DOE/EA-1846

FINAL
ENVIRONMENTAL ASSESSMENT

FOR

AIR PRODUCTS AND CHEMICALS, INC.
RECOVERY ACT: DEMONSTRATION OF CO_2 CAPTURE AND SEQUESTRATION OF STEAM METHANE REFORMING PROCESS GAS USED FOR LARGE SCALE HYDROGEN PRODUCTION

U.S. Department of Energy
National Energy Technology Laboratory

June 2011

ACRONYMS AND ABBREVIATIONS

3-D	three-dimensional
µg/m3	microgram per cubic meter
aMDEA	activated methyldiethanolamine
AMSL	above mean sea level
APCI	Air Products and Chemicals, Inc.
AP LLC	Air Products LLC
APE	area of potential effect
ARRA	American Recovery and Reinvestment Act of 2009
ATWS	additional temporary work space
AZMI	above-zone monitoring interval
Bcf	billion cubic feet
BCGCD	Brazoria County Groundwater Conservation District
BEA	Bureau of Economic Analysis
BEG	(Texas) Bureau of Economic Geology
BMPs	best management practices
BPA	Beaumont-Port Arthur
CAA	Clean Air Act
CCS	carbon capture and sequestration
CEQ	Council on Environmental Quality (U.S.)
CFR	Code of Federal Regulations (U.S.)
CO	carbon monoxide
CO_2	carbon dioxide
DOE	U.S. Department of Energy
e.g.	*exempli gratia,* for example
EA	Environmental Assessment
EIS	Environmental Impact Statement
EOR	enhanced oil recovery
EPA	U.S. Environmental Protection Agency
ESLs	effects screening levels
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FR	Federal Register
ft	feet or foot
GHG	greenhouse gas
GIS	geographic information systems
GIWW	Gulf Intracoastal Waterway
gpm	gallons per minute
GT	gas turbine
H_2	hydrogen (gas)
HAPs	hazardous air pollutants
HDD	horizontal directional drill
HFPP	Hurricane/Shore Flood Protection Project
HHV	higher heating value

HRSG	heat recovery steam generator
IPCC	Intergovernmental Panel on Climate Change
JCDD7	Jefferson County Drainage District Number 7
lb/hr	pounds per hour
lbs	pounds
LNG	liquefied natural gas
md	Millidarcy
mg/l	milligrams per liter
mg/m^3	milligram per cubic meter
MMBbls	million barrels
MMBTU/hr	million British Thermal Units per hour
MMSCF	million standard cubic feet (at 60 °F and 14.696 psia)
MSA	Metropolitan Statistical Area
MSS	maintenance, startup, and shutdown
MVA	monitoring, verification, and accounting
MW	megawatt
MWH	megawatt hours
NAAQS	National Ambient Air Quality Standards
NaOH	sodium hydroxide
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act of 1966
NO	nitrogen oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	Nation Register of Historic Places
NuC	Neel-Urban Land Complex soil type
NWI	National Wetlands Inventory
NWP	Nationwide Permit
O_3	ozone
OAQPS	Office of Air Quality and Planning Standards
OSHA	Occupational Safety and Health Administration
P&A	plugged and abandoned
PA1	Air Products' Port Arthur One hydrogen plant
PA2	Air Products' Port Arthur Two hydrogen plant
Pb	lead
PEM	Palustrine emergent wetland
PM_{10}	particulate matter (less than 10 microns in diameter)
$PM_{2.5}$	particulate matter (less than 2.5 microns in diameter)
ppm	parts per million
PSA	pressure swing adsorber or pressure swing adsorption
psia	pounds per square inch absolute
PSS	Palustrine scrub-shrub wetland

RFT	repeat formation test
ROI	region of influence
ROW	right-of-way
RRC	Texas Railroad Commission
SETRPC	Southeast Texas Regional Planning Commission
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMR	steam methane reformer or steam methane reforming
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control and Countermeasure
SPH	Standard Project Hurricane
SWQS	surface water quality standards
TA	Temporarily abandoned
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
Tcf	trillion cubic feet
TDS	total dissolved solids
TEG	triethylene glycol
THC	Texas Historical Commission
TMDL	Total Maximum Daily Load
TPWD	Texas Parks and Wildlife Department
tpy	short tons (2,000 lbs) per year
TWC	Texas Workforce Commission
TWDB	Texas Water Development Board
TXNDD	Texas Natural Diversity Database
UIC	Underground Injection Control
U.S.	United States
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USDW	underground sources of drinking water
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compounds
VSA	vacuum swing adsorption
VSP	vertical seismic profile

Note: Numbers in this EA generally have been rounded to two or three significant figures. Therefore, some total values might not equal the actual sums of the values.

COVER SHEET

Responsible Agency: U.S. Department of Energy (DOE)

Title: *Final Environmental Assessment for Air Products and Chemicals, Inc. Recovery Act: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production* (DOE/EA-1846)

Contact: For additional copies or more information concerning this environmental assessment (EA), please contact:

Mr. Fred Pozzuto
U.S. Department of Energy
National Energy Technology Laboratory 3610 Collins Ferry Road
Bldg. 1, MS B07
Morgantown, WV 26507-0880
Email: fred.pozzuto@netl.doe.gov

Abstract: DOE prepared this EA to evaluate the potential environmental consequences of providing a financial assistance grant under the *American Recovery and Reinvestment Act of 2009* (Recovery Act) (Recovery Act; Public Law 111-5, 123 Stat. 115) to Air Products and Chemicals, Inc. (Air Products).

If Air Products received the funding, the company would demonstrate the capture of carbon dioxide (CO_2) from steam methane reformers at Air Products facilities in Port Arthur, Texas; transporting the CO_2 via pipeline; and conducting monitoring, verification, and accounting (MVA) related to enhanced oil recovery (EOR) at the West Hastings Field. The CO_2 would be sequestered in the Frio formation as part of the EOR activities. Air Products would capture approximately one million short tons of CO_2 per year using vacuum swing adsorption. The compressed CO_2 would be piped approximately 12.8 miles to the existing Green Pipeline, which would in turn convey the CO_2 to the West Hastings Field south of Houston, Texas. Denbury Onshore, LLC. is a subcontractor to Air Products for the use of the Green Pipeline and will share responsibility for conducting the MVA activities.

DOE's proposed action would provide approximately $284 million in financial assistance in a cost-sharing arrangement to Air Products. The cost of the proposed project would be approximately $431 million.

This EA evaluates the environmental resource areas DOE commonly addresses in its EAs and identifies no significant adverse environmental impacts for the proposed project. The proposed project could result in beneficial impacts to the nation's energy efficiency, through capture of CO_2 at existing Air Products facilities within the Valero Port Arthur Refinery, and to the local

economy; increase domestic oil production; and could contribute to a minor reduction of greenhouse gases.

Availability: A Notice of Availability for the Draft EA was placed in *The Port Arthur News* and the *Houston Chronicle* on May 20, 21, and 22, 2011. This Final EA is available on DOE's NEPA web site at http://nepa.energy.gov/DOE_NEPA_documents.htm.

June 21, 2011

Dear Reader:

The Department of Energy (DOE) hereby publishes this Final Environmental Assessment (DOE/EA1846) for the Air Products and Chemicals, Inc. project referred to as *Recovery Act: Demonstration of* CO_2 *Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production.* A Notice of Availability for the Draft EA was published in *The Port Arthur News* and the *Houston Chronicle* on May 20, 21, and 22, 2011 to announce the beginning of the 30-day public review and comment period, which was conducted from May 17, 2011 through June 17, 2011.

This Final EA is available on DOE's National Environmental Policy Act (NEPA) web site at http://nepa.energy.gov/DOE_NEPA_documents.htm.

Sincerely,

Fred Pozzuto
Environmental Manager / NEPA Compliance Officer

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

SUMMARY

The U.S. Department of Energy (DOE) awarded a financial assistance grant under the American Recovery and Reinvestment Act of 2009 in the form of a cooperative agreement to Air Products and Chemicals, Inc. (Air Products or APCI). The DOE selected Air Products to receive funding from the Industrial Carbon Capture and Sequestration (ICCS) program at the National Energy Technology Laboratory (NETL) for its *Recovery Act: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production* project (DE-FOA-0000015). DOE's proposed action would provide approximately $284 million in the form of financial assistance in a cost shared arrangement with Air Products. Total cost of the proposed project is estimated at $431 million.

For this project, Air Products would design and demonstrate a state-of-the-art system to concentrate CO_2 from two steam methane reformer (SMR) hydrogen (H_2) production plants, and purify the CO_2 to make it suitable for delivery via pipeline for injection and sequestration in an existing oil field for an enhanced oil recovery (EOR) project. Air Products proposes to retrofit each of its two Port Arthur SMRs, located within the existing Valero Refinery, with a vacuum swing adsorption (VSA) system to separate the CO_2 from the process gas stream, followed by compression and drying processes. This process would convert the initial stream, which contains more than 10 percent CO_2, to greater than 97 percent CO_2 purity for delivery to a proposed 12.8-mile-long pipeline lateral, with negligible impact on the efficiency of H_2 production.

The technology that Air Products proposes to employ would capture greater than 90 percent of the CO_2 from the process gas stream used in a world-class scale H_2 production facility. Proposed project activities include engineering and design, construction, commissioning and startup, and the operation of all components of the project. A monitoring, verification, and accounting (MVA) program to monitor CO_2 injection and sequestration in a portion of the West Hastings Field in Brazoria County, Texas would also be designed and implemented as part of Air Products' proposed project.

The project goal is to advance Carbon Capture and Sequestration (CCS) technologies from the demonstration stage to commercial scale viability. The project objective is to capture CO_2 from two SMR H_2 production plants and deliver it for use in an existing EOR operation at an oil field in order to successfully demonstrate the technology and maximize the economic viability of commercial-scale CCS.

The three major components of the project are:

- Design, construction, and operation of a carbon capture facility at the two existing Air Products Port Arthur SMR H_2 production plants (PA1 and PA2) located within the existing Valero Port Arthur Refinery;
- Design, construction, and operation of a 12.8-mile-long, 8-inch-diameter pipeline lateral to transport compressed CO_2 from the Port Arthur carbon capture facility to the Denbury Green Pipeline at a point north of Port Arthur; and

- Perform MVA activities at a designated site within the existing West Hastings Field south of Houston, Texas.

