriate measures to be initiated if there were any problems. This would reduce the risk to human health and safety. The maximum surface injection pressure of 2,200 pounds per square inch (15,300 kPa) is under the anticipated fracture pressure for the area (ADM, 2008a). This reduces the possibility of air and water contamination by CO_2 from fractures (See Section 4.2). The probability of hazardous leaks from the storage is small (NETL, 2008c; Heinrich et al., 2004). With proper monitoring and mitigation, the risk from induced seismicity and fractures would be expected to be below the significance threshold.

ADM along with the MGSC would have a public outreach program that would inform multiple groups, such ADM staff and their families as well as general public and regulatory and governmental agencies, about CO_2 sequestration (MGSC, No date). Education about potential threats and processes could reduce the risks and consequences of health and safety issues like accidents. A local emergency response plan would help reduce the risk of impact to the workers and the general public (DOE, 2007a). The primary human health risk from the Proposed Action to the general public would be pipeline leaks releasing CO_2 (DOE, 2007a). A rapid release of CO_2 has a very low probability due to monitoring, proper siting, and BMPs (DOE, 2007a). The risks could be minimized by having appropriate safety and operating procedures currently in place for gas processing facilities and pipelines including monitoring and inspections (DOE, 2007a). In general, CO_2 injection has occurred safely for over twenty years with oil and gas activities (NETL, 2008c). Therefore, with proper safety procedures and plans, the risk to the general public should not exceed the significance threshold.

The wet, uncompressed CO_2 would be transported in stainless steel ductwork, which reduces the corrosion concerns. However, even this CO_2 would be scrubbed. Thus, leaks from this wet, uncompressed CO_2 would not be a substantial concern for human health and safety as it is currently permitted for discharge to atmosphere (Carroll, 2008a).

Other than having a smaller diameter, the CO_2 pipeline from the compression-dehydration facility to the injection site would be similar to most CO_2 pipeline systems. The carbon steel pipe segments are nominally 40 feet (12.19 m) long with welded seams. Stainless steel is not necessary for this section of the CO_2 piping as the CO_2 is dehydrated. Wall thickness would be determined based on final operating outlet pressure of the compression system plus appropriate safety allowances.

The right of way for the pipeline would be both aboveground on a pipe bridge across the railroad tracks south of the test site and below ground as it approaches the wellhead. Line markers would be used to locate the pipeline, and the location would be entered into the ADM database of plant facilities and information. Having the pipeline location information known in the database should help reduce the risk of accidents from construction and operation of other onsite activities. All the monitoring for CO_2 (See Section 2.1.3.3) would reduce the risk for CO_2 leaks, and the mitigation measures would reduce the consequences of any incidents. A risk assessment is in progress to quantify these risks.

The Proposed Action would include an ambient CO_2 monitoring and alarm system during injection operations (MGSC, No date). Under the Proposed Action, ADM would install pressure and temperature alarms along the pipeline to inform personnel of problems. Incorrect pressure (too much or too little) would cause automatic shutdown of the compressor and injection system to reduce the safety risks from equipment malfunction (ADM, 2008a). Pipeline inspection and monitoring would reduce the risks of failures and thus to human health. A common mitigation measure for leaking casing is venting the CO_2 under appropriate controlled conditions (MGSC, No date). One of the major concerns regarding pipeline safety is water and other contaminants causing corrosion leading to pipe failure (DOE, 2007a). However, the CO_2 would be dried and removed of contaminants, which reduces the risk from pipeline failure (MGSC, 2008).

A detailed plan including human health, safety, and environment concerns would be written (MGSC, No date). Atmospheric gas monitors with alarms would be installed along the CO_2 pipeline and in close proximity to the CO_2 injection wells. In the event that atmospheric CO_2 concentrations increase to a prescribed concentration, alarms would be sounded to alert workers of a potential CO_2 release. In addition, an Eddy Covariance tower would be installed downwind of the CO_2 pipeline and injection well to continuously measure atmospheric CO_2 fluxes. In the event of a substantial CO_2 release, employees would have been informed and trained regarding appropriate evacuation procedures following ADM safety plans. Further, modeling of atmospheric dispersion and CO_2 concentration distribution around the test site and vicinity from worst case scenario/s of atmospheric CO_2 releases would be conducted in order to develop and implement additional emergency response plans that are essential to reduce impacts to human health and the environment.

The workers on the project would be subject to the same types of health risks that are generally associated with their professions (DOE, 2007a). Protective equipment such as hard hats, safety shoes, hearing protection (earplugs), and safety glasses would be worn (MGSC, 2008). Any further safety equipment needed for the possible hazards should be used such as a respirator or dust mask for someone working with equipment that generates dust. Following safety hazards would minimize occupational hazards (DOE, 2007a).

The risks to human health and safety from a rapid release of CO_2 as a result of activities associated with the Proposed Action would depend on the amount released and conditions (such as wind direction and strength) at the time of the release (DOE, 2007c). A sudden and rapid release of CO_2 from equipment, such as a wellhead being removed, would likely be detected quickly. The processes for containing well blow-outs would be employed to stop such a release. Workers on-site would be the primary group affected. If concentrations of CO_2 greater than 7 to 10% in the air were created, it would cause immediate danger to humans. Depending on the amount released and the pressure, the leak could take hours to days to contain, but it could take as little as minutes (IPCC, 2005; Heinrich et al., 2004). However, the leaked CO_2 amount is likely to be minimal compared to the amount injected due to dispersion of CO_2 in the ground away from injection site (Heinrich et al., 2004; IPCC, 2005). Once the release is over, no lingering effects would occur (Heinrich et al., 2004). In addition, the oil and gas industry employs engineering and administrative controls to manage these types of hazards regularly (IPCC, 2005). Therefore, while the risk of accidents exists, the risks to human health and safety, with the proper response plans and monitoring, should be below the significance threshold.

Currently, ADM staff handles and transports CO_2 and has experience with high-pressure pipelines (ADM, 2008c). This experience is not with CO_2 at supercritical conditions. However, the personnel are already familiar with the general risks and procedures associated with CO_2. ADM's current process safety management plan would be amended. Workers would also be updated on safety procedures, especially ones related to handling of high pressure CO_2 (MGSC, 2008). Additionally, the Proposed Action should be implemented in accordance with applicable guidance from the OHSA (Occupational Safety and Health Standards: 29 CFR 1910) as well as other applicable industry standards and regulations (DOE, 2007a). Decommissioning of the facility would represent the same types of risks as the operation. Thus, with proper safety procedures, the impact to human health and safety should be minimal. While a risk assessment for Richland College has been completed, further risk assessments are planned. With the low failure rate of CO_2 pipelines, proper siting, and the monitoring involved, the overall risk to human health and safety is not expected to exceed the significance threshold.

4.9.3 Effects of No-Action

Under the No-Action alternative, there would be no construction, operation, or decommissioning of the sequestration test site. Thus, none of the risks listed in the previous section would occur, which would mean no impacts to human health and safety. The exception would be the fact that the Proposed Action's purpose is to further the research for options in preventing global climate change. Possible deaths from sea levels rising, deaths from increased severity of storms, increase respiratory diseases, and increased deaths from heat are some of the wide variety of potential human health and safety impacts from global climate change (Miller, 2003). However, as many other projects are in operation or being proposed to assist in the reduction of risk from global climate change, not all of the global climate change risks are attributable to the No-Action alternative. Nevertheless, the No-Action alternative does represent some risk to human health and safety, but not a substantial one.

4.9.4 Cumulative Effects

Since CO_2 is not flammable, there is less of a risk to human health and safety from the Proposed Action in combination with any existing projects in the area (IPCC, 2005). There are no planned projects in or near the project area (ADM, 2008b; Chamber, 2008; Decatur, 2008b). The cumulative impacts of existing activities in and around the project area does not represent a substantial risk to human health and safety with existing and upcoming mitigation and safety procedures in place, which means the cumulative impacts with implementing the Proposed Action is not expected to exceed the significance criteria.

Since the current projects in the area do not pose a substantial risk to human health and safety, the No-Action alternative does not represent any additional risks to human health and safety. As described in the previous section, the exception is that not implementing the Proposed Action (thus, implementing the No-Action alternative) would have an adverse impact to the progress towards solutions for global climate change. However, since this is a single project of many, the cumulative impacts to human health and safety for the No-Action alternative are not expected to exceed the threshold of significance.

4.10 Cultural Resources

Cultural and historic resources are protected by a variety of laws and regulations, including the NHPA, as amended, and the Archaeological Resources Protection Act. Section 106 of the National Historic Preservation Act and implementing regulations (36 CFR 800) outline the procedures to be followed in the documentation, evaluation, and mitigation of impacts cultural resources. The Section 106 process applies to any federal undertaking that has the potential to affect cultural resources. The Illinois Historic Preservation Agency (IHPA) is the SHPO for Illinois (IHPA, 2007).

4.10.1 Description

No historical sites, federal or state historical areas, or Native American Indian reservations occur in the proposed project area (EDR, 2008; MGSC, 2008). The closest National Register of Historic Places (NRHP) property is approximately 3.5 miles (5.7 km) away to the northeast from the test site boundary (HAARGIS, 2002). Within the project area, the majority of the land is already disturbed (Figure 2.1.1-2). With this disturbance, no archeological or historical resources have been found (See Appendix D). Further, the project area is outside the "high archaeological resource potential area." This is defined as the presence of certain soil types, such as Parkland Sand and Mackinaw Member, and within a buffer of stream floodplains (ISM, 1994).

Two federally recognized Native American tribes have land claims in Macon County, the Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas and the Kickapoo Tribe of Oklahoma (Lavallee, 2006). DOE sent consultation letters to the nearby Native American Tribes and appropriate Bureau of Indian Affairs Regional Offices to inform them of the project, invite input, and request information of any known sites or issues in the project area. The Bureau of Indian Affairs, which was the only response received, requested a particular consultation process including contacting the SHPO (See Appendix E). DOE performed this process, and no concerns were found. The closest cemetery to the project area is St. John cemetery, which is approximately 0.7 miles (1 km) south from the test site boundary (Figure 4.10.1).