Air Products LLC (Air Products or AP LLC) owns and operates the two existing Port Arthur SMRs and would also own the proposed CO_2 pipeline lateral. Air Products' subcontractor, Denbury, would receive the CO_2 at their recently completed Green Pipeline and deliver it to their existing EOR operations at the existing West Hastings Field in Brazoria County, Texas. Denbury would perform the MVA activities including construction of monitoring wells, collection of soil gas samples, and other monitoring.

In compliance with the National Environmental Policy Act (NEPA) (42 U.S.C. Section 4321 et seq.) and DOE's NEPA implementing regulations (10 CFR Part 1021) and procedures, this Environmental Assessment (EA) examines the potential environmental impacts of DOE's proposed action, Air Products' proposed project, and the No-Action Alternative. Its purpose is to inform DOE and the public of the potential environmental consequences of the proposed project and the alternatives.

In this EA, DOE analyzed impacts to air quality, water resources, land use, geology and soils, biological resources, cultural resources, socioeconomics, environmental justice, and human health and safety. Design, construction, and operation of the proposed project would not have any meaningful or detectable impacts on noise, utilities, materials, and waste generation.

Operation of the proposed carbon capture facility would create minor air emissions of volatile organic compounds, nitrogen oxides, carbon monoxide, sulfur dioxide and fine particulate matter. All of the emissions would constitute less than 0.1 % percent of the existing emissions in the Beaumont-Port Arthur (BPA) Metropolitan Statistical Area (MSA), which consists of Hardin, Jefferson, and Orange Counties, for these respective pollutants. The emissions would be small and there would be no impact to the State Implementation Plan (SIP). The proposed CO_2 pipeline and the MVA activities would have even lower emissions of air pollutants. A positive impact of the project would be removal of approximately one million tons per year of CO_2 that otherwise would be atmospherically vented by the two SMRs.

The proposed carbon capture facility would generate wastewater streams that are similar to those currently generated by the PA1 and PA2 SMR Plants. The wastewaters would be conveyed to the Valero Refinery for treatment or reuse similar to the way wastewater is managed at the existing SMR Plants. During construction and operations, storm water runoff would be controlled by use of best management practices (BMPs) established and currently in use by Air Products at its Port Arthur operations, including the Spill Prevention, Control, and Countermeasure (SPCC) Plan. Storm water runoff would be directed to the Valero Refinery's storm water system. Impacts to groundwater are not anticipated.

Several segments of the proposed CO_2 pipeline lateral would cross 100-year floodplains and/or jurisdictional wetlands. Impacts to flood flows would be minimized by performing construction during dry seasons when flooding is less likely to occur. The proposed pipeline design does not include permanent structures that would obstruct flood flows or alter existing flowage conditions.

Land use impacts would be minor because the activities would be consistent with current land uses. The carbon capture facility would be constructed in an existing industrial area. The CO_2 pipeline lateral would be constructed and generally aligned in a corridor adjacent to other pipelines running north of the Valero Refinery. The MVA activities would take place in an existing oil field.

No threatened or endangered species populations or habitat protected by the Endangered Species Act would be affected by the proposed project. Several wetland areas would be crossed by the proposed CO_2 pipeline lateral. Major waterbody and wetland crossings would be constructed using horizontal directional drilling (HDD) to reduce the potential impact to the wetlands. BMPs would be applied to further reduce impacts to wetlands.

The potential for cultural and historic resources was evaluated through a records search and field survey. No features or structures were identified within the project areas that have the potential to be eligible for nomination to the National Register of Historic Places. Therefore, no impacts to cultural and historic resources are anticipated.

The proposed project would create approximately 189 temporary construction jobs and 14 permanent jobs to support operations. Expenditures for goods and services would occur in Jefferson and Brazoria Counties and in the region for construction materials and equipment. Fabrication of large plant components may be local, regional, or global. These expenditures would likely be short-term in duration with the exception of the employment-related revenue from operations.

Construction risks typical to industrial and oil field construction and operations would be the primary risks for workers. During construction of the CO_2 pipeline lateral there is a remote possibility that an existing pipeline could be ruptured. Such an event is considered unlikely due to implementation of notification, pipeline marking, and other precautions that would be taken by the construction crew. A remote potential exists for an accidental release of CO_2 from the carbon capture facility or the pipeline lateral. Training of workers to respond to such an unexpected release of CO_2 would reduce the potential for injuries to workers or members of the public. Personal protective equipment, as appropriate, would be used by all workers to protect them from hazards in the workplace, consistent with Air Products', Valero's, and Denbury's workplace safety plans.

Under the No-Action Alternative, DOE would not provide funding to Air Products. Therefore, the carbon capture facility and the CO_2 pipeline lateral would not be constructed and operated and the MVA activities would not be implemented. Under the No-Action Alternative, no impacts to the existing environment or, in some instances, minor impacts would occur. Additionally, the beneficial impacts of CO_2 sequestration and enhanced oil recovery would not be realized.

PART I. OVERVIEW

I.1 INTRODUCTION

As part of the American Recovery and Reinvestment Act of 2009 (the Recovery Act, or ARRA; Public Law 111-5, 123 Stat. 115), the U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL), under the Carbon Capture and Sequestration from Industrial Sources and Innovative Concepts for Beneficial CO_2 Use (ICCS) program, is providing up to $612 million in competitively awarded funding for the deployment of carbon capture and storage (CCS) demonstration projects (DOE 2010a).

Carbon dioxide (CO_2) emissions from industrial processes are linked to global climate change. Advancing development of technologies that capture and store or beneficially reuse CO_2 that would otherwise reside in the atmosphere for extended periods is the mission of this particular DOE Program. CCS technologies offer significant potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the ICCS program, the DOE is collaborating with industry in cost-sharing arrangements to demonstrate the next generation of technologies that would capture CO_2 emissions from industrial sources and either sequester those emissions or beneficially reuse them. The technologies included in the ICCS program have progressed beyond the research and development stage to a scale that can be readily replicated and deployed into commercial practice within the industry.

The funding of these projects requires compliance with the National Environmental Policy Act (NEPA) of 1969, as amended (NEPA; 42 U.S.C. 4321 et seq.), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500 to 1508), and DOE NEPA implementation procedures (10 CFR Part 1021).

The DOE selected Air Products to receive ICCS program funding for its *Recovery Act: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production* project. For this project, Air Products would design and demonstrate a state-of-the-art system to concentrate CO_2 from two steam methane reformer (SMR) hydrogen (H_2) production plants, and purify the CO_2 to make it suitable for sequestration by injection into an existing oil reservoir, called the West Hastings Field, as part of an ongoing enhanced oil recovery (EOR) project. To accomplish this, Air Products plans to retrofit its two Port Arthur SMRs with two vacuum swing adsorption (VSA) systems to separate the CO_2 from the process gas streams at these facilities so that the CO_2 can be compressed, dried, and delivered by a new pipeline lateral to the existing Denbury Green Pipeline, which would deliver the CO_2 to the West Hastings Field. The legal name for the Green Pipeline in Texas is Denbury Green Pipeline Texas, LLC. This entity owns and operates the pipeline portions in Texas. Denbury Onshore, LLC, (Denbury) operates the West Hastings Field. Air Products' carbon capture processes would convert the initial gas streams, which contain more than ten percent CO_2, to greater than 97 percent CO_2 purity with negligible impact on the efficiency of H_2 production. The technology would remove more than 90 percent of the CO_2 from the process gas stream used in a world-class scale H_2 production facility. It should be noted that CO_2 that may resurface within the recovered crude oil would be re-captured and re-injected.

In compliance with NEPA and its implementation procedures, this Environmental Assessment (EA) examines the potential environmental consequences of DOE's proposed action (i.e., providing funding), Air Products' proposed project, and the No-Action Alternative (under which it is assumed that, as a consequence of DOE's denial of financial assistance, Air Products would not proceed with the proposed project). The EA's purpose is to inform DOE, resource agencies, and the public of the potential environmental consequences of the proposed project and alternatives.

This EA is subdivided into the following five parts:

- Part I includes the Introduction, Project Overview, and Summary of Environmental Consequences. This part explains NEPA and related regulations (Section I.1.1), summarizes the proposed project (Section I.1.2), the purpose and need for DOE action (Section I.1.3), the environmental resource areas that DOE did not carry forward to detailed analysis (Section I.1.4), and the environmental analysis approach (Section I.1.5). Section I.2 discusses DOE's proposed action, Air Products' proposed project, the No-Action Alternative, and action alternatives.
- Part II explains the proposed carbon capture activities at Air Products' two Port Arthur, Texas H_2 production facilities (PA1 and PA2) located within the existing Valero Refinery and related environmental impacts.
- Part III addresses the proposed construction and operation of the CO_2 pipeline lateral that would service the PA1 and PA2 facilities, connected to the Denbury Green Pipeline, and related environmental impacts.
- Part IV describes the proposed monitoring, verification, and accounting (MVA) activities that are proposed to support CO_2 storage activities at the existing West Hastings Field.
- Part V addresses the combined project impacts, including discussion of socioeconomics, environmental justice, cumulative impacts, and the overall conclusions of this EA.

Because each of the primary project components are geographically distinct and have different environmental issues to consider, Parts II through IV of this EA are presented in the form of sections that focus on each three primary project components. The proposed carbon capture and CO_2 pipeline lateral components would be located in Jefferson County, Texas. The proposed MVA activities would be conducted at the West Hastings Field in Brazoria County, Texas.

I.1.1 NEPA and Related Regulations

In accordance with DOE NEPA implementation procedures, DOE must evaluate the potential environmental impacts of its proposed action that could have a significant impact on human health and the environment, including decisions on whether to provide financial assistance to states and private entities. In compliance with these regulations and DOE's procedures, this EA:

- Examines the potential environmental impacts of the proposed action and the No-Action Alternative;
- Identifies unavoidable adverse environmental impacts of the proposed action;

- Describes the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- Characterizes any irreversible and irretrievable commitments of resources that would be involved should DOE decide to implement its proposed action.

DOE must meet these requirements before it can make a final decision to proceed with any proposed federal action that could cause adverse impacts to human health or the environment. This EA fulfills DOE's obligations under NEPA and provides DOE with the information needed to make an informed decision about helping to finance the construction and operation of Air Products' proposed carbon capture facilities, CO_2 pipeline lateral, and MVA activities.

This EA evaluates the potential individual and cumulative impacts of the proposed project. No other action alternatives are analyzed. For purposes of comparison, this EA also evaluates the impacts that could occur if DOE did not provide funding (the No-Action Alternative), under which DOE assumes that Air Products would not proceed with the proposed project. This assumption may be incorrect—that is, Air Products might proceed without federal assistance. However, this assumption allows DOE to compare the impacts of an alternative in which the project occurs with one in which it does not.

I.1.2 Background of the Carbon Capture and Sequestration Program

In December 2009, Air Products announced that it had signed a cooperative agreement with the DOE to move forward on Phase 1 of a potential two-phase program to conduct an engineering study and project plan to capture, concentrate, and purify CO_2 emitted from industrial operations for use in EOR. As described in further detail in Section II.2, Air Products is proposing to design and construct a system to capture approximately one million tons per year (tpy) of CO_2 from its two Port Arthur, Texas H_2 plants to be delivered via pipeline for sequestration and use in EOR operations at the existing West Hastings Field in Brazoria County, Texas.

As DOE announced in October 2009, Air Products' Phase 1 project was selected for evaluation as one of 12 projects proposed to capture carbon dioxide from industrial sources for storage or beneficial use. These 12 projects were cost-shared collaborations between the DOE and industry that were intended to help increase investment in clean industrial technologies and sequestration projects (DOE 2010b).

During the Phase 1 process, each project sponsor was afforded the opportunity to submit a Renewal Application to DOE to document the engineering study and plan for the proposed projects. As part of this review process, Air Products' Renewal Application was evaluated, in competition with the other projects selected for Phase 1 funding that submitted Renewal Applications, by DOE's NETL. In June 2010, DOE selected the Air Products Port Arthur project as one of three projects to receive Phase 2 (i.e., execution phase) funding.

I.1.3 Purpose and Need for DOE Action

The DOE's 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, 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. The focus of NETL's "Carbon Capture and Sequestration from Industrial Sources and Innovative Concepts for Beneficial CO_2 Use" initiative 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 NETL 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 (GHG) intensity and stabilization of atmospheric concentrations of CO_2 (DOE 2007). One of those options, geologic sequestration, involves the placement of CO_2 or other GHGs into porous and permeable subsurface rock formations in such a way that they remain permanently stored, which is one of the factors considered in selecting the West Hastings Field for this project.

The purpose of the proposed Air Products project would be to demonstrate the ability of the Frio formation sands at the West Hastings Field to accept and retain approximately one million tons per year of CO_2 (Air Products 2010); thus testing large-scale sequestration sooner than might otherwise be possible. The CO_2 to be used for EOR would result in approximately 1.6 to 3.1 million barrels (MMBbls) of additional domestic oil production.

Although the processes of geologic sequestration are relatively well known, there is a need for additional research and demonstration 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 have assessed how CO_2 geologic sequestration would work in the subsurface. Comparing predictions from bench scale tests and numerical models with field results from large-scale injections is necessary to validate the models and demonstrate that scientific understanding is correct in order to proceed further into commercial scale projects (DOE 2003).

The proposed project, under carefully controlled and monitored conditions, would 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 sandstone formations. Another possible issue pertains to the acceptable leakage rate from the formation into overlying strata (DOE 2007).

If funded, the proposed project would:

- Reduce GHG 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 development of large-scale CCS projects 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 involving the use of multiple high volume injection wells at a scale similar to what would be done if CO_2 from power plants were captured and sequestered.

I.1.4 Environmental Resources Not Carried Forward

Sections II.3, III.3, IV.3, V.1, and V.2 of this EA examine the potential environmental consequences of the proposed project and the No-Action Alternative for the following resource areas that are carried forward:

- Air quality
- Water resources
- Land use
- Biological resources
- Cultural and historic resources
- Geology and soils

DOE EAs commonly address a number of resource and subject areas in addition to the six listed above. In an effort to streamline the NEPA process and enable a timely award to the selected project, this assessment did not examine all environmental resource areas at the same level of detail as the resource areas listed above. The focus for the more detailed analyses was on those activities or actions that would require new or revised permits, have the potential for adverse environmental impacts, or have the potential for public controversy. For the reasons discussed below, DOE concludes that Air Products' proposed project would result in no impacts or very minor impacts to the resource areas listed in Table I.1-1. Therefore, these resource areas listed in Table I.1-1 are not carried forward for further discussion in this EA.

Table I.1-1. Environmental Resources Not Carried Forward

Resource Area	Comments
Noise	Most of the construction activity would take place in industrial areas or open space. The noise receptors are distant in most cases. After construction, operational noise would be similar to the current noise levels.
Utilities and materials	Approximately 7,200 MWH of electricity and 1,240 MMSCF of natural gas would be purchased annually. The amounts of energy required are readily available from existing utility suppliers. The following materials would be used in various quantities: • Optisperse HP54707, Cortrol OS5700, and MEA for the heat recovery steam generator (HRSG) Boiler • Gengard GN8108 and 12% sodium hydroxide (NaOH) solution for the cooling water tower • 25% NaOH Solution for waste water neutralization • Lube oil and hydraulic fluid in several pieces of machinery • Triethylene Glycol (TEG) in the TEG drier • Ceramic balls, molecular sieve, and activated alumina in the VSA vessels • Sand and activated carbon in filters and beds These are all readily available materials with available Material Safety Data Sheets to inform workers of potential safety hazards and precautions.
Transportation	Construction and operation of the proposed project would not disrupt or impact current transportation patterns and systems.
Waste generation	The proposed project would not generate hazardous or nonhazardous waste beyond small temporary amounts, primarily consisting of construction debris.

I.1.5 Environmental Analysis Approach

This section describes how the environmental review team analyzed the potential impacts of Air Products' proposed project. Parts II, III, and IV provide a description of the affected environment and the potential environmental effects of Air Products' proposed project along with an analysis of environmental effects if the proposed project was not implemented.

This EA is intended to be a clear, focused analysis of impacts. It is not intended to be merely a compilation of encyclopedic historical information about the project or about the historic general environmental impacts of the area. Accordingly, the environmental review team used a systematic approach to identify and then answer the relevant impact questions. The initial step was to develop a detailed description of the components of the proposed carbon capture process, CO_2 pipeline lateral, and MVA activities to be used on this project. For each project component, 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.

A systematic process was then used to assess the significance of the predicted impacts of the proposed project on human health and the environment. The process of assessing significance involved comparing the predicted impacts to a set of significance criteria established by the EA team. Table I.1-2 below presents the identified significance criteria for each resource area. These significance criteria are based on existing regulatory and statutory constraints and on the professional technical judgment of the EA team personnel.

Table I.1-2. Impact Significance Thresholds

Resource Area	Impact Significance Threshold[1]
Air	The project would not produce emissions that would impede the area from conformity with the State Implementation Plan under the Clean Air Act.
Surface Water	Any changes to surface water quality or hydrology would be confined to the immediate project area. Full recovery to preconstruction conditions following completion of the proposed action would occur in a reasonable time[2], considering the size of the project and the affected area's preconstruction condition. (as well as, through compliance with all water resource related permitting)
Groundwater	Any changes to groundwater quality and quantity would be at the lowest detectable levels. Full recovery would occur in a reasonable time[2]. Mitigation, if needed, would be simple to implement and has been proven to be effective in previous applications.
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 [2], considering the size of the project. Mitigation, if needed, would be simple to implement and has been proven to be effective in previous applications.

Resource Area	Impact Significance Threshold[1]
Land Use	Any change in land use would be limited to a small area and would not noticeably alter land use within any of the project areas or in adjacent areas. The affected areas would fully recover in a reasonable time once the project is completed.
Cultural and Historic 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. Consultations with the Texas Historical Commission and any potentially affected groups would result in the determination of effect under Section 106 of the National Historic Preservation Act (NHPA) of no adverse effect.
Floodplains and Wetlands	Any impacts to wetlands/floodplains 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.
Biology	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.
Socioeconomic	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.
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, 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.

[1] An impact would be significant if it were to exceed the stated threshold.
[2] Recovery in a reasonable time is assumed to equate to a constant, sustainable improvement being apparent and measurable if the site is routinely observed subsequent to the completion of the proposed action and full recovery is achieved over a period of no more than several years.

I.2 SUMMARY OF PROPOSED ACTION AND ALTERNATIVES

I.2.1 DOE's Proposed Action

DOE's proposed action is to award approximately $284 million of financial assistance in the form of a cooperative agreement to Air Products and Chemicals, Inc. (Air Products) through the ARRA to facilitate Air Products' proposed project, which is located in Jefferson County and Brazoria County, Texas. Air Products contribution is estimated to be $147 million for a total estimated project cost of $431 million.

I.2.2 Summary of Air Products' Proposed Project

Air Products' proposed project involves an integrated carbon capture, transport, injection, sequestration, and monitoring program that would accelerate commercialization of large-scale CO_2 storage from industrial sources and would capture approximately one million tons per year (tpy) of CO_2 from Air Products' two Port Arthur, Texas H_2 plants. As indicated in Figure I.2-1, the primary components of Air Products' proposed project include the following:

1) CO_2 capture, concentration, and purification at Air Products' two Port Arthur, Texas H_2 plants (PA1 and PA2), which are located within the Valero Port Arthur Refinery;
2) Transport of CO_2 within Jefferson County, Texas through a new 12.8-mile-long, 8-inch-diameter pipeline lateral that would interconnect with an existing CO_2 pipeline system for injection into an existing oil field, the West Hastings Field in Brazoria County, Texas, for EOR; and
3) Implementation of a comprehensive MVA program to monitor the potential impacts of injection and sequestration of the injected CO_2 at a portion of the West Hastings Field.

Air Products LLC (Air Products) owns and operates the two existing Port Arthur SMRs and would also own the proposed CO_2 pipeline lateral, which parallels existing utility corridors along the majority of its proposed route. The CO_2 pipeline lateral would connect to an existing pipeline, called the Green Pipeline, which is owned and operated by Denbury. Denbury, which is partnering with Air Products to implement the proposed project, also owns and operates the West Hastings Field and would conduct the West Hastings Field MVA program.