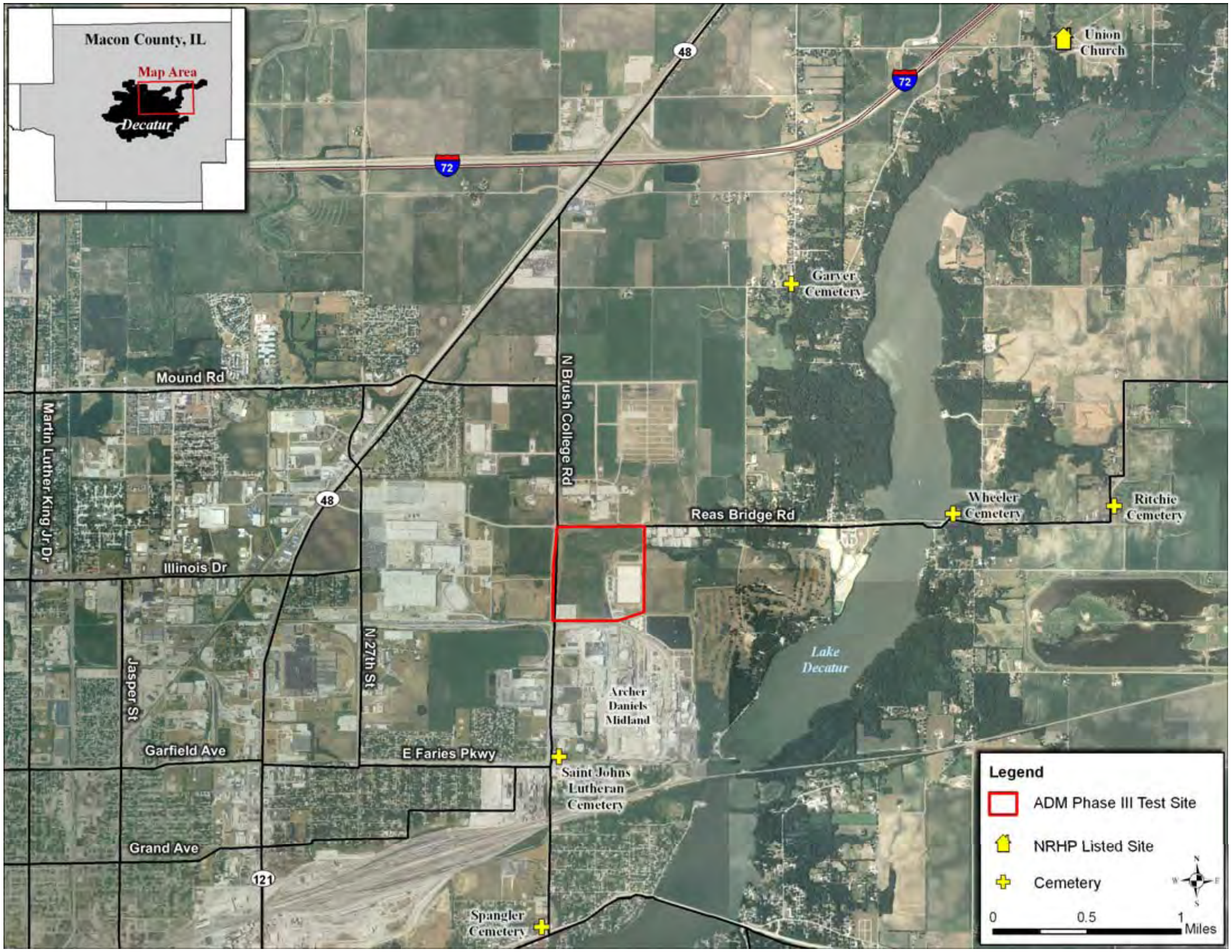


Figure 4.10.1. Cemeteries and NRHP-listed Sites near Project Area

ADM has not performed a cultural resources survey in the project area (Carroll, 2008e).

Fossils need to be at or near the surface to allow access to them. Fossils are formed in sedimentary rock. There are no outcropping surface sedimentary rocks in the project area, so there should be no readily accessible fossils (See Section 4.2).

4.10.2 Effects of Proposed Action

The potential for impacts to cultural resources is the greatest during the construction phase. Discovery of previously unknown cultural resources can occur during construction activities in historically undisturbed areas. The construction noise and earthmoving activities can also deteriorate the use of the area for Native American activities (DOE, 2007a).

Some construction activities occurring under the Proposed Action with the potential to disturb cultural resources are land clearing, transporting equipment, leveling, drilling, and laying pipelines. These earthmoving activities can cause an adverse impact to cultural resources by altering drainage patterns, creating fugitive dust, and crushing the resources. Altered drainage patterns and runoff can deteriorate the artifacts or move them. Fugitive dust can cover and remove, in the case of paintings, artifacts. Spills from refueling equipment also damages cultural resources, which reduces the information potentially gained by the items. Further, construction activities can alter or destroy the context of the cultural resources. Operational impacts include use of heavy equipment, which is described above, and improved access to the area, which increases the possibility of illegal collection of properties (DOE, 2007a). Decommissioning would require similar heavy equipment but would be a relatively short time frame relative to the operation and construction phases. Thus, decommissioning would be the same type of possible impacts as described above.

The SHPO also states that there are no historical properties that would be affected by the project (See Appendix D). The project area is previously disturbed. Consequently, since no cultural resources have been found yet, there would be less of a possibility for discovering cultural resources during the Proposed Action.

As there is no surface sedimentary rock, the risk to fossils (paleontological resources) that could be used for scientific/educational purposes is negligible (See Section 4.2). Due to distance to the nearest NRHP site (3.5 miles or 5.7 km), there should be no substantial impacts to visual resources to any known eligible or existing NRHP sites. DOE sent consultation letters to the nearby Native American Tribes and appropriate Bureau of Indian Affairs Regional Offices to inform them of the project, invite input, and request information of any known sites or issues in the project area. The Bureau of Indian Affairs, which was the only response received, requested a particular consultation process including contacting the SHPO. DOE performed this process, and no concerns were found (See Appendix E).

The cemetery is not in the location of the construction and operation. Thus, the Proposed Action should not have any direct impacts to the cemetery. The cemetery is in an industrial site, so the impacts from the Proposed Action should be no greater than what the cemetery has experienced in the past (See Sections 4.8.5 and 4.8.6).

If cultural resources were discovered during the construction, the construction would be stopped, and the SHPO, any relevant Tribes, or other agencies consulted. If the cultural resources were found to be substantial, then the construction component would need to be relocated elsewhere or other acceptable mitigation performed as SHPO and any relevant tribes or agencies dictate.

Based on the information above, the impacts from implementing the Proposed Action are not expected to exceed the impact significance threshold.

4.10.3 Effects of No-Action

Under the No-Action alternative, ADM would not conduct the CO_2 test or put the corresponding infrastructure in place. Thus, there would be no construction, operation, or decommissioning activities. Therefore, there would be no impacts to cultural resources. However, the No-Action alternative would not fulfill the need of the project.

4.10.4 Cumulative Effects

ADM has no other projects planned for the area (Carroll, 2008b). Since there are no substantial impacts to cultural resources, the Proposed Action and the No-Action alternative do not substantially contribute to the cumulative impacts to cultural resources in the vicinity of the project area or in the project area. As impacts to cultural resources are generally local (heavy machinery crushing resources, etc.), the Proposed Action and the No-Action alternative both are unlikely to contribute to impacts to cultural resources outside the vicinity of the project area, and those local impacts would not be expected to exceed the threshold of significance.

4.11 Waste Management

4.11.1 Description

During the drilling stage of the proposed project, which would include the drilling of one injection well and two verification wells, a number of wastes would be generated. These wastes could potentially include:

- Lubricating oils and greases,
- Used solvents,
- Used hydraulic fluid,
- Metal parts, wire and cable,
- Oily rags,
- Domestic sewage,
- Domestic solid waste,
- Contaminated soil from spills,
- Discarded cement,
- Containers (metal, wood, plastic, etc.),
- Produced water (oily and/or saline), and
- Drilling mud and cuttings.

All drilling waste disposal methods will be in accordance with existing ADM conditions for the Decatur ADM Complex and or any and all local/federal or state regulations as indicated from any permit requirements for the project (Litynski, 2008c). An earthen “reserve pit” or earthen pit will be constructed and properly lined for drill cuttings, water-based drilling fluids, rig wash water and to a certain degree, rain water.

As cuttings are developed by the drilling operation, they will be diverted to this lined earthen reserve pit and after the drilling/completion operations are completed, the pit will be “farmed” back to as close to its original state as possible, keeping in mind future operations for each of the wells to be drilled in the area. All used engine oils and any other chemical-related items that need to be changed/rolled out as part of the drilling process, will be placed in sealed barrels, properly labeled and transported to an appropriate disposal location.

The underground injection control permit application indicated that upon decommissioning, tubing would be sold as scrap metal, and the site would not treat, store or dispose of hazardous waste (ADM, 2008a). The permit application also indicated shallow groundwater monitoring wells would be drilled using wireline coring tools, which would require the use of bentonite based drilling mud, or the use of hollow stem augers.

A project environmental questionnaire indicated that 9,240 gallons (35 kiloliters) of wastewater would be produced from the dehydration/compression/cooling processes (MGSC, 2008). The water would be directed to the wastewater treatment facility or the water re-use system that exists for the Decatur ADM Complex. Additionally, the operation of a compressor would generate waste products that could include:

- Used lube oil,
- Spent glycols,
- Used metal parts,
- Used gaskets,
- Oily rags,
- Filters,
- Containers,
- Contaminated soils from spills and leaks, and
- Domestic solid wastes.

The final compressor selections have not been made but would likely include an electric driven multi-stage reciprocating compressor. The exact nature and volumes of waste generated would be dependent on the final compressor selection. It is assumed that frame lubrication oil (which is typically lower weight mineral or synthetic oil) would typically be changed twice per year and cylinder oil (which is typically an animal fat for this application) would be continuously metered into the compressor cylinders at low rates and would remain in the CO_2 stream. Each type of oil has a filter, and it is projected that approximately 8 to 16 filters would be used per year. The lubrication oil and oil filters would be sent either to a waste oil recycler or disposed in accordance with applicable regulations.

If a TEG glycol dehydration unit would be selected for use, approximately 48 waste glycol particulate filters (half rich, half lean) would be generated per year. Glycol carbon filters are changed as needed and it is estimated 200 lbs/year (90.72 kilograms (kg)/year) waste carbon would be generated from regular maintenance. The glycol particulate filters and the spent carbon would be disposed of offsite in accordance applicable regulations. The exact disposal protocol would follow that established by ADM to dispose of their other wastes. No hazardous waste would be generated.