I.2.2.1 CARBON CAPTURE

Both the PA1 and PA2 plants use SMR technology for H_2 production. At each H_2 plant, a CO_2 removal unit utilizing Air Products' CO_2 VSA technology would be retrofitted to the existing SMR train. Each VSA unit is designed for removal of more than 90 percent of the CO_2 contained in the pressure swing adsorption (PSA) unit feed gas that it would process. CO_2 produced off the VSA units would be combined into a single train and compressed and dried at the PA2 plant. Air Products would also install a new cogeneration unit to supply electricity and steam to the VSA and SMR plants. See Section II.2 of this EA for additional details regarding the carbon capture and processing component of this project.

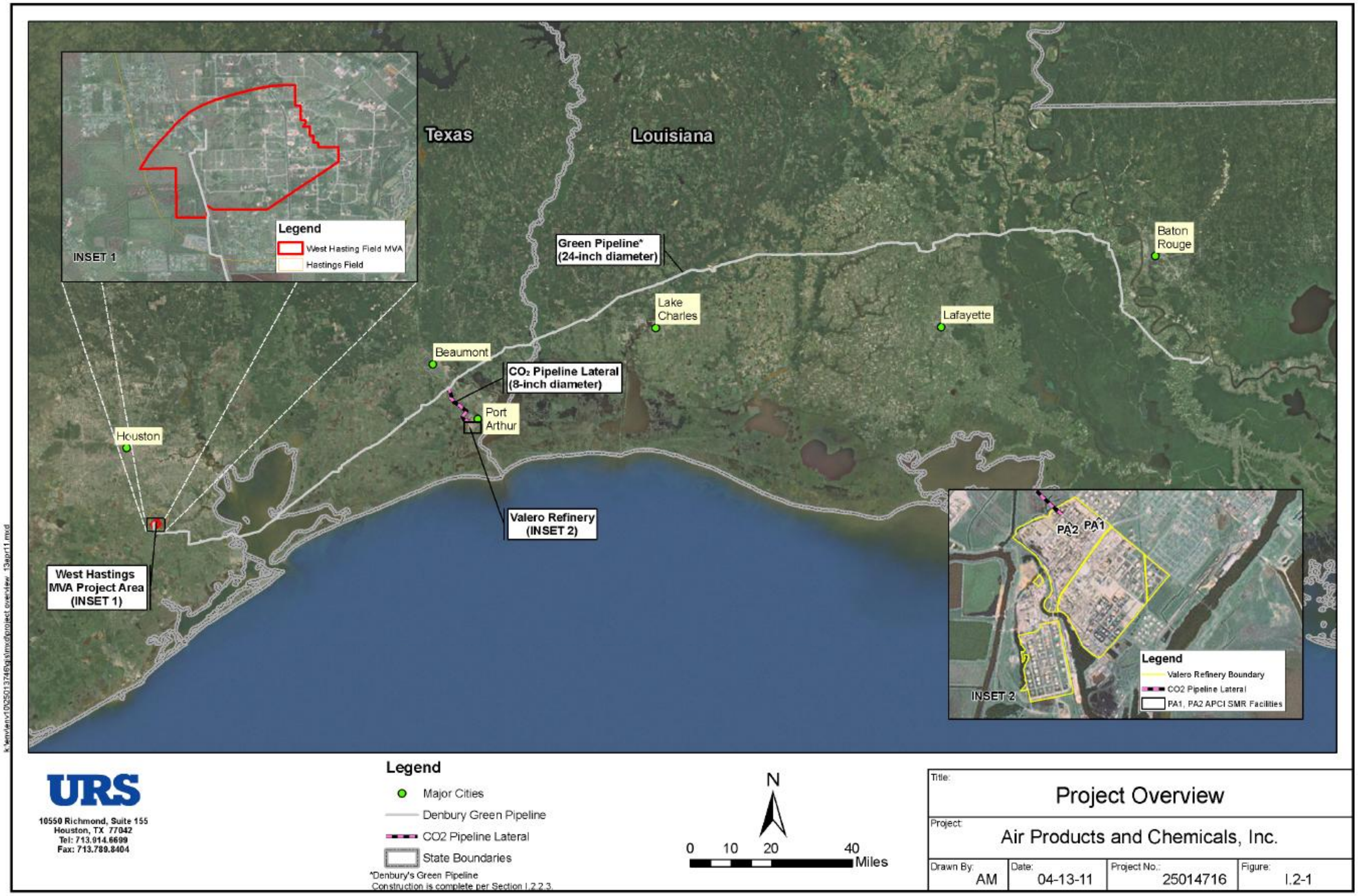


Figure I.2-1. Project Overview

I.2.2.2 PIPELINE LATERAL

Once the CO_2 stream is compressed and dried, it would enter Air Products' CO_2 pipeline lateral at the pipeline tie-in point located on the southeast battery limit (plant south) of the PA2 plant. This new 12.8-mile-long, 8-inch-diameter pipeline lateral would transport the CO_2 within Jefferson County, Texas to an interconnect with Denbury's Green Pipeline. The proposed interconnect is located approximately 12 miles northwest of Port Arthur and approximately 3 miles southeast of Beaumont, Texas, as shown in Figure I.2-1. See Section III.2 of this EA for additional details regarding the CO_2 pipeline lateral.

I.2.2.3 GREEN PIPELINE (EXISTING)

Denbury's Green Pipeline (Figure I.2-1) is an approximately 320-mile-long, 24-inch-diameter CO_2 pipeline that extends from near Donaldsonville, Louisiana, which is located south of Baton Rouge, westward to the West Hastings Field in Brazoria County, Texas, which is located south of Houston. Construction of the Green Pipeline commenced in November 2008 and the initial portion from Donaldsonville to Galveston Bay was completed in December 2009. The portion across Galveston Bay and on to West Hastings Field was completed in late 2010. (Denbury 2010a, 2011a) Denbury currently utilizes CO_2 from the Green Pipeline for CO_2 injection at multiple oil fields along the southeast Texas Gulf Coast, including the West Hastings Field. (Denbury 2010b).

The Green Pipeline is designed to transport up to 800 million standard cubic feet (MMSCF) per day of CO_2 from natural and anthropogenic (man-made) sources. Denbury's natural source of CO_2 is the Jackson Dome, which is an underground formation located near Jackson, Mississippi that is believed to contain approximately 7.1 trillion cubic feet (Tcf) of CO_2 (Denbury 2011b). Denbury anticipates that anthropogenic sources of CO_2 (e.g., power plants or other industrial sources) located along the route of the Green Pipeline could provide several times more CO_2 than Jackson Dome. Denbury expects the existing Green Pipeline would ultimately be used to ship CO_2 that is predominately from anthropogenic sources (Denbury 2010c).

The Green Pipeline was constructed independent and regardless of Air Products' proposed project; therefore, it will not be considered in further detail in this EA.

I.2.2.4 WEST HASTINGS FIELD (EXISTING)

The West Hastings Field is an existing oil field located south of Houston, Texas, in Brazoria County (Figure I.2-1) that has been in production since 1934. While the overall extent of the West Hastings Field covers approximately 25 square miles of rural farmlands, suburban areas, and residential neighborhoods, the proposed project area within the West Hastings Field (Figure I.2-1) covers less than four square miles and is located between Alvin and Pearland, Texas on State Highway 35.

Denbury purchased the Hastings Field from another operator in 2009. The field was discovered and initially developed by Stanolind Oil Company (Amoco) in 1934. Ownership of the field has changed hands multiple times in its history. The field has had a long history of activity, starting with primary oil production and progressing to a secondary water flood and pressure maintenance program. Denbury has received its U.S. Army Corps of Engineers (USACE)

Section 404 permit for facility construction at the West Hastings Field and commenced CO_2 injections at the West Hastings Field on December 16, 2010 (Denbury 2011c).

This CO_2 injection process, referred to as a tertiary flood or EOR, requires large volumes of nearly pure CO_2, which is obtained at the West Hastings Field from the Green Pipeline. In general, Denbury anticipates that tertiary recovery (i.e., EOR using CO_2) yields almost as much oil from a field that was considered to be depleted before EOR, such as the West Hastings Field, as either the primary (i.e., conventional pumping) or secondary (i.e., water flood) recovery phases of production (Denbury 2010b). Even though the West Hastings Field was considered depleted prior to EOR, the project area currently contains approximately 80 active, 100 inactive, and 110 plugged and abandoned wells, as well as a number of temporarily abandoned wells (Air Products 2010). As of December 31, 2009, the West Hastings Field has conventional proved reserves of approximately 8.9 MMBbls of oil (Denbury 2010c). However, Denbury estimates that using CO_2 injections, the West Hastings Field has between 60 and 90 MMBbls of potential CO_2 recoverable oil.

Because the commercial operation of the West Hastings Field is not being developed as part of Air Products' proposed project, it will not be considered further in this EA beyond the MVA aspects of this project, as discussed below.

I.2.2.5 MONITORING, VERIFICATION, AND ACCOUNTING (MVA)

As part of Air Products' proposed project, Denbury would conduct research MVA activities at a portion of the West Hastings Field to monitor the potential impacts of injection and sequestration of the injected CO_2 at the West Hastings Field and to determine the effectiveness of EOR for long-term geologic storage of anthropogenic CO_2. The research MVA activities would supplement privately-funded, on-going monitoring activities conducted in conjunction with Denbury's commercial EOR operations. See Section IV.2 of this EA for additional details regarding the MVA component of this project.

I.2.3 Alternative Actions

DOE's alternatives to this project consisted of the 83 technically acceptable applications received in response to the *Funding Opportunity Announcement, Carbon Capture and Sequestration from Industrial Sources and Innovative Concepts for Beneficial CO_2 Use (DE-FOA-0000015)*. Prior to selection, DOE made preliminary determinations regarding the level of review required by NEPA based on potentially significant impacts identified in reviews of acceptable applications. DOE conducted these preliminary environmental reviews pursuant to 10 CFR §1021.216. These preliminary NEPA determinations and reviews were provided to the selecting official, who considered them during the selection process. A synopsis of the potential environmental consequences of the proposed projects is attached as Appendix D, in accordance with 10 CFR §1021.216(h).

Because DOE's proposed action is limited to providing financial assistance in cost-sharing arrangements to projects submitted by applicants in response to a competitive funding opportunity, DOE's decision is limited to either accepting or rejecting the project as proposed by the proponent, including its proposed technology and selected sites. DOE's consideration of reasonable alternatives is therefore limited to the technically acceptable applications and a No-Action Alternative for each selected project.

I.2.3.1 NO-ACTION ALTERNATIVE

DOE's provision of cost sharing in Air Products' proposed project is the Federal action that brings the proposed project under NEPA. Under the No-Action Alternative, DOE would not provide partial funding for the proposed project. In the absence of DOE funding, DOE assumes that the project's proponent (Air Products) would not proceed with the proposed project tasks. Thus, the components of the proposed project, including building of the carbon capture facilities and the CO_2 pipeline lateral, and performance of the MVA program, would not occur under the No-Action Alternative.

If Air Products is unable to capture and transport CO_2 for sequestration and EOR, the CO_2 gas produced at the Air Products facility would continue to be released to the environment and alternative sources of CO_2 would be utilized by Denbury to maintain EOR at the existing West Hastings Field.

I.2.3.2 DOE ALTERNATIVE ACTIONS

As noted above, DOE's consideration of reasonable alternatives is limited to 83 other technically acceptable applications and a No-Action Alternative for each of the selected projects.

I.2.3.3 AIR PRODUCTS ALTERNATIVE ACTIONS

I.2.3.3.1 CO_2 Capture

Air Products conducted a comparison of commercially available technologies for CO_2 capture -- activated methyldiethanolamine (aMDEA), low pressure VSA, and high pressure VSA -- when designing the proposed project and determined that the high pressure VSA process described in Section II.2 is the preferred option for Air Products' Port Arthur Facility. The advantages of high pressure VSA as compared to the aMDEA technology are lower overall cost due to less thermal energy requirements. The advantages and efficiencies of high pressure VSA to treat the PSA purge gas as compared to low pressure VSA are that it consumes less power and has higher CO_2 recovery.

I.2.3.3.2 Pipeline Lateral

In designing the proposed CO_2 pipeline lateral, Air Products has considered a variety of routing and design alternatives that help to minimize environmental impacts while resulting in a constructible and commercially viable pipeline. It is acknowledged that wetland impacts may occur; however, the resulting route, as shown on Figure I.2-1, parallels existing utility corridors for greater than 95% of its 12.8-mile length. With regard to design, Air Products has minimized the width of the construction right-of-way (ROW) to 60 feet along the entire length of the pipeline lateral, located additional temporary workspace (ATWS) outside of sensitive areas, and is employing approximately 4.1 miles of horizontal directional drills (HDDs) instead of open cuts to minimize impacts to surface features (i.e., wetlands, waterbodies, roads).

If Air Products were not able to construct a pipeline to transport CO_2 from the PA1 and PA2 facilities, Air Products could alternatively transport the CO_2 by truck or rail. Under these scenarios, approximately one million tons per year of CO_2 would need to be transported approximately 83 miles from the Air Products facility to the West Hastings Field. Utilizing trucks capable of transporting 20 tons of CO_2 (0.349 MMSCF) per shipment, 137 trucks shipments would be required each day to transport CO_2 from Port Arthur to the West Hastings Field. Utilizing rail cars capable of transporting 60 tons of CO_2 (1.05 MMSCF) per shipment, 46 rail cars would be required each day to transport CO_2 from Port Arthur to the West Hastings Field (i.e., if complete interconnected rail service is available). Therefore, transportation of CO_2 by means other than pipeline is generally considered to be inefficient as it would entail use of more fuel for rail or truck transport than would be consumed to ship by pipeline, and cause the project to be uneconomical. Additionally, the amount of tank trucks/cars that would be required to transport the CO_2 by road or rail could result in additional safety concerns when transporting through populated areas on congested roads or highways.

I.2.3.3.3 MVA

The West Hastings Field was selected by Air Products, Denbury, and Denbury's MVA consultants (including the University of Texas Bureau of Economic Geology) from among two fields that were evaluated for the proposed MVA activities. The West Hastings Field was highly desirable because of the following attributes that were not present at the other considered field:

1) The West Hastings Field is located on the Green Pipeline, which is proximate to several potential anthropogenic CO_2 sources, significantly reducing pipeline lateral costs.
2) The West Hastings Field is in the early development stages for EOR. Because the proposed Fault Block B and C EOR development and research MVA activity schedule is closely aligned with DOE's schedule for Phase 2, only Hastings can be suitably monitored for baseline data before CO_2 injections begin.
3) The West Hastings Field is compartmentalized into a set of contiguous, large-scale, fault-segregated geologic blocks (fault blocks), which provide a well-defined study area (i.e., Fault Blocks B and C) within which the proposed research MVA activities can be conducted.

If the MVA were not conducted (i.e., the No-Action Alternative for the MVA), commercial EOR development and CO_2 sequestration in the West Hastings Field would still take place. However, the research elements of the MVA program that would provide an opportunity to gain additional understanding of the subsurface fate of, and ultimately the long term storage capability for, CO_2 injected in a large-scale EOR setting such as the West Hastings Field would not be realized. Therefore, the opportunity for achieving and demonstrating a successful and safe sequestration in such a setting would not be afforded to the U.S. public and policy makers. The No-Action Alternative would turn away from a highly leveraged demonstration of long-term EOR sequestration of CO_2 which has the peripheral benefit of concurrently developing safe, domestically produced oil for the U.S. Delays in acquiring this information on the fate of CO_2 in a representative EOR environment would result in implementation delays of this possible "low cost" strategy to safely sequester CO_2. Additionally, this strategy is likely the fastest strategy to deploy and expand the sequestration of CO_2 from anthropogenic CO_2 sources. Hence, the No-Action Alternative would delay meaningful research with regard to sequestration efforts, thereby jeopardizing goals of rapid action on GHG mitigation issues.

I.3 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Table I.3-1 summarizes the environmental impacts that would occur from the proposed action and the No-Action Alternative.

Table I.3-1. Comparison of Impacts

Resource	Air Products' Proposed Action	No-Action Alternative
Air	Minor impacts	No Impact
Water	Minor impacts	No Impact
Land Use	Minor to no impact	No Impact
Biology	Minor impacts	No Impact
Historic and Cultural	Minor impacts	No Impact
Geology and Soils	Minor temporary impacts	No Impact
Socioeconomics	Minor impacts	No impact
Environmental Justice	No impact	No impact
Health and Safety	Minor impacts	No impact

I.4 CONSULTATIONS AND PUBLIC COMMENT

I.4.1 Preparation for Development of this Environmental Assessment

A kick-off teleconference occurred in January 2011 by members of the team charged with the development of this EA. Subsequent to that meeting, a review was made of available information necessary for the completion of the EA and plans for closing data gaps were developed.

I.4.2 Agency Coordination

CEQ regulations for implementing NEPA allow 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.

I.4.2.1 U.S. FISH AND WILDLIFE SERVICE (USFWS)

The primary mission of the USFWS is to administer the Endangered Species Act of 1973. Other functions may include conservation, protection, and enhancement of fish, wildlife, and plants and their habitats for the continuing benefit of American people. See Appendix B for correspondence with USFWS related to Air Products' proposed project.

I.4.2.2 TEXAS PARKS AND WILDLIFE DEPARTMENT (TPWD)

The mission of the TPWD is to manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations. See Appendix B for correspondence with TPWD related to Air Products' proposed project.

I.4.2.3 STATE HISTORIC PRESERVATION OFFICE (SHPO)

The NHPA requires DOE to consult with the SHPO prior to any construction to ensure that no historical properties or archeologically sensitive resources 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. In Texas, the Texas Historical Commission (THC) fulfills the role of SHPO. See Appendix B for correspondence with the SHPO related to Air Products' proposed project.

I.4.2.4 NATIVE AMERICAN TRIBES

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 cultures and 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. See Appendix B for correspondence with Tribal Councils related to Air Products' proposed project.

I.4.2.5 U.S. ARMY CORPS OF ENGINEERS (USACE)

The proposed CO_2 pipeline lateral would cross waterbodies (including wetlands) that are considered to be jurisdictional Waters of the United States as defined in the Clean Water Act (CWA). DOE has consulted with the USACE regarding the impacts of the proposed project on waters of the United States and permit requirements under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. See Appendix B for correspondence with USACE related to Air Products' proposed project.

PART II. CARBON CAPTURE

II.1 INTRODUCTION

This part of the EA presents a description of the activities that would take place as part of the proposed action at the Air Products PA1 and PA2 H_2 plants located within to the Valero Refinery in Jefferson County, near Port Arthur, Texas. Part II also describes the existing environment in the vicinity of the facilities and the potential environmental impacts from the proposed action and the No-Action Alternative are also described in Part II.

This chapter is organized as follows: An introductory discussion (Section II.1), details pertaining to the proposed construction and operation of the carbon capture facility (Section II.2), and the affected environment and expected environmental consequences from construction and operation of the carbon capture facility and appurtenances and of the No-Action Alternative (Section II.3).

II.2 CARBON CAPTURE DETAILS

Air Products' PA1 and PA2 H_2 plants are located within the Valero Port Arthur Refinery near Port Arthur, Texas, as shown in Figure II.2-1. PA1 is located along the northeast perimeter of the Valero refinery along State Highway 82, which is also known as West Levee Road and Martin Luther King Drive. PA2 is located approximately 1,000 feet south of the north Valero Refinery perimeter and 3,000 feet east of Alligator Bayou. PA1 and PA2 are physically separated by a distance of about 800 feet with PA1 located to the east of PA2. Air Products has operated PA1 since 2000 and PA2 since 2006. Both the PA1 and PA2 plants use SMR technology for H_2 production and deliver the H_2 to Valero and other West Gulf Coast customers via pipeline. Air Products proposes to capture CO_2 using a VSA process. The CO_2 stream would be routed through a compressor before entering the proposed CO_2 pipeline lateral. A cogeneration plant is proposed to be constructed and operated to provide electricity and steam for use at the CO_2 capture facilities and other operations at PA1 and PA2. Details regarding the proposed CO_2 capture facilities are discussed in the sections below.