There should be little to no saline water brought to the surface that is not controlled through well control or direct sampling via drill stem test (DST) or modular formation dynamics tester (MDT). The drilling fluids will have weight enough to be in excess of formation pressure, thus no flow back is expected. Only during times when sampling is occurring will fluids be brought to surface in contained jugs and/or sample chambers, likely using MDT. If large amounts of fluids are required, a DST would be used and there may be some fluid spillage on the rig floor, which will be washed to the reserve pit (Greenberg, 2008).

4.11.2 Effects of Proposed Action

Based on the volumes of drill waste generated, it is not anticipated that there will be any drilling wastes that exceed the significance threshold (Litynski, 2008c). All drilling waste disposal methods will be in accordance with existing local, state, or regulations.

Waste lube oil, filters, and spent carbon generated from dehydration/compression/cooling and transportation processes would be handled according to applicable regulations and should not exceed any significance thresholds. Other waste streams generated should not pose significant waste management problem as they would not be unique to the carbon sequestration process.

Based on the anticipated volumes of domestic wastes to be generated and the approved disposal options available the impacts from these waste streams should not exceed significance thresholds. No hazardous waste is to be generated. Therefore, no hazardous waste management issues should arise.

Any waste formation brine resulting from geochemical sampling would be in sufficiently low enough volumes that a suitable disposal option would be available. Therefore, impacts from waste management are not expected to exceed the significance threshold.

4.11.3 Effects of No-Action

Under the No-Action alternative, no drilling waste would be generated. No wastes from the dehydration/compression/cooling and transportation of the CO_2 would be generated and no waste formation brine from sampling would be realized.

4.11.4 Cumulative Impacts

Potential cumulative impacts related to the drilling of the wells would include disposal of drilling mud and a minor quantity of produced water. Provided all regulatory requirements were met and wastes were disposed of through an approved waste receiver, the cumulative waste impacts, related to the drilling requirements of the Proposed Action, would not be expected to exceed the threshold of significance.

Potential cumulative impacts related to the waste products from the compression and transportation of CO_2 for the Proposed Action are not expected to be substantial assuming suitable collection and handling of solid wastes, lubricating oils and coolants, and the treatment and/or re-use of the wastewater stream at the Decatur ADM Complex.

There would likely to be negligible cumulative impacts regarding wastes related to sampling and monitoring of the wells due to the relatively small volumes of waste that would be generated from these activities.

Overall, the Proposed Action would not cause air, water, or soil to be contaminated with hazardous materials (assuming appropriate drilling waste management and compressor waste containment strategies are in place) to a degree that would pose a threat to human or ecological health and safety.

5.0 CONSULTATION AND COORDINATION

A kick-off meeting was held on May 14, 2008, at the NETL office in Morgantown, West Virginia, with representatives from NETL, the University of Texas, and Mangi Environmental Group to formally begin the EA process. Subsequent to that meeting, a review was made of available information necessary for the completion of the EA and data gaps were submitted to NETL. A site visit and project briefing from the MGSC was held on May 22, 2008 in Champaign, Illinois, and Decatur, Illinois, where opportunities were provided to ask questions and interview key personnel from the MGSC project.

5.1 Agency Coordination

The CEQ's regulations for implementing NEPA allows Federal agencies to invite comment from tribal, state, and local agencies, as well as other Federal agencies in the preparation of EAs. The purpose of this coordination is to obtain special expertise with respect to environmental and cultural issues in order to enhance interdisciplinary capabilities, and otherwise ensure successful, effective consultation in decision-making.

5.1.1 U.S. Fish and Wildlife Service (USFWS)

The mission of the USFWS is to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of American people. The email from USFWS requested the Endangered Species Section 7(a)(2) Consultation process. The analysis addressed issues raised by USFWS in the body of the document, which incorporated the requested process, and the necessary documentation memo is in Appendix B.

See Appendix B for letters sent to and received from agency.

5.1.2 State Historic Preservation Office (SHPO)

NHPA requires DOE to consult with the SHPO prior to any construction to ensure that no historical properties would be adversely affected by a proposed project. DOE must also afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed project. The SHPO had no objection to the project.

See Appendix D for letters sent to and received by the agency.

5.1.3 Bureau of Indian Affairs

The American Indian Religious Freedom Act, 42 USC § 1996, establishes policy to protect and preserve the inherent and Constitutional right of Native Americans to believe, express, and exercise their traditional religions. The law ensures the protection of sacred locations; access of Native Americans to those sacred locations and traditional resources that are integral to the practice of their religions; and establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by construction and operation of proposed facilities. Only the Bureau of Indian Affairs responded.

Their only concern was to conduct a particular consultation process, such as contacting the SHPO, which DOE performed and the analysis addressed in the text of the document.

See Appendix E for letters sent to the Bureau of Indian Affairs and Tribal Councils and the one letter received.

5.2 Public Involvement

The public comment period on the Draft EA was August 25 to September 25, 2008. An article informing the public of the availability of the Draft EA at the Decatur Public Library ran in the Herald & Review on August 25th and 26th. DOE received no comments from the public (Noceti, 2008).

6.0 LIST OF PREPARERS

6.1 Mangi Environmental Group

James Mangi; Contract Management
Randy Williams, Program Manager
Dave Henney; MGSC Assessment Project Manager, Proposed Action; No-Action, Project Location; Alternatives, Land Use
Dick Wildermann; Purpose and Need, Threshold Significance Criteria,
Meghan Morse; Associate Project Manager, Document/Administrative Record Management, Human Health and Safety, Cultural Resources; Cause-Effect-Questions
Ian Duncan; Geology and Soils; Water Resources
Eveline Martin; Wetlands, Wildlife, Terrestrial Plants, Visual Resources
Tim Lavallee; Air Quality, Noise
Bud Watson; Legal Framework
Rick Heffner; Socioeconomics
Mark Blevins; GIS
Lisa Edouard; Glossary

6.2 Wiebe Environmental Services

Jason Breakey; Operations/Program Manager
Ed Osborne; Project Management, Soils
Craig Robertson; Water Resources and Geology
John Railton; Review for Threshold Impact and Public Significance
Harald Thimm; Construction, Operation and Decommissioning.
Kai Nielsen; Waste Management
Kate Forbes; Background Research and Report Preparation.

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8.0 GLOSSARY

Adiabatic Decompression – Thermodynamic process in which no heat is transferred to or from the working fluid.

Adsorbed – Condensed and forming a thin film on a surface.

Ambient – The natural surroundings of a location.

Anthropogenic – Caused or produced by humans.

Anticline – In structural geology, a fold that is convex up and has its oldest beds at its core.

Argillaceous Dolomitic Sandstone – Sandstone containing substantial amounts of clay-like components and sedimentary carbonate rock.

Asphyxiation – A condition of severely deficient supply of oxygen to the body that arises from being unable to breathe normally.

Attainment Areas – A zone within which the level of a pollutant is considered to meet United States National Ambient Air Quality Standards.

A-weighted Decibels – An expression of the relative loudness of sounds in air as perceived by the human ear.

Best Management Practices – Innovative, dynamic, and improved environmental protection practices applied to oil and natural gas drilling and production to help ensure that energy development is conducted in an environmentally responsible manner.

Blowdown – Minimum discharge of recalculating water to discharged materials contained in the water, the further buildup of which would cause concentration in amounts exceeding limits established by best engineering practice.

Brine – Water saturated or nearly saturated with salt.

Caprock – A non permeable rock formation that prevents fluids from migrating upward from a porous formation.

Carbon Dioxide – Greenhouse gas created by combustion and emitted primarily from human activity such as the burning of fossil fuels to generate electricity and operate vehicles, abbreviated CO_2.

Carbon Sequestration – The capture and storage of carbon long-term in an effort to avoid release of that carbon as carbon dioxide in the atmosphere.

Class I Non-Hazardous – These wells have nonhazardous materials underneath the lowest underground source of drinking water (IEPA, 2007).

Criteria Pollutants – The Clean Air Act requires USEPA to set standards for six common air pollutants. These commonly found air pollutants (also known as "criteria pollutants") are found all over the United States. They are particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead.

Cultural Resources – Archaeological sites, historical sites (e.g. standing structures), Native-American resources, and paleontological resources.

Cumulative Effects – Those effects on the environment that result from the incremental effect of the action when added to past, present and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions.

Day-night Sound Level – The A-weighted equivalent sound level for a 24 hour period with an additional 10 dB imposed on the equivalent sound levels for night time hours of 10 P.M. to 7 A.M.

Decibel – A unit of measurement that expresses the magnitude of a physical quantity (usually intensity) relative to a specified or implied *reference level*. The decibel is useful for a wide variety of measurements in science (for this application, it is sound).

Downhole – A location in the geologic strata that is lower/below a designated location.

Endangered Species – A species whose numbers are so small that the species is at risk for extinction. A federal list of endangered species can be found in 50 CFR 17.11 (wildlife), 50 CFR 17.12 (plants), and 50 CFR 222.23(a) (marine organisms). Illinois maintains its list of endangered species with the Illinois Endangered Species Protection Board.

Effluent – Waste stream flowing into the atmosphere, surface water, groundwater, or soil.

Emergent – Amphibious plants or ecosystems that are partially or temporarily in the water or but not continuously or entirely.

EA – (Environmental Assessment), A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

EIS – (Environmental Impact Statement), A detailed written statement required by Section 102(2) (C) of the National Environmental Policy Act, analyzing the environmental impacts of a Proposed Action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Environmental Justice – The confluence of social and environmental movements, which deals with the inequitable environmental burden born by groups such as racial minorities, women, or residents of developing nations.

Equivalent Sound Level – The level of a steady-state noise without impulses or tone components which is equivalent to the actual noise emitted over a period of time.

Erodible – The erodibility of soils can be described as their sensitivity to the effects of wind and water on the soil structure. This property is expressed as an erodibility index, where low values indicate high susceptibility to erosion, and high values correspondingly indicate a low susceptibility to erosion. The erodibility index is determined by combining the effects of slope and soil type, rainfall intensity and land use. These aspects are represented by terrain morphology (soil and slope), mean annual rainfall, and broad land use patterns.

FONSI – (Finding of No Significant Impact), A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Greenhouse Gas – Greenhouse gases are the gases present in the earth's atmosphere which reduce the loss of heat into space and therefore contribute to global temperatures.

Hazardous Waste – Waste substances which can pose a substantial or potential hazard to human health or the environment when improperly managed.

Hertz – The frequency of sound waves.

Hydrocarbon Traps – A subsurface pool of hydrocarbons contained in porous rock formations that are trapped by overlying rock formations with lower permeability.

Isopach Map – A map with contours that display the stratigraphic thickness of a subsurface rock unit.

Kilowatt – A measurement of electric power.

Lithology – Geological field focusing on macroscopic hand-sample or outcrop-scale description of rocks.

Median Household Income – The median household income is commonly used to provide data about geographic areas and divides households into two equal segments with the first half of households earning less than the average household income and the other half earning more.

Minority – Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

Minority Population – Identified where either the affected area's minority population exceeds 50 percent or the affected area's minority population percentage is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Moraine – Glacially formed accumulation of unconsolidated glacial debris (soil and rock) which can occur in currently glaciated and formerly glaciated regions, such as those areas acted upon by a past ice age.

NAAQS – (National Ambient Air Quality Standards), Standards established by the USEPA that apply for outdoor air throughout the country. Primary standards are designed to protect human health, with an adequate margin of safety, including sensitive populations such as children, the elderly, and individuals suffering from respiratory disease.

NEPA – (National Environmental Policy Act), Requires all agencies, including Department of Energy, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (40 CFR 1500).

New Source Performance Standards – Are pollution control standards issued by the USEPA. The term is used in the Clean Air Act Extension of 1070 to refer to air pollution emission standards, and in the Clean Water Act referring to standards for discharges of industrial wastewater to surface waters.

Nonattainment Areas – The Clean Air Act and Amendments of 1990 define a "nonattainment area" as a locality where air pollution levels persistently exceed national standards or that contributes to ambient air quality in a nearby area that fails to meet standards. Designating an area as nonattainment is a formal rulemaking process, and USEPA normally takes this action only after air quality standards have been exceeded for several consecutive years.

Paleogeography – The study of what the geography was in times past. It is most often used in connection with the physical landscape.

Palustrine – Non-tidal wetlands.

Particular Matter – Small solid particles and liquid droplets in the sir.

Perfluorocarbons – (PFCs), Compounds derived from hydrocarbons by replacement of hydrogen atoms by fluorine atoms. PFCs are made up of carbon and fluorine atoms only.

Permeability – Formations that transmit fluids readily, such as sandstones, are described as permeable and tend to have many large, well-connected pores.

pH – The measure of the acidity or alkalinity of a solution.

Point Source Pollution – Single identifiable localized source of air, water, thermal, noise, or light pollution.

Porosity – A measure of the void spaces in a material.

Quaternary – The geologic time period after the Neogene Period roughly 1.8 million years ago to the present.

Saline Formation – Layers of porous rock that are saturated with bring water.

Sequestration – Development and demonstration of technologies for the placement of CO_2 into a repository such that it will remain stored for very long periods of time (hundreds to thousands of years); the three potential pathways for storage are geologic sequestration, terrestrial sequestration, and ocean sequestration.

Stakeholders – A person, company, group of people, etc., that have a concern and financial interest in an issue.

Stratigraphy – A branch of geology; studies of rock layers and layering.

Subsurface wireline correlations – Information derived from a logging procedure that consists of lowering a 'logging tool' on the end of a wireline into an oil well (or hole) to measure the rock and fluid properties of the formation.

Supercritical CO_2 – Carbon dioxide that is in a fluid state while also being at or above both its critical temperature and pressure.

Vadose Zone – Area of soil between the ground surface and the area directly above the groundwater surface (i.e., the water table) of unconfined aquifers.

Vertical Seismic Profile – (VSP), A technique of seismic measurements used for correlation with surface seismic data.

Wetland – Area inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

APPENDICES

Appendix A Air Emission Calculations

Table A-1. Drilling Emissions

Heavy Equipment Use

Equipment Type	Number of Units	Days on Site	Hours Per Day	Operating Hours
Bore/Drill Rigs	1	90	24	2160
Generator Sets	4	90	24	8640
Other Construction Equipment	3	90	24	6480

Drilling Equipment Emission Factors (lbs/hour)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Bore/Drill Rigs	0.5281	1.3416	0.1295	0.0017	0.0591	0.0591
Generator Sets	0.3461	0.6980	0.1075	0.0007	0.0430	0.0430
Other Construction Equipment	0.4504	1.1575	0.1215	0.0013	0.0503	0.0503

Source: (CARB, 2007b)

Drilling Equipment Emissions (tons)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Bore/Drill Rigs	0.5704	1.4489	0.1399	0.0019	0.0638	0.0638
Generator Sets	1.4952	3.0154	0.4642	0.0030	0.1858	0.1858
Other Construction Equipment	1.4592	3.7504	0.3937	0.0041	0.1631	0.1631
Total Equipment Emissions	**3.5247**	**8.2147**	**0.9978**	**0.0090**	**0.4127**	**0.4127**

Drilling Worker Commutes

Number of Workers	30
Number of Trips	2
Miles Per Trip	30
Days of Drilling	90
Total Miles	162000

Table A-1. Drilling Emissions

Pollutant	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Emission Factor (lbs/mile)	0.0105	0.0011	0.0011	0.0000	0.0001	0.0001
Total Emissions (lbs)	1708.85	178.67	174.83	1.74	13.78	8.57
Total Emissions (tons)	**0.8544**	**0.0893**	**0.0874**	**0.0009**	**0.0069**	**0.0043**

Source: (CARB, 2007b)

Total Drilling Emissions (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Heavy Equipment	3.5247	8.2147	0.9978	0.0090	0.4127	0.4127
Worker Commutes	0.8544	0.0893	0.0874	0.0009	0.0069	0.0043
Total Drilling Emissions	**4.3791**	**8.3040**	**1.0852**	**0.0099**	**0.4195**	**0.4169**

Table A-2. Construction Emissions

Construction Equipment Use

Equipment Type	Number of Units	Days on Site	Hours Per Day	Operating Hours
Air Compressors	1	30	4	120
Cement & Mortar Mixers	1	30	7	210
Cranes	1	30	7	210
Generator Sets	1	30	7	210
Tractors/Loaders/Backhoes	1	30	7	210

Construction Equipment Emission Factors (lbs/hour)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Air Compressors	0.3782	0.7980	0.1232	0.0007	0.0563	0.0563
Cement and Mortar Mixers	0.0447	0.0658	0.0113	0.0001	0.0044	0.0044
Cranes	0.6011	1.6100	0.1778	0.0014	0.0715	0.0715
Generator Sets	0.3461	0.6980	0.1075	0.0007	0.0430	0.0430
Tractors/Loaders/Backhoes	0.4063	0.7746	0.1204	0.0008	0.0599	**0.0599**

Source: (CARB, 2007b)

Table A-2. Construction Emissions

Construction Equipment Emissions (tons)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Air Compressors	0.0227	0.0479	0.0074	0.0000	0.0034	0.0034
Cranes	0.0631	0.1691	0.0187	0.0001	0.0075	0.0075
Generator Sets	0.0363	0.0733	0.0113	0.0001	0.0045	0.0045
Tractors/Loaders/Backhoes	0.0427	0.0813	0.0126	0.0001	0.0063	0.0063
Total Equipment Emissions	**0.1648**	**0.3716**	**0.0500**	**0.0003**	**0.0217**	**0.0217**

Painting

VOC Content	1.25	lbs/gallon
Coverage	400	sqft*/gallon
Emission Factor	0.003125	lbs/sqft

Building/Facility	Wall Surface	VOC [lbs]	VOC [tons]
Compressor Housing	1000	3.125	0.0015625
Support Facilities	5000	15.625	0.0078125
Total	**6000**	**18.75**	**0.009375**

Source: (CARB, 2007b)

Delivery of Equipment and Supplies

Number of Deliveries	2
Number of Trips	2
Miles Per Trip	30
Days of Construction	30
Total Miles	3600

Pollutant (pounds/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Emission Factor (lbs/mile)	0.0219	0.0237	0.0030	0.0000	0.0009	0.0007
Total Emissions (lbs)	79.02	85.37	10.77	0.09	3.08	2.66
Total Emissions (tons)	**0.0395**	**0.0427**	**0.0054**	**0.0000**	**0.0015**	**0.0013**

Source: (CARB, 2007b)

Worker Commutes

Number of Workers	20

Table A-2. Construction Emissions						
Number of Trips	2					
Miles Per Trip	30					
Days of Construction	30					
Total Miles	36000					
Pollutant (pounds/mile)	**CO**	**NO_x**	**VOC**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Emission Factor (lbs/mile)	0.0105	0.0011	0.0011	0.0000	0.0001	0.0001
Total Emissions (lbs)	379.74	39.70	38.85	0.39	3.06	1.91
Total Emissions (tons)	**0.1899**	**0.0199**	**0.0194**	**0.0002**	**0.0015**	**0.0010**
Source: (CARB, 2007b)						
Total Construction Emissions (tons)						
Activity/Source	**CO**	**NO_x**	**VOC**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Construction Equipment	0.1648	0.3716	0.0500	0.0003	0.0217	0.0217
Painting	0.0000	0.0000	0.0094	0.0000	0.0000	0.0000
Delivery of Equipment and Supplies	0.0395	0.0427	0.0054	0.0000	0.0015	0.0013
Worker Commutes	0.1899	0.0199	0.0194	0.0002	0.0015	0.0010
Total Construction Emissions	**0.3942**	**0.4341**	**0.0842**	**0.0006**	**0.0248**	**0.0240**

*Note: sqft=square feet

Table A-3. CO_2 Emission Calculations		
Drilling and Construction		
Diesel Fuel Usage	500	Gallons Per Day
Drilling Period	90	Days
Total Fuel	45000	Gallons
Total Fuel	170343	Liters
Emission Factor	2.6304	kgCO_2 per liter
Total Emissions	448070.2	kg
Total Emissions	494	Tons
Electricity Usage		
Electricity Usage	6000	kW
Hours	26280	Hours

Table A-3. CO_2 Emission Calculations		
Power	157680000	kWh
Emission Factor	0.6510	kg CO_2/kWh
Total Emissions	102649680	kg
Total Emissions	113120	Tons
Worker Commutes		
Number of Workers	20	Workers
Number of Trips	2	Trips
Miles Per Trip	30	Miles
Days of Operation	1095	Days
Total Miles	1314000	Miles
Emission Factor	1.1	lbs/mile
Total Emissions	1444785.4	lbs
Total Emissions (tons)	722.4	tons
Source: (CARB, 2007b)		
Total CO_2 Emissions (tons)		
Activity/Source	**Emissions (tons)**	
Drilling and Construction	494	
Electricity Usage	113120	
Worker Commutes	722	
Sequestration	(1102300)	
Total Emissions	(987964)	

Appendix B USFWS Consultation

U.S. Department of Energy

National Energy Technology Laboratory

June 24, 2008

Chief, Division of Endangered Species
U.S. Fish and Wildlife Service
Bishop Henry Whipple Federal Building
One Federal Drive
Ft. Snelling, MN 55111-4056

Dear Sir/Ma'am:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 metric tons (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

The proposed project will demonstrate the ability of the Mt. Simon Sandstone to accept and retain one million metric tons of carbon dioxide injected over a period of three years. Specifically, the proposed project will include the construction of a surface facility and approximately 3000-foot long pipeline, the deep-well injection of CO_2, and post-injection monitoring. The facility will include the CO_2 compression and dehydration equipment necessary to capture and condition the CO_2 from the ADM ethanol production plant. The facility will be capable of delivering 1 million metric tons of CO_2 over a three year period. The pipeline will deliver the CO_2 from the compression-dehydration facility to the injection well. Prior to construction of the facility all required permits will be obtained from the Illinois Environmental Protection Agency (IEPA) and other appropriate regulatory authorities.