A CO_2 removal unit utilizing Air Products CO_2 VSA technology would be retrofitted to each of the two existing SMR trains (i.e., at PA1 and PA2). (Figure II.2-1) Each VSA unit is designed to remove more than 90 percent of the CO_2 contained in the reformer pressure swing adsorber (PSA) feed gas that the VSA unit would receive. "Sweet" syngas (i.e., with CO_2 removed) would return from the VSA system and feed the existing PSAs at PA1 and PA2. The CO_2 removal process would change the offgas flow and composition exiting the PSAs when compared with the existing process. As a result, existing SMR burners at PA1 and PA2 may require modification or replacement. CO_2 produced off the VSA units would be compressed and dried in a single train located at PA2 before entering the CO_2 from the CO_2 capture process would enter the CO_2 pipeline lateral at the pipeline tie-in point located on the southeast battery limit (plant south) of the PA2 plant. A conceptual process flow diagram for the CO_2 capture process is presented in Figure II.2-2.

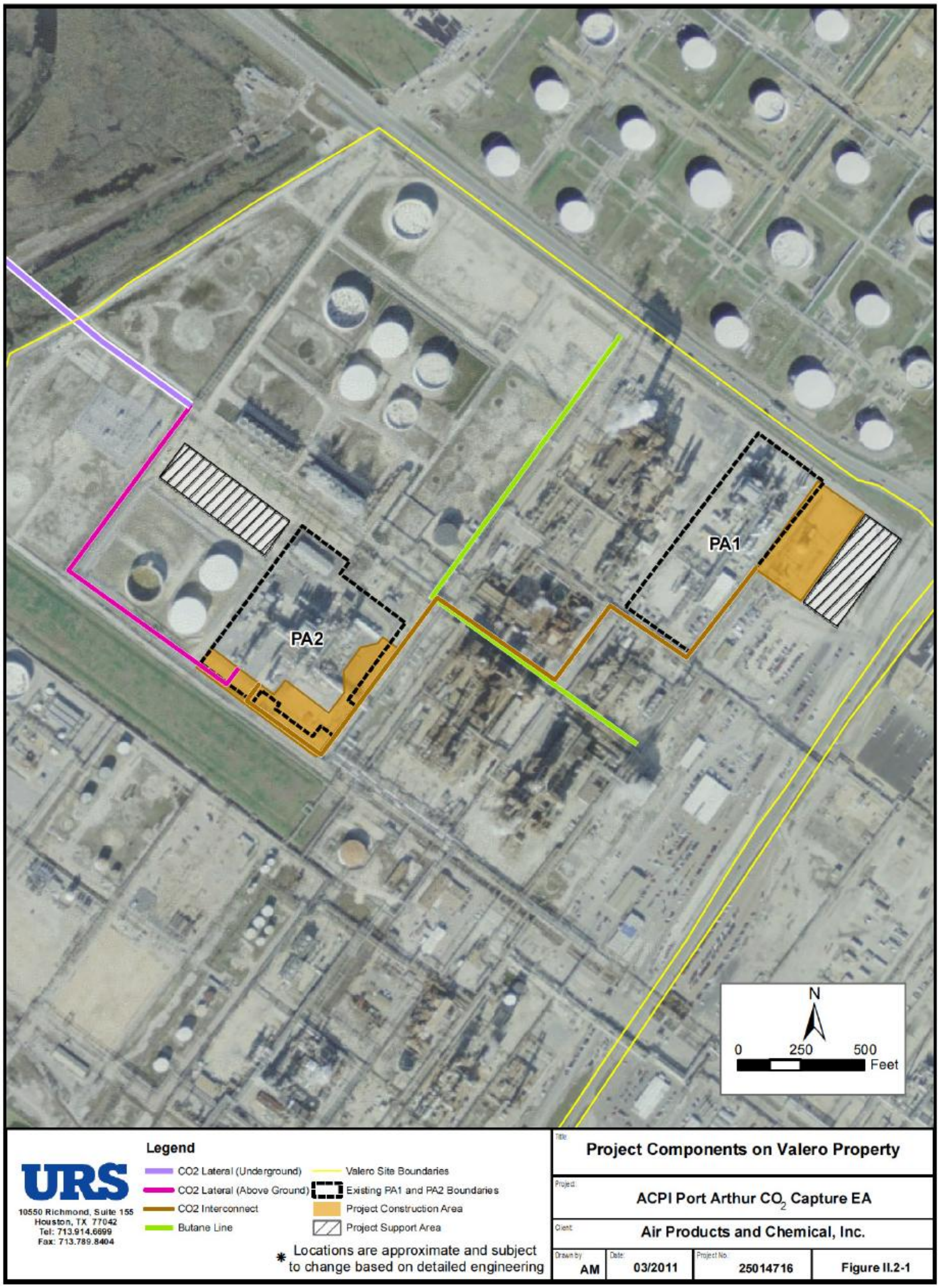


Figure II.2-1. Approximate Locations of Project Components on Valero Refinery Property

In addition to the CO_2 capture process described above, Air Products would install a new cogeneration unit to supply electricity and steam to the VSA and SMR plants.

When Air Products' CO_2 capture technology is fully functional, the process would remove greater than 90 percent of the CO_2 in the processed feed gas, resulting in the capture of approximately one million tons per year (tpy) of CO_2.

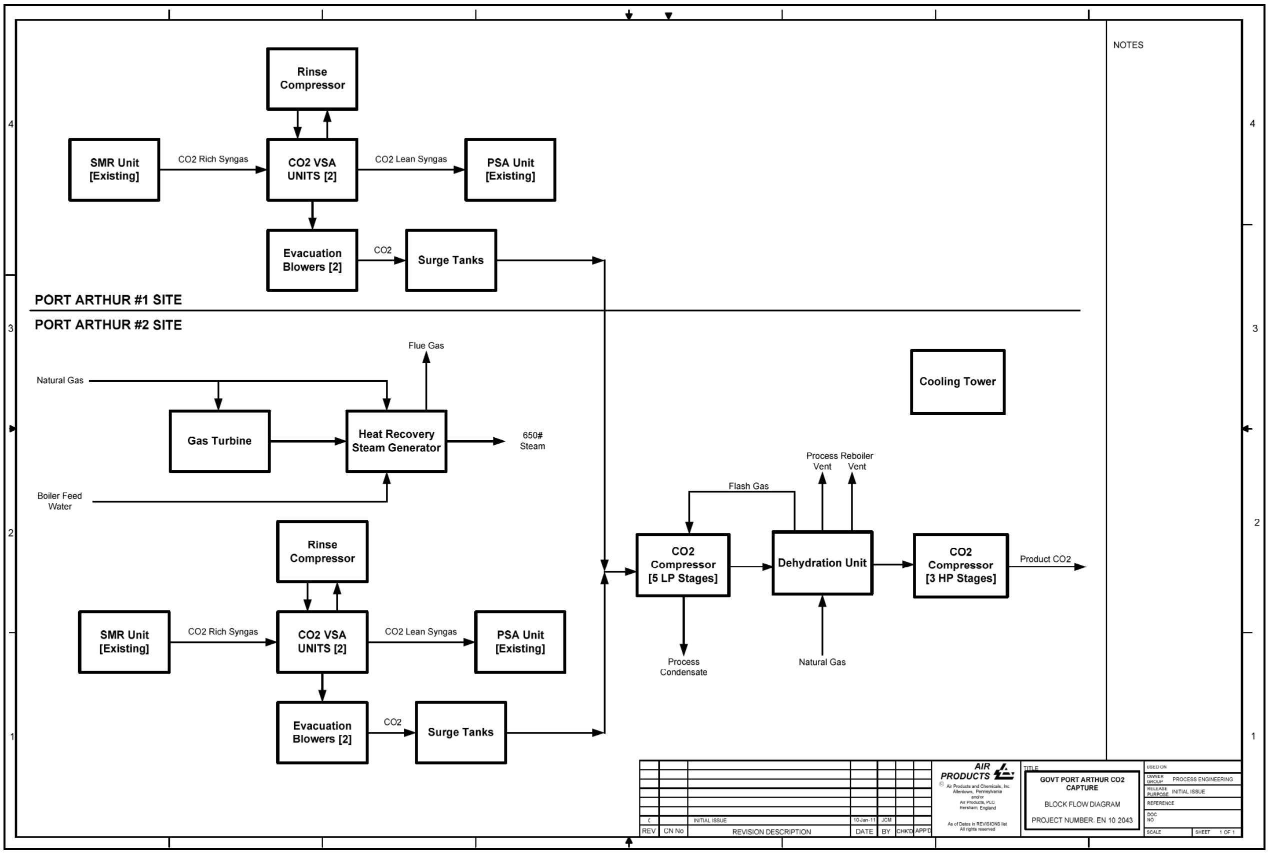


Figure II.2-2. Conceptual Process Flow Diagram for the CO_2 Capture Process

II.3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

II.3.1 Air Quality

II.3.1.1 AFFECTED ENVIRONMENT

II.3.1.1.1 Atmospheric Conditions and Air Quality

This section presents a review of air quality issues, including the affected environment and as it pertains to air quality, related to Air Products' plans to construct and operate a CO_2 removal process at the Air Products facility near Port Arthur, Texas. The topics discussed include applicable air quality regulations, regional ambient air monitoring, and regional emissions to the atmosphere.

For this air quality analysis, the study area has been defined as the three-county Beaumont-Port Arthur (BPA) Metropolitan Statistical Area (MSA). The BPA MSA includes Hardin, Jefferson, and Orange counties.

II.3.1.1.2 Applicable Air Quality Regulations

The maximum levels of pollutants in the air considered to be acceptable are specified by U.S. Environmental Protection Agency (EPA) regulations. The Clean Air Act (CAA) established two types of National Ambient Air Quality Standards (NAAQS). Primary standards set limits to protect public health and secondary standards set limits to protect public welfare. The EPA Office of Air Quality and Planning Standard (OAQPS) set NAAQS for the following six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), respirable particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3), and sulfur dioxide (SO_2) (EPA 2010a). These standards are shown in Table II.3.1-1.

II.3.1.1.3 Regional Ambient Air Monitoring

Throughout the BPA MSA, air pollutants are measured by numerous air monitoring stations, operated by the Texas Commission on Environmental Quality (TCEQ) and the Southeast Texas Regional Planning Commission (SETRPC). Most of the stations in the region measure the concentrations of criteria pollutants, as well as outdoor temperature, wind velocity, wind direction, and other meteorological parameters. A map of the stations that monitor criteria pollutants in the BPA MSA is provided as Figure II.3.1-1.

Monitored concentrations for the BPA MSA, as shown in Table II.3.1-2, demonstrate that the BPA MSA is in attainment of all of the NAAQS.

Table II.3.1-1. National Ambient Air Quality Standards

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour [1]	None	
	35 ppm (40 mg/m^3)	1-hour [1]		
Lead	0.15 $\mu g/m^3$ [2]	Rolling 3-Month Average	Same as Primary	
	1.5 $\mu g/m^3$	Quarterly Average	Same as Primary	
Nitrogen Dioxide	0.053 ppm (100 $\mu g/m^3$)	Annual (Arithmetic Mean)	Same as Primary	
	0.100 ppm	1-hour [3]	None	
Particulate Matter (PM_{10})	150 $\mu g/m^3$	24-hour [4]	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 $\mu g/m^3$	Annual [5] (Arithmetic Mean)	Same as Primary	
	35 $\mu g/m^3$	24-hour [6]	Same as Primary	
Ozone	0.075 ppm (2008 standard)	8-hour [7]	Same as Primary	
	0.08 ppm (1997 standard)	8-hour[8]	Same as Primary	
	0.12 ppm	1-hour [9]	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm (1300 $\mu g/m^3$)	3-hour [1]
	0.14 ppm	24-hour [1]		
	.075 ppm	1-hour		

[1] Not to be exceeded more than once per year.
[2] Final rule signed October 15, 2008.
[3] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 parts per million (ppm) (effective January 22, 2010).
[4] Not to be exceeded more than once per year on average over 3 years.
[5] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m3.
[6] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).
[7] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)
[8] (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
(c) EPA is in the process of reconsidering these standards (set in March 2008).
[9] (a) EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.

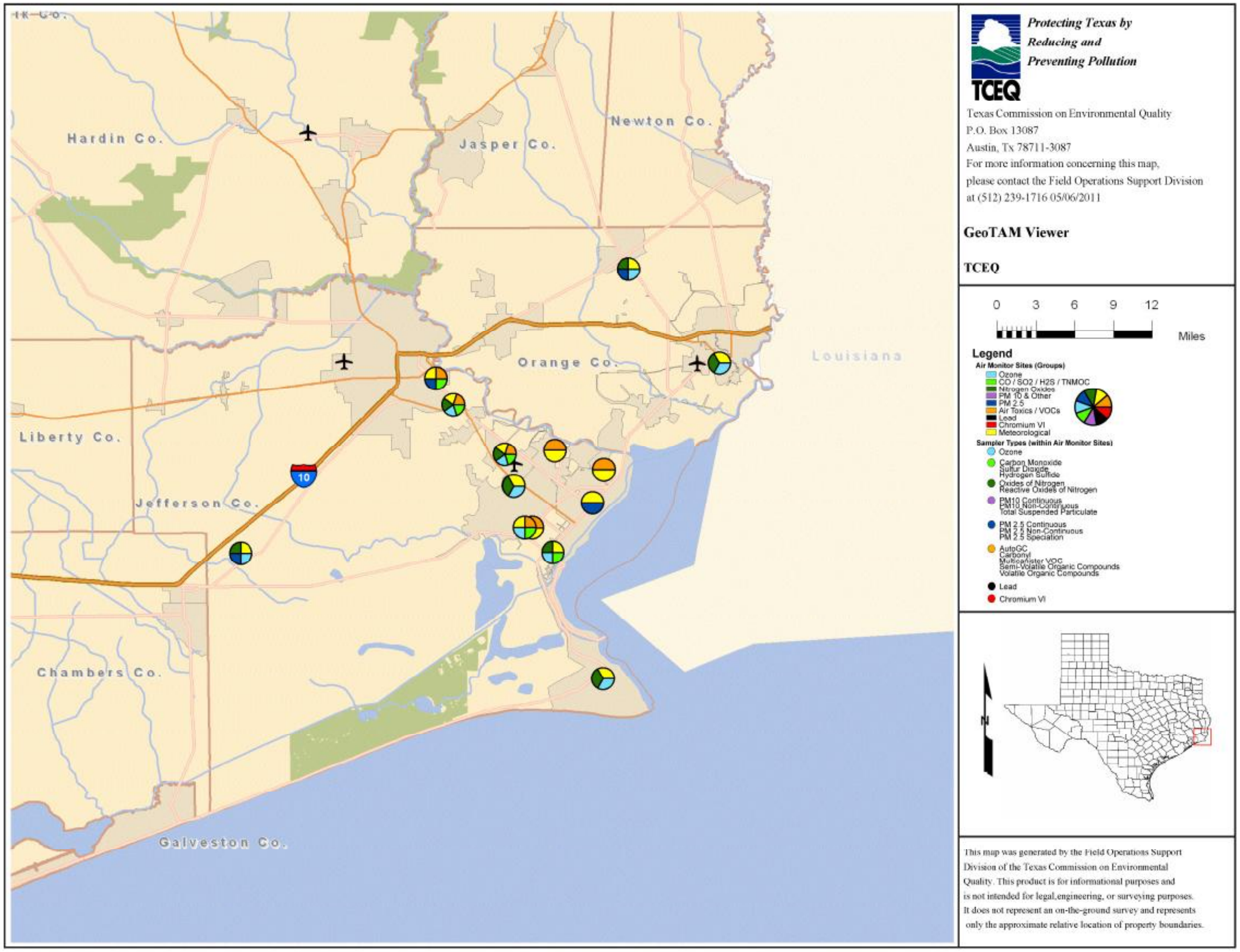


Figure II.3.1-1. BPA MSA Air Monitoring Station Locations (TCEQ 2011b).

Table II.3.1-2. Monitored Concentrations for the BPA MSA

Compound	Avg. Period	Primary NAAQS	Monitored Concentration	Percent NAAQS
CO (µg/m^3)	1-hour	40,000	1,942.9	4.9%
	8-hour	10,000	914.3	9.1%
Pb (µg/m^3)	Quarterly Average	0.15	NA[1]	
NO_2 (µg/m^3)	1-hour	188.6	10	5.3%
	Annual	100	0.01	<1%
$PM_{2.5}$ (µg/m^3)[3]	24-hour	35	32.6	93.1%
	Annual	15	10.4	69.3%
O_3 (ppm)	8-hour	0.75	0.74[4]	98.7%
SO_2 (µg/m^3)	1-hour	195	NA[5]	NA[5]
	3-hour	1,300	166	12.8%
	24-hour	365	46.8	1.2%
	Annual	80	7.8	9.8%

1 Lead concentrations are not monitored in BPA.
2 There are no lead emissions from this project.
3 PM_{10} is not monitored in the BPA; therefore $PM_{2.5}$ is used for comparison in this report.
4 This is the most recent data (2010) and was obtained from the TCEQ. The web site reference for this data is: http://www.tceq.state.tx.us/cgi-bin/compliance/monops/8hr_attainment.pl
5 The 1-hour SO_2 is a new standard. There are no official monitoring results to compare with the new 1-hour standard.

II.3.1.1.4 Regional Air Emissions

Ambient concentrations are the result of anthropogenic (man-made) emissions and natural emissions to the atmosphere. The natural emissions (called biogenic emissions) are difficult to quantify and control because they originate from unclassified sources, such as vegetation. Natural emissions are therefore not part of an evaluation on the impacts from plant modifications or expansions (TCEQ 2011c).

However, the anthropogenic emissions are routinely quantified. Table II.3.1-3 shows the anthropogenic emissions in the BPA MSA for CO, nitrogen oxides (NO_x), PM_{10}/$PM_{2.5}$, volatile organic compounds (VOC), and SO_2.

Table II.3.1-3. Anthropogenic Emissions in the BPA MSA

Compound	Point Sources (tpy)	Non-point & Mobile Sources (tpy)	Total (tpy)
CO	16,761	118,192	134,953
NO_x	35,344	50,898	86,242
$PM_{2.5}$	2,583	8,035	10,618
VOC	14,660	25,253	39,913
SO_2	30,899	9,067	39,966

Sources: USEPA 2011b

These data provide a qualitative characterization of the air quality in the BPA MSA by documenting the emissions in the airshed in which Air Products' proposed project would be built. These emission quantities are be used in a comparison with the emission increases expected from the proposed project to develop quantitative conclusions regarding potential impact from the proposed project, as discussed in Section III.3.1.2.

II.3.1.2 ENVIRONMENTAL CONSEQUENCES

This section summarizes expected emissions from the new equipment that would be installed as part of the proposed CO_2 capture project and discusses the impact of these new emissions on air quality in the area.

II.3.1.2.1 Proposed Project

Table II.3.1-4 shows the new sources that would be part of the CO_2 capture facility. It should be noted that where the operation is categorized as "control valve/intermittent", the facility would not have continuous emissions.

Table II.3.1-4. New Sources

Facility	Pollutants	Operation
TEG Surge Tank	VOC	Breathing and working losses
Cooling Tower	VOC,$PM_{2.5}$	Continuous
TEG Reboiler	VOC , NO_x, CO, $PM_{2.5}$	Continuous
35 Megawatt (MW) Cogeneration Facility	NO_x, CO, SO_2, $PM_{2.5}$, NH_3	Continuous
Plant Fugitives	VOC, NO_x, CO	Continuous
Maintenance, Startup, and Shutdown (MSS) Emissions	VOC, NO_x, CO, SO_2, $PM_{2.5}$	Intermittent, but planned and predictable.

Note: 35 MW is used as a potential maximum output. The rated output of the cogeneration facility is approximately 33 MW.