A description of the proposed project and graphics depicting its location are provided as Enclosures.

As part of our coordination and consultation responsibilities, and to comply with both Section 7 of the Endangered Species Act of 1973, as amended, and provisions of the Fish & Wildlife Coordination Act, we would appreciate receiving any information you have on wildlife resources, including endangered and threatened species or critical habitat, in the project area.

Based on the scope of the proposed project, DOE plans to prepare an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no endangered or threatened species (or their habitat) are present in the project area, and that neither protected species nor their habitat would be affected by the proposed action, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided for review upon availability.

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236-0940 3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507-0880
REPLY TO: Pittsburgh Office • Pierina.Noceti@netl.doe.gov • Voice (412) 386-5428 • Fax (412) 386-4775 • www.netl.doe.gov

U.S. Department of Energy

National Energy Technology Laboratory

NETL

June 24, 2008

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Specialist

Enclosures

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U.S. Department of Energy

National Energy Technology Laboratory

June 24, 2008

Richard Nelson, Field Supervisor
U.S. Fish and Wildlife Service
Rock Island Illinois Field Office (RIFO)
1511 47th Avenue
Moline, Illinois 61265

Dear Sir:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

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June 24, 2008

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Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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Description of the Proposed Action

AN ASSESSMENT OF GEOLOGICAL CARBON SEQUESTRATION OPTIONS IN THE ILLINOIS BASIN—PHASE III

The proposed action is for the U.S. Department of Energy (DOE) to provide partial funding for a project with the Midwest Geologic Sequestration Consortium (MGSC) and the Archer Daniels Midland (ADM) Company, an agricultural products processing company, to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

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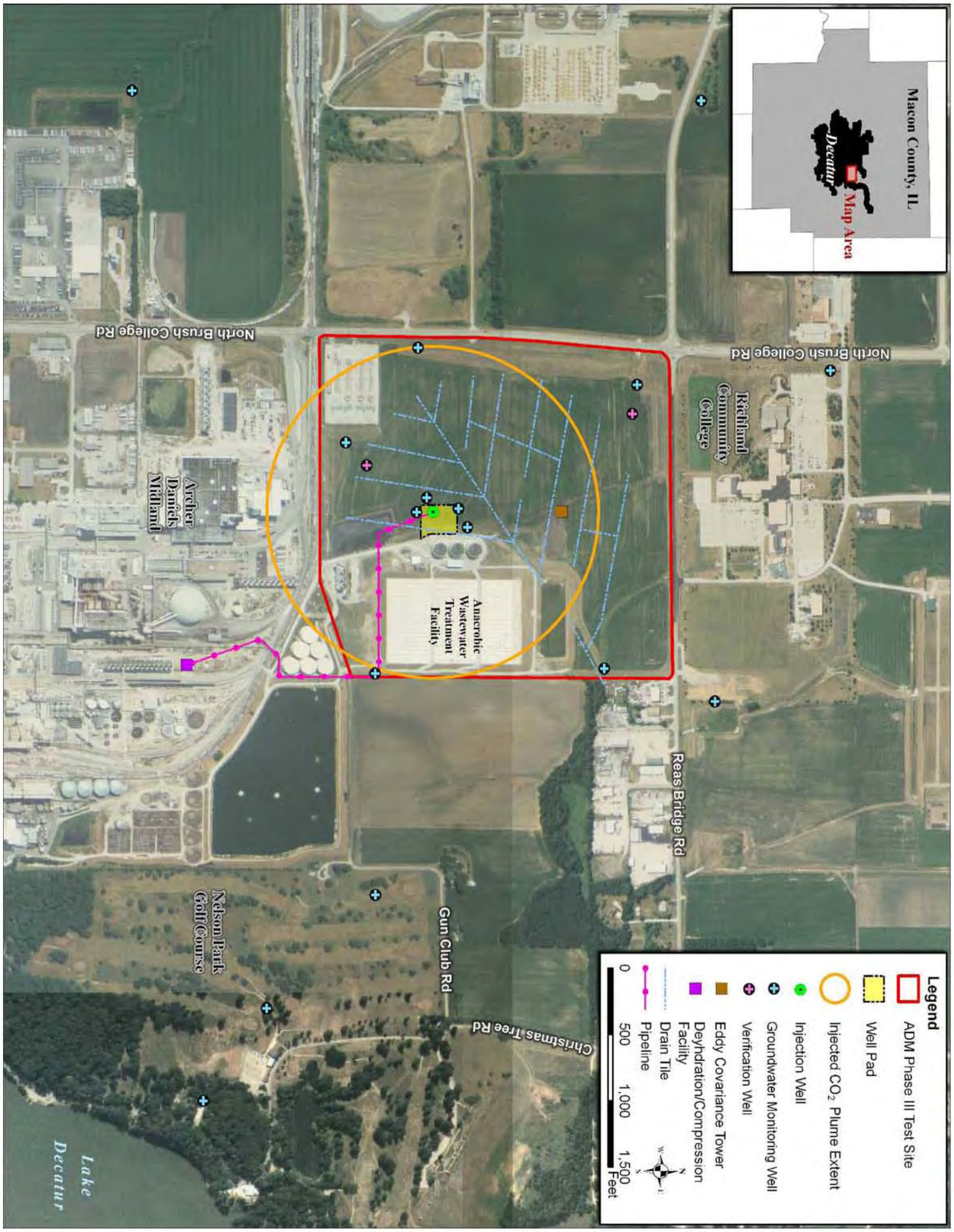
The outlet CO_2 stream from the ethanol fermentor will typically be 99%+ pure CO_2, saturated with water vapor at 80° F and atmospheric pressure. Common impurities in the fermentor gas stream are ethanol and nitrogen in the range of 600 to 1000 ppmv. Other impurities in lesser amount can include oxygen, methanol, acetaldehyde and hydrogen sulfide. The compression dehydration facility will consist of an inlet water knockout prior to the first stage of compression. The first stage of compression will use an electrically driven screw compressor to compress the low pressure CO_2 from atmospheric pressure to approximately 300 psia. Cooling of the CO_2 after the initial compression stage will be achieved using an air cooled exchanger or tube heat exchanger. A water knockout will be necessary before the 300 psia CO_2 stream is routed to a once-through water scrubber. Next, the CO2 stream will pass through a packed-bed water scrubber to remove impurities such as acetaldehyde, methanol, and other water soluble organic chemicals. The CO_2 stream will then be dehydrated using a triethylene glycol (TEG) absorbing solution.

Water-saturated CO_2 will be fed to the bottom of a packed-bed absorber tower where it will contact TEG in a countercurrent flow. The water laden TEG will leave the bottom of the absorber and will cross exchange with pure TEG in a heat exchange that cools the TEG on its way to the top of the absorber. A fuel-fired heater will heat the TEG to remove water vapor and regenerate the TEG in the stripper. The dehydrated CO_2 will leave the top of the absorber and go to a multi-stage reciprocating compressor. The two-stage reciprocating compressor will compress the CO_2 to a density and pressure needed for injection. Interstage cooling between compression steps will be performed using a

heat exchanger. It is anticipated the outlet pressure of CO_2 will be 1400 psia. The critical pressure for CO_2 is 1071 psia, so the CO_2 should be at critical conditions prior to injection. The pipeline that will transfer the CO_2 from the compression-dehydration facility to the CO_2 injection site will be 4" to 6" diameter Schedule. 40 or 80 steel pipe designed to meet standards for the temperature and pressure of the CO_2 stream. At this time it is not known if the pipeline will be installed underground, at the surface, or a combination of surface and subsurface. The pipeline will follow as much as possible the current pipeline alleys at the ADM plant site. The pipeline will be located only on ADM property.

Following compression the CO_2 will be injected into the Mount Simon sandstone for three years. Following the 3-year injection period the project will monitor the fate of the injected CO_2 and verify the simulations that were performed. During this period, routine sampling will include geophysical surveys, water sampling from underground sources of drinking water (USDW) and target formations; airborne and near surface sampling.


Legend
ADM Phase III Test Site
Well Pad
Injected CO_2 Plume Extent
Injection Well
Groundwater Monitoring Well
Verification Well
Eddy Covariance Tower
Deyhdration/Compression Facility
Drain Tile
Pipeline
0 500 1,000 1,500 Feet
Macon County, IL
Decatur
Map Area
North Brush College Rd
North Brush College Rd
Richland Community College
Archer Daniels Midland
Anaerobic Wastewater Treatment Facility
Reas Bridge Rd
Gun Club Rd
Christmas Tree Rd
Nelson Park Golf Course
Lake Decatur

Dear Ms. Noceti,

This is in response to your letter of June 24, 2008, requesting information on the potential impacts on endangered species from the proposed saline sequestration test at ADM's ethanol fermentation facility in Macon County, Illinois.

Section 7 of the Endangered Species Act of 1973 requires that actions authorized, funded, or carried out by Federal agencies not jeopardize federally threatened or endangered species or adversely modify designated critical habitat. To fulfill this mandate, Federal agencies (or their designated non-federal representative) must consult with the U.S. Fish and Wildlife Service (Service) if they determine their project "may affect" listed species or critical habitat. If Federal agencies or their non-federal representatives determine their actions will have "no effect" on listed species, their habitats, or designated critical habitat, consultation is not required. However, we recommend you maintain a written record of why "no effect" findings are warranted for your Federal actions.

Our data indicate that the species on the attached list may occur in the area of your proposed action. Descriptions of the habitat requirements are included with the list. You may use these descriptions to help you determine if there is suitable habitat within your project area.

We invite you to use a new tool the Service has designed to help with the consultation process – the new Section 7(a)(2) Technical Assistance webpage (http://www.fws.gov/midwest/endangered/section7/s7process/index.htm). By following the instructions, you can determine what your action area is, whether listed species may be found within the action area, and if the project may affect listed species.

You will find several products on the site that can streamline the consultation process for this and future projects. When determining if listed species may be located within a project area, you can download county specific species lists for all of the states in Region 3. Species specific best management practices will also eventually be available. Example letters and templates are available to assist with documenting "no effect" determinations and preparing requests for "not likely to adversely affect" concurrence.

These comments are provided as technical assistance in accordance with the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq).

If you have any questions regarding our comments, please contact me.

Kristen Lundh
U.S. Fish & Wildlife Service
Rock Island Ecological Services Field Office
1511 47th Ave.
Moline, IL 61265
309-757-5800 ext 215
fax: 309-757-5807

THE MANGI ENVIRONMENTAL GROUP, INC.
7915 Jones Branch Dr. McLean VA 22102
703 760 4801 Fax 703 760 4899
www.mangi.com

Viet Nam
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MEMO

TO: Department of Energy and Midwest Geological Sequestration Consortium

FROM: Eveline Martin, Mangi Environmental Group

DATE: June 11, 2008

RE: Section 7 Endangered Species Act Consultation – Phase III amendment to the work of the Midwest Geological Sequestration Consortium

The Midwest Geological Sequestration Consortium, with funding from the Department of Energy, is in the process of completing NEPA documentation for the Assessment of Geological Carbon Sequestration Options in the IL Basin Phase III. The project is located on property of consortium member Archer Daniels Midland (ADM), immediately adjacent to Decatur, Illinois, Macon County, Sec 5 T16N R3E.

The overall effort of this study will demonstrate the ability of the Mt. Simon Sandstone, a major regional saline reservoir in the Illinois Basin, to accept and retain one million metric tons of carbon dioxide injected over a period of three years. The project would consist of construction of a CO_2 compression and dehydration surface facility and approximately 3000-foot long pipeline.

The Mangi Environmental Group carefully reviewed the U.S. Fish and Wildlife technical assistance website on June 10, 2008 for federally listed threatened and endangered species. According to the website, three species are listed and may be present in Macon County: the Indiana bat, the eastern prairie fringed orchid, and the prairie bush clover.

The action area for the proposed project is made up almost entirely of fallow agricultural field and industrial complex on ADM property. This property does not contain habitat for any of the three listed T&E species in Macon County.

For this reasons, we conclude that the Assessment of Geological Carbon Sequestration Options in the IL Basin Phase III project will have "no effect" on listed species, their habitats, or proposed or designated critical habitat.

Appendix C Noise Calculations

Table C-1. Drilling Noise													
NSA 1 – Community College	**Feet 1800**	**Meters 549**											
	Octave Band Center Frequency, Hz												
Source				**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB**
Drill Rig (@25 Feet)				93	97	94	91	92	91	88	81	76	
Power level (PWL)				121	125	123	120	121	120	116	109	105	
Transmission Loss (TL) Enclosure (1/2" wood)				0.5	-5.5	-11.5	-17.5	-23.5	-29.5	-35.6	-41.6	-47.6	
PWL with enclosure				122	23	17	11	5	-1	-7	-13	-19	
Mud Handling (Shaker and Pump) (@25 Feet)				89	90	88	81	79	78	75	74	68	
PWL				118	119	117	110	108	107	104	103	97	
Generators (Light Plant)	**325**	**435.5**	CF	**5**	**9**	**3**	**7**	**15**	**19**	**25**	**35**	**43**	
Exhaust Noise	Lw	145.1		140.1	136.1	142.1	138.1	130.1	126.1	120.1	110.1	102.1	134
			Muffler Correction	25	25	29	29	27	25	24	23	23	
			PWL	115.1	111.1	113.1	109.1	103.1	101.1	96.1	87.1	79.1	107
			CF	**4**	**11**	**13**	**13**	**12**	**9**	**8**	**9**	**17**	
Inlet Noise	Lw	107.6	PWL	103.6	96.6	94.6	94.6	95.6	98.6	99.6	98.6	90.6	105
			CF	**22**	**14**	**7**	**7**	**8**	**6**	**7**	**13**	**20**	
Casing Noise	Lw	118.1	**PWL**	96	104	111	111	110	112	111	105	98	117
Excavator (@25 Feet)					84	85	81	81	81	78	73		
PWL				29	113	114	110	110	110	107	102	29	
Total Sound Intensity				2.4907	1.0575	1.0167	0.3944	0.2741	0.3185	0.2104	0.0725	0.0122	
Total PWL				**124**	**120**	**120**	**116**	**114**	**115**	**113**	**109**	**101**	**128**
Hemispherical Spreading				-69	-69	-69	-69	-69	-69	-69	-69	-69	
Atmospheric Absorption				0	0	0	-1	-2	-3	-5	-13	-23	

Table C-1. Drilling Noise

Flat Sound Level				55	52	51	47	44	44	40	27	9	
Octave Band A-Weighted Correction				-39	-26	-16	-9	-3	0	1	1	-1	
A-Weighted Sound Level				16	26	35	38	41	44	41	28	8	**48**
												Ldn	**54**

Notes:

Calculations based on available data from typical equipment set-ups, actual equipment would vary dependent on results of geotechnical evaluation and site specific design.

Lw is sound power levels, CF is center frequency, and Ldn is equivalent day night level.

Calculations do not account for effect of topographic features, reflection, and natural barriers

Table C-2. Compressor Noise

NSA 1 - Community College		**Feet** 4000	**Meters** 1219										
	Octave Band Center Frequency, Hz												
Source				**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB**
Reciprocating Compressor		**6000.0**	CF	**11**	**15**	**10**	**11**	**13**	**10**	**5**	**8**	**15**	
	Lw	126.5	**PWL**	116	112	117	116	114	117	122	119	112	125
Total Sound Intensity				0.3554	0.1415	0.4474	0.3554	0.2242	0.4474	1.4149	0.7091	0.1415	
Total PWL				**116**	**112**	**117**	**116**	**114**	**117**	**122**	**119**	**112**	**126**
Hemispherical Spreading				-76	-76	-76	-76	-76	-76	-76	-76	-76	
Atmospheric Absorption				0	0	0	-1	-3	-6	-11	-28	-51	
Octave Band A-Weighted Correction				-39	-26	-16	-9	-3	0	1	1	-1	
A-Weighted Sound Level (without barrier)				1	10	24	30	31	35	36	16	-16	**40**
												Ldn	**46**

Table C-2. Compressor Noise

	Feet	**Meters**											
Critical Distance Calculation	**1000**	**305**											
	Octave Band Center Frequency, Hz												
Source				**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB**
Reciprocating Compressor		**6000.0**	CF	**11**	**15**	**10**	**11**	**13**	**10**	**5**	**8**	**15**	
	Lw	126.5	**PWL**	116	112	117	116	114	117	122	119	112	125
Total Sound Intensity				0.3554	0.1415	0.4474	0.3554	0.2242	0.4474	1.4149	0.7091	0.1415	
Total PWL				**116**	**112**	**117**	**116**	**114**	**117**	**122**	**119**	**112**	**126**
Hemispherical Spreading				-64	-64	-64	-64	-64	-64	-64	-64	-64	
Atmospheric Absorption				0	0	0	0	-1	-2	-3	-7	-13	
Octave Band A-Weighted Correction				-39	-26	-16	-9	-3	0	1	1	-1	
A-Weighted Sound Level (without barrier)				13	22	37	43	46	51	56	49	34	**58**
												Ldn	**65**

Appendix D SHPO Consultation

U.S. Department of Energy

National Energy Technology Laboratory

NETL

June 24, 2008

Mr. William L. Wheeler, SHPO
Associate Director
Illinois Historic Preservation Agency
1 Old State Capitol Plaza
Springfield, IL 62701-1512

Dear Mr. Wheeler:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

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A description of the proposed project and graphics depicting its location are provided as Enclosures.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966, we would appreciate receiving any information you have regarding historic or cultural properties in the project area.

Based on the scope of the proposed project, DOE has initiated preparation of an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no historic or cultural properties are present in the project area, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided for review upon availability.

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U.S. Department of Energy

National Energy Technology Laboratory

NETL

June 24, 2008

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Sincerely,

Pierina Noceti
NEPA Specialist

Enclosures

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The outlet CO_2 stream from the ethanol fermentor will typically be 99%+ pure CO_2, saturated with water vapor at 80° F and atmospheric pressure. Common impurities in the fermentor gas stream are ethanol and nitrogen in the range of 600 to 1000 ppmv. Other impurities in lesser amount can include oxygen, methanol, acetaldehyde and hydrogen sulfide. The compression dehydration facility will consist of an inlet water knockout prior to the first stage of compression. The first stage of compression will use an electrically driven screw compressor to compress the low pressure CO_2 from atmospheric pressure to approximately 300 psia. Cooling of the CO_2 after the initial compression stage will be achieved using an air cooled exchanger or tube heat exchanger. A water knockout will be necessary before the 300 psia CO_2 stream is routed to a once-through water scrubber. Next, the CO2 stream will pass through a packed-bed water scrubber to remove impurities such as acetaldehyde, methanol, and other water soluble organic chemicals. The CO_2 stream will then be dehydrated using a triethylene glycol (TEG) absorbing solution.

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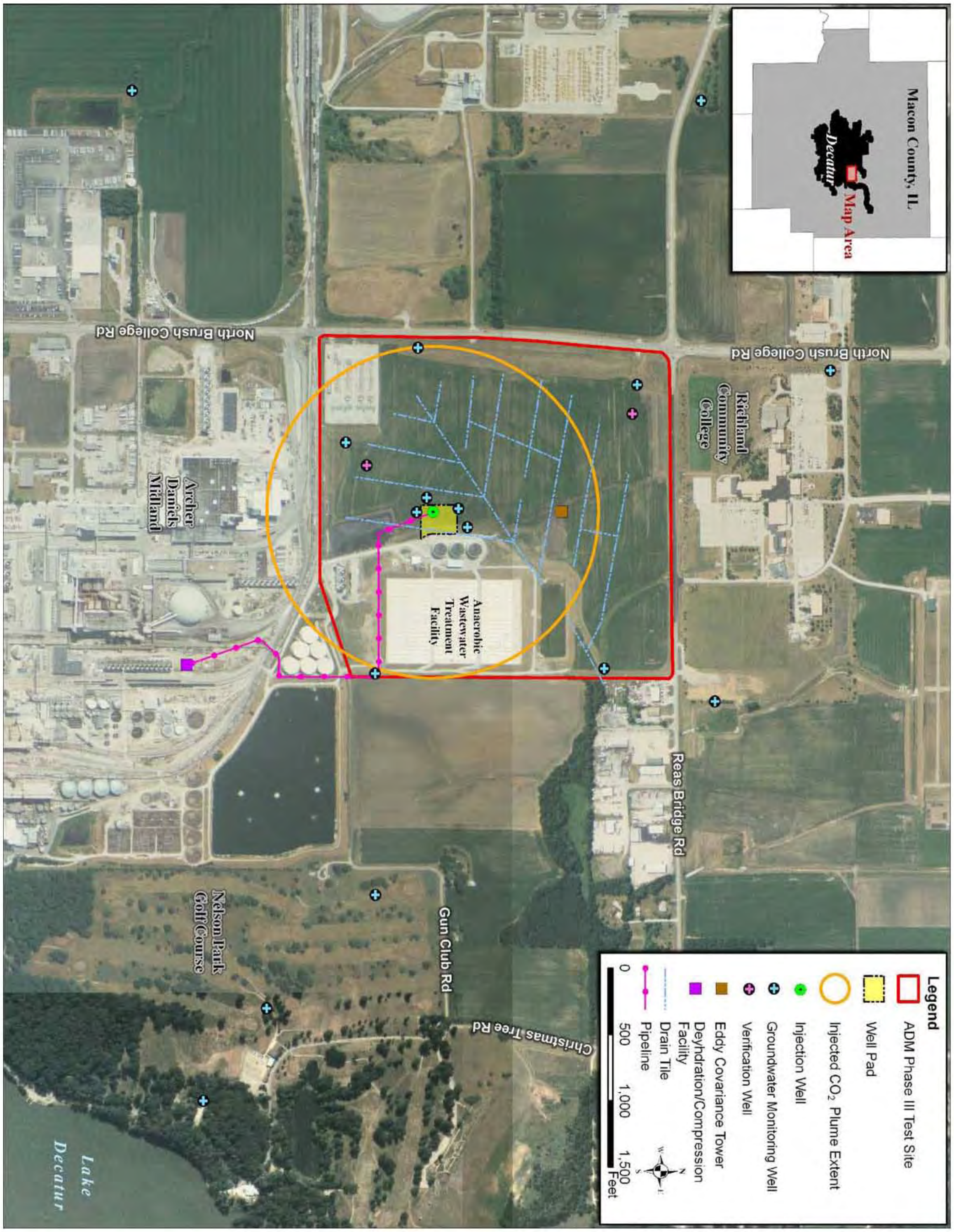
heat exchanger. It is anticipated the outlet pressure of CO_2 will be 1400 psia. The critical pressure for CO_2 is 1071 psia, so the CO_2 should be at critical conditions prior to injection. The pipeline that will transfer the CO_2 from the compression-dehydration facility to the CO_2 injection site will be 4" to 6" diameter Schedule. 40 or 80 steel pipe designed to meet standards for the temperature and pressure of the CO_2 stream. At this time it is not known if the pipeline will be installed underground, at the surface, or a combination of surface and subsurface. The pipeline will follow as much as possible the current pipeline alleys at the ADM plant site. The pipeline will be located only on ADM property.

Following compression the CO_2 will be injected into the Mount Simon sandstone for three years. Following the 3-year injection period the project will monitor the fate of the injected CO_2 and verify the simulations that were performed. During this period, routine sampling will include geophysical surveys, water sampling from underground sources of drinking water (USDW) and target formations; airborne and near surface sampling.


Macon County, IL
Decatur
Map Area
North Brush College Rd
North Brush College Rd
Archer Daniels Midland
Richland Community College
Anaerobic Wastewater Treatment Facility
Reas Bridge Rd
Gun Club Rd
Nelson Park Golf Course
Christmas Tree Rd
Lake Decatur
Legend
ADM Phase III Test Site
Well Pad
Injected CO2 Plume Extent
Injection Well
Groundwater Monitoring Well
Verification Well
Eddy Covariance Tower
Deyhdration/Compression Facility
Drain Tile
Pipeline
0 500 1,000 1,500
Feet

Illinois Historic Preservation Agency

1 Old State Capitol Plaza • Springfield, Illinois 62701-1512 • www.illinois-history.gov

Macon County PLEASE REFER TO: IHPA LOG #018070708
Decatur
NEC of North Brush College Road and Reas Bridge Road
Saline Sequestration Test Phase III/ADM Ethanol Fermentation Facility

July 14, 2008

Pierina Noceti
U.S. Department of Energy
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburg, PA 15236-0940

Dear Madam:

We have reviewed the documentation submitted for the referenced project(s) in accordance with 36 CFR Part 800.4. Based upon the information provided, no historic properties are affected. We, therefore, have no objection to the undertaking proceeding as planned.

Please retain this letter in your files as evidence of compliance with section 106 of the National Historic Preservation Act of 1966, as amended. This clearance remains in effect for two (2) years from date of issuance. It does not pertain to any discovery during construction, nor is it a clearance for purposes of the Illinois Human Skeletal Remains Protection Act (20 ILCS 3440).

If you are an applicant, please submit a copy of this letter to the state or federal agency from which you obtain any permit, license, grant, or other assistance.

Sincerely,

Anne E. Haaker

Anne E. Haaker
Deputy State Historic
Preservation Officer

AEH

A teletypewriter for the speech/hearing impaired is available at 217-524-7128. It is not a voice or fax line.

Appendix E Contact with the Bureau of Indian Affairs and Tribal Councils

U.S. Department of Energy

National Energy Technology Laboratory

July 9, 2008

Galen Hubbard, Superintendent
Horton Agency
Bureau of Indian Affairs
P.O. Box 31
Horton, KS 66439

Dear Superintendent Hubbard:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

The proposed project will demonstrate the ability of the Mt. Simon Sandstone to accept and retain one million metric tons of carbon dioxide injected over a period of three years. Specifically, the proposed project will include the construction of a surface facility and approximately 3000-foot long pipeline, the deep-well injection of CO_2, and post-injection monitoring. The facility will include the CO_2 compression and dehydration equipment necessary to capture and condition the CO_2 from the ADM ethanol production plant. The facility will be capable of delivering 1 million metric tons of CO_2 over a three year period. The pipeline will deliver the CO_2 from the compression-dehydration facility to the injection well. Prior to construction of the facility all required permits will be obtained from the Illinois Environmental Protection Agency (IEPA) and other appropriate regulatory authorities.

A description of the proposed project and graphics depicting its location are provided as enclosures.

As part of our coordination and consultation responsibilities, and to comply with provisions implementing Section 106 of the National Historic Preservation Act of 1966 and Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," we would appreciate receiving any information you have regarding historic or cultural properties in the project area.

Based on the scope of the proposed project, DOE has initiated preparation of an Environmental Assessment (EA), in accordance with requirements of the National Environmental Policy Act, to analyze, document, and disseminate information on the potential environmental consequences of the proposed project. Information that you provide will be incorporated and appropriately addressed in the EA. If your initial review concludes that no historic or cultural properties are present in the project area, a written acknowledgement of that conclusion would be appreciated. In any case, the information that you provide will be considered in preparing a draft EA, which will be provided for review upon availability.

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
pierina.noceti@netl.doe.gov@netl.doe.gov • Voice (412) 386-5428 • Fax (412) 386-4775 • www.netl.doe.gov

U.S. Department of Energy

National Energy Technology Laboratory

NETL

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti

Pierina Noceti
NEPA Document Manager

Enclosures

626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
pierina.noceti@netl.doe.gov@netl.doe.gov • Voice (412) 386-5428 • Fax (412) 386-4775 • www.netl.doe.gov

U.S. Department of Energy

National Energy Technology Laboratory

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July 2, 2008

Marlon E. Frye, Chairman
Kickapoo Tribe of Oklahoma
P.O. Box 70
McCloud, OK 74851

Dear Chairman Frye:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

The proposed project will demonstrate the ability of the Mt. Simon Sandstone to accept and retain one million metric tons of carbon dioxide injected over a period of three years. Specifically, the proposed project will include the construction of a surface facility and approximately 3000-foot long pipeline, the deep-well injection of CO_2, and post-injection monitoring. The facility will include the CO_2 compression and dehydration equipment necessary to capture and condition the CO_2 from the ADM ethanol production plant. The facility will be capable of delivering 1 million metric tons of CO_2 over a three year period. The pipeline will deliver the CO_2 from the compression-dehydration facility to the injection well. Prior to construction of the facility all required permits will be obtained from the Illinois Environmental Protection Agency (IEPA) and other appropriate regulatory authorities.

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U.S. Department of Energy

National Energy Technology Laboratory

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Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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U.S. Department of Energy

National Energy Technology Laboratory

July 2, 2008

Steve Cadue, Chairman
Kickapoo Tribe in Kansas
P.O. Box 271
Horton, KS 66439

Dear Chairman Cadue:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

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U.S. Department of Energy

National Energy Technology Laboratory

Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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U.S. Department of Energy

National Energy Technology Laboratory

July 2, 2008

Dan Deerinwater, Regional Director
Southern Plains Regional Office
Bureau of Indian Affairs
WCD Office Complex
P.O. Box 368
Anadarko, OK 73005

Dear Director Deerinwater:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

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Sincerely,

Pierina Noceti

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NEPA Document Manager

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U.S. Department of Energy

National Energy Technology Laboratory

July 2, 2008

Frances Wetselline, Realty Specialist
Shawnee Agency
Bureau of Indian Affairs
624 West Independence, Suite 109
Shawnee, OK 74801

Dear Specialist Wetselline:

The United States Department of Energy (DOE) is considering funding the Midwest Geologic Sequestration Consortium (MGSC) and its partner, Archer Daniels Midland (ADM) Company (an agricultural products processing company), to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

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U.S. Department of Energy

National Energy Technology Laboratory

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Should you require additional information, please contact me by telephone at (412) 386-5428 or by e-mail at pierina.noceti@netl.doe.gov.

Sincerely,

Pierina Noceti
NEPA Document Manager

Enclosures

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Enclosures

Description of the Proposed Action

AN ASSESSMENT OF GEOLOGICAL CARBON SEQUESTRATION OPTIONS IN THE ILLINOIS BASIN—PHASE III

The proposed action is for the U.S. Department of Energy (DOE) to provide partial funding for a project with the Midwest Geologic Sequestration Consortium (MGSC) and the Archer Daniels Midland (ADM) Company, an agricultural products processing company, to conduct a large volume saline sequestration test at ADM's ethanol fermentation facility located in Decatur, Illinois. The test will involve the injection of 333,000 tonnes (367,000 U.S. tons) of CO_2 per year from the fermentation plant for three years into the Mount Simon Sandstone, a major regional saline formation in the Illinois Basin.

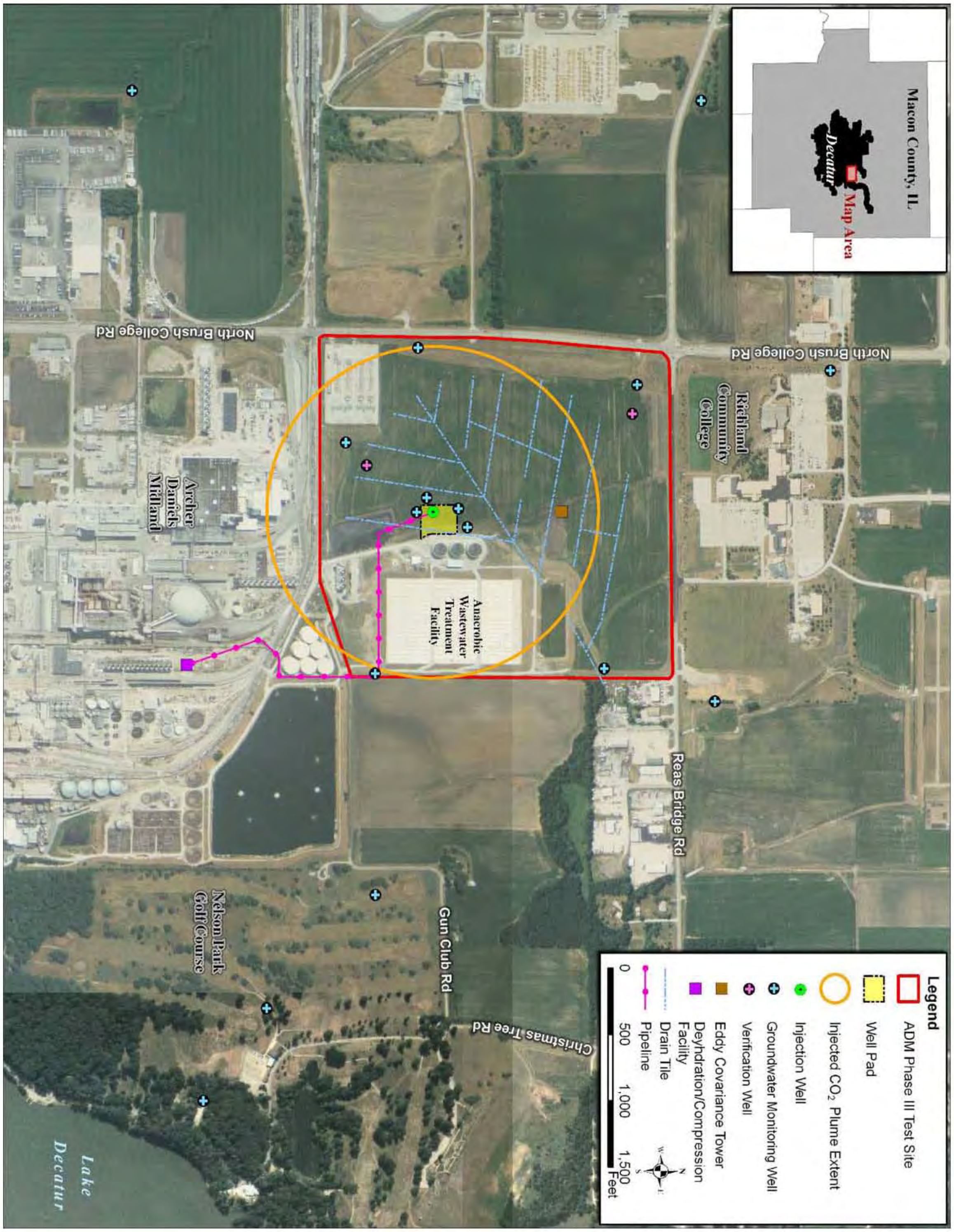
The proposed project will demonstrate the ability of the Mt. Simon Sandstone to accept and retain one million metric tons of carbon dioxide injected over a period of three years. Specifically, the proposed project will include the construction of a surface facility and approximately 3000-foot long pipeline, the deep-well injection of CO_2, and post-injection monitoring. The facility will include the CO_2 compression and dehydration equipment necessary to capture and condition the CO_2 from the ADM ethanol production plant. The facility will be capable of delivering 1 million metric tons of CO_2 over a three year period. The pipeline will deliver the CO_2 from the compression-dehydration facility to the injection well. Prior to construction of the facility all required permits will be obtained from the Illinois Environmental Protection Agency (IEPA) and other appropriate regulatory authorities.

The outlet CO_2 stream from the ethanol fermentor will typically be 99%+ pure CO_2, saturated with water vapor at 80° F and atmospheric pressure. Common impurities in the fermentor gas stream are ethanol and nitrogen in the range of 600 to 1000 ppmv. Other impurities in lesser amount can include oxygen, methanol, acetaldehyde and hydrogen sulfide. The compression dehydration facility will consist of an inlet water knockout prior to the first stage of compression. The first stage of compression will use an electrically driven screw compressor to compress the low pressure CO_2 from atmospheric pressure to approximately 300 psia. Cooling of the CO_2 after the initial compression stage will be achieved using an air cooled exchanger or tube heat exchanger. A water knockout will be necessary before the 300 psia CO_2 stream is routed to a once-through water scrubber. Next, the CO2 stream will pass through a packed-bed water scrubber to remove impurities such as acetaldehyde, methanol, and other water soluble organic chemicals. The CO_2 stream will then be dehydrated using a triethylene glycol (TEG) absorbing solution.

Water-saturated CO_2 will be fed to the bottom of a packed-bed absorber tower where it will contact TEG in a countercurrent flow. The water laden TEG will leave the bottom of the absorber and will cross exchange with pure TEG in a heat exchange that cools the TEG on its way to the top of the absorber. A fuel-fired heater will heat the TEG to remove water vapor and regenerate the TEG in the stripper. The dehydrated CO_2 will leave the top of the absorber and go to a multi-stage reciprocating compressor. The two-stage reciprocating compressor will compress the CO_2 to a density and pressure needed for injection. Interstage cooling between compression steps will be performed using a

heat exchanger. It is anticipated the outlet pressure of CO_2 will be 1400 psia. The critical pressure for CO_2 is 1071 psia, so the CO_2 should be at critical conditions prior to injection. The pipeline that will transfer the CO_2 from the compression-dehydration facility to the CO_2 injection site will be 4" to 6" diameter Schedule. 40 or 80 steel pipe designed to meet standards for the temperature and pressure of the CO_2 stream. At this time it is not known if the pipeline will be installed underground, at the surface, or a combination of surface and subsurface. The pipeline will follow as much as possible the current pipeline alleys at the ADM plant site. The pipeline will be located only on ADM property.

Following compression the CO_2 will be injected into the Mount Simon sandstone for three years. Following the 3-year injection period the project will monitor the fate of the injected CO_2 and verify the simulations that were performed. During this period, routine sampling will include geophysical surveys, water sampling from underground sources of drinking water (USDW) and target formations; airborne and near surface sampling.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United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
Midwest Regional Office
Bishop Henry Whipple Federal Building
One Federal Drive, Room 550
Ft. Snelling, Minnesota 55111

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

Environmental, Cultural and Safety

JUL 23 2008

Pierina Noceti, NEPA Document Administrator
U.S. Department of Energy
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, Pennsylvania 15236

RE: Carbon Dioxide Sequestration Project in Decatur, Illinois

Dear Ms. Noceti:

Your letter of July 9, 2008 regarding your federal compliance responsibilities for the subject project was forwarded to the BIA's Midwest Region from the Horton Agency in Horton, Kansas. Illinois is within our region.

Regulations for compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321-4347) and Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (16 U.S.C. 470e), requires direct contact with the affected tribal governments related to archaeological resources and traditional cultural properties.

The federal statutes, such as NEPA and NHPA, require an assessment of the effects or impacts that a federal action (undertaking) may have on possible historic properties in or near the subject area of potential effect (APE). Before contacting us further, we recommend that your agency first conduct background research to determine if the project area is located within the boundaries of ceded territories. This could be done either by your office or by a qualified contractor conducting the NEPA process. You or the contractor should also contact the relevant State Historic Preservation Office for the location of recorded historic properties in and within 1 mile of the project area (APE).

To identify which Indian tribes resided in your project areas historically, you should investigate the *Map of Judicially Established Indian Areas 1978*. The *Atlas of Great Lakes Indian History* (1987, University of Oklahoma Press, edited by Helen Hornbeck Tanner) and the Smithsonian Institution's series on North American Indians are other sources you may wish to consult. Many of these documents can be found in academic or large public libraries or in some of the state historic preservation offices. These maps and other useful maps are also available at the National Park Services' website. For example, a consultation database called the National NAGPRA-Native American Consultation Database can be found at: **www.cr.nps.gov/nagpra/nacd.htm**. Also, you could directly contact the National Park Service by telephone or letter.

Regardless of project location, it appears to us that the Department of Energy is the lead agency in the process and is ultimately responsible to ensure compliance with all federal laws. If this project affects Native American trust resources within ceded territories then the BIA becomes a cooperating agency and can provide technical expertise and recommendations for cultural resource surveys under NEPA and Section 106 of NHPA.

If the project will not affect trust resources within ceded territories, please consult directly with the historically pertinent tribe(s) known to have been in the area. The BIA could then become a commenting agency and can provide guidance as to the efficacy of your compliance efforts.

If you need further clarification, please contact Richard Berg, Regional Archaeologist, at 612-725-4512.

Sincerely,

Terrance L. Virden

Regional Director