Operational parameters for the emission sources associated with this CO_2 capture facility include:

- **TEG Reboiler:** The TEG reboiler would have a nominal firing rate of 1.5 MMBTU/hr (HHV).
- **Cooling Tower:** There would be one cooling water tower associated with the proposed project. The cooling tower would have a recirculation rate of 10,000 gallons per minute (gpm).
- **Storage Tank:** There would be one storage tank for TEG, which would result in emissions of VOC. Storage tank emissions are complex calculations and require many variables to be identified. Therefore, rather than present detailed calculations, for the purpose of this EA, a conservative estimate (i.e., an over estimate) is made that the storage tank emission would be no more than 1 ton per year (tpy) of VOC.
- **Cogeneration Unit:** There would be a nominal 35 MW cogeneration unit that would be built as part of this project. The cogeneration unit would consist of a gas turbine (GT) and HRSG followed by a selective catalytic reduction (SCR) device to reduce NOx emissions.
- **Plant Fugitives:** Plant fugitives grouping would result from fugitive components (i.e., emissions from valves, pumps, compressors, pressure relief valves, flanges, connectors and other piping components) and miscellaneous vents.

Table II.3.1-5 shows the emissions (as quantified by Air Products) from all the continuous sources related to APCI's proposed project. Detailed emission calculations will be included in the permit applications submitted to TCEQ

Table II.3.1-5. Emissions from New Emission Sources

Source	Emissions									
	NO_x		CO		$PM_{2.5}$		SO_2		VOC	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
TEG Surge Tank	-	-	-	-	-	-	-	-	.01	.01
Cooling Tower	-	-	-	-	0.17	.074	-	-	0.42	1.84
TEG Reboiler	0.15	0.64	.12	0.54	0.01	0.05	0.00	0.00	0.01	0.04
35 MW Co-generation Facility	4.9	17.4	20.5	74.1	2.4	8.7	10.0	36.1	2.6	9.2
Plant Fugitives	0.08	0.08	14.03	2.77	0	0	0	0	0.4	1.6
MSS Emissions	287.7	1.4	6306.7	16.8	45.0	0.07	0.42	0.00	161.0	0.07
Total	292.83	19.52	6,341.35	94.21	47.58	8.894	10.42	36.1	164.44	12.76

Source: Emissions as quantified by Air Products based on current project design.

Determining the air quality impact from any proposed project can be a very complex task and usually requires sophisticated air emission and atmospheric modeling. Because of the amount of engineering data needed for these analyses, the modeling can only accurately be done after the detailed engineering for a project is completed. At the current stage of this project, the detailed engineering is yet to be completed. Therefore, it is not appropriate to perform the modeling that would be used in a comprehensive air quality impact analysis. A somewhat less sophisticated analysis can, however, be performed in this EA to provide some general conclusions concerning the impact from the proposed project. This section presents an analysis of air quality impacts related to the proposed CO_2 capture facility that is consistent with the level of engineering that has been completed to date.

II.3.1.2.1.1 Ozone

The BPA MSA is classified as a Moderate Nonattainment area for ozone. Therefore, the State of Texas is required to have an air quality management plan for the area, called a State Implementation Plan (SIP). However, it should be noted that there are no sources of ozone emissions. Ozone is an atmospheric pollutant that is formed via a photochemical reaction with the class of emissions known as VOC and NO_x. These two classes of compounds are called ozone precursors. Therefore, it is necessary to understand the emissions of VOC and NO_x in order to determine the impact of the proposed project on ambient ozone concentrations. The TCEQ defines a major emission increase (for ozone precursor pollutants VOC and NO_x) as any new source or modification that has an emission increase of VOC or NO_x of more than 25 tpy. As can be seen in Table II.3.1-5, the proposed CO_2 capture facility would have relatively small VOC emissions of approximately 13 tpy and NO_x emissions of approximately 19 tpy. Therefore, this modification to the Air Products facilities is not considered a major modification. As an additional comparison, it is useful to compare the emission increases from the proposed project to the total emissions in the BPA MSA. Table II.3.1-6 compares the annual ozone precursor emissions and three other criteria pollutants from the proposed project to other emissions in the airshed.

Table II.3.1-6 Comparison of CO_2 Capture Project Emission Increases to Emissions in BPA Airshed

Airshed Comparison	**VOC (tpy)**	**NO_x (tpy)**	**CO (tpy)**	**SO_2 (tpy)**	**$PM_{2.5}$ (tpy)**
BPA MSA	39,913	86,242	134,953	39,966	10,618
Proposed Project (from Table II.3.1-5)	12.76	19.52	94.21	36.10	8.89
% of BPA MSA Emissions	0.03%	0.02%	0.07%	0.09%	0.08%

Table II.3.1-6 clearly illustrates that the ozone precursor emissions related to the project are less than 0.1% of the emissions in the airshed. Because the proposed emission increase is not considered by TCEQ to be a major modification and the emissions are less than 0.1% of the emissions in the airshed, a general conclusion can be made that the proposed project would have a negligible impact on the ozone air quality in the area. In addition, since the emissions increases from this project are small, there would be no impact on the state air quality management plan (i.e., SIP).

II.3.1.2.1.2 Nitrogen Dioxide

NO_x emissions are the sum total of the emissions of nitrogen oxide (NO) and NO_2. As a conservative assumption, the final disposition of all emissions of NO_x is NO_2. Therefore, the emissions of NO_x can be used in determining the impact of the proposed CO_2 capture facility on air quality related to the NO_2 NAAQS. The TCEQ defines a major emission increase for NO_2 as any new source or modification that has an emission increase of NO_x of more than 40 tpy. As can be seen in Table II.3.1-5, the proposed CO_2 capture facility would have NO_x emissions of approximately 20 tpy. Therefore, this modification to the Air Products Port Arthur facility is not considered a major modification for NO_2. Table II.3.1-6 compares the annual NO_x emissions from the proposed project to other NO_x emissions in the airshed. The NO_x emissions related to the project are less than 0.1% of the emissions in the airshed. Because the proposed emission increase is not considered by TCEQ to be a major modification and the emissions are less than 0.1% of the emissions in the airshed, a general conclusion can be made that the proposed project would have a negligible impact on the NO_2 air quality in the area.

II.3.1.2.1.3 Carbon Monoxide

The emissions of CO can be used in determining the impact of the proposed facility on the air quality as it relates to the CO NAAQS. The TCEQ defines a major emission increase for CO as any new source or modification that has an emission increase of CO of more than 100 tpy. As can be seen in Table II.3.1-5, the proposed CO_2 capture facility would have CO emissions of approximately 94 tpy. Therefore, this modification to the Air Products Port Arthur Facility is not considered a major modification for CO. Table II.3.1-6 compares the annual CO emissions from the proposed project to other CO emissions in the airshed. The CO emissions related to the project are less than 0.1% of the emissions in the airshed. Because the proposed emission increase is not considered by TCEQ to be a major modification and the emissions are less than 0.1% of the emissions in the airshed, a general conclusion can be made that the proposed project would have a negligible impact on the CO air quality in the area.

II.3.1.2.1.4 Sulfur Dioxide

The emissions of SO_2 can be used in determining the impact of the proposed facility on the air quality as it relates to the SO_2 NAAQS. The TCEQ defines a major emission increase for SO_2 as any new source or modification that has an emission increase of SO_2 of more than 40 tpy. As can be seen in Table II.3.1-5, the proposed CO_2 capture facility would have SO_2 emissions of approximately 36 tpy. Therefore, this modification to the Air Products Port Arthur Facility is not considered a major modification for SO_2. Table II.3.1-6 compares the annual SO_2 emissions from the proposed project to other SO_2 emissions in the airshed. The SO_2 emissions related to the project are less than 0.1% of the emissions in the airshed. Because the proposed emission increase is not considered by TCEQ to be a major modification and the emissions are less than 0.1% of the emissions in the airshed, a general conclusion can be made that the proposed project would have a negligible impact on the SO_2 air quality in the area.

II.3.1.2.1.5 Particulate Matter ($PM_{2.5}$)

The emissions of $PM_{2.5}$ can be used in determining the impact of the proposed facility on the air quality as it relates to the $PM_{2.5}$ NAAQS. The TCEQ defines a major emission increase for $PM_{2.5}$ as any new source or modification that has an emission increase of $PM_{2.5}$ of more than 10 tpy. As can be seen in Table II.3.1-5, the proposed CO_2 capture facility would have $PM_{2.5}$ emissions of approximately 9 tpy. Therefore, this modification to the Air Products Port Arthur facility is not considered a major modification for $PM_{2.5}$. Table II.3.1-6 compares the annual $PM_{2.5}$ emissions from the proposed project to other $PM_{2.5}$ emissions in the airshed. The $PM_{2.5}$ emissions related to the project are less than 0.1% of the emissions in the airshed. Because the proposed emission increase is not considered by TCEQ to be a major modification and the emissions are less than 0.1% of the emissions in the airshed, a general conclusion can be made that the proposed project would have a negligible impact on the $PM_{2.5}$ air quality in the area.

II.3.1.2.1.6 Toxic and Hazardous Air Pollutants

EPA has published a list of 188 pollutants that are defined as hazardous air pollutants (HAPs), which are listed in §112(b) of the CAA. Air Products' proposed CO_2 capture project should not have any emissions of the 188 pollutants specifically identified as HAPs. TCEQ has not developed any rules that specifically regulate any air toxics other than the HAPs identified by EPA. Therefore, the CO_2 capture project would have no impact on toxic or hazardous air pollutants.

II.3.1.2.1.7 Objectionable Odors

At this stage of engineering, no air contaminant has been identified that would be emitted at levels that could result in objectionable odors. Therefore, the CO_2 capture project would have no impact on objectionable odors.

II.3.1.2.1.8 Other Air Emissions

TCEQ has established a list of Effects Screening Levels (ESLs), which are based on data concerning health effects, the potential for odors to be a nuisance, effects on vegetation, and corrosive effects. ESLs are screening levels used in TCEQ's air permitting process to predict impacts based on air dispersion modeling results. ESLs are not ambient air standards.

TCEQ has identified an ESL for TEG and ammonia. Current engineering estimates indicate that TEG emissions resulting from the proposed project would be less than 1 tpy TEG and less than

19 tons per year of ammonia. Based on these levels of predicted emissions, Air Products does not anticipate that an air dispersion modeling study would be required to predict impacts associated with the proposed project. In addition to the emission sources that have previously been identified in this EA, there may be other minor air emissions, such as very small quantities of VOC emitted from the storage tanks and fugitive emissions. These minor air emissions would not result in any predicted impacts for any contaminant identified in the TCEQ ESL list. Therefore, the proposed project would result in negligible impacts associated with "other air emissions".

Table II.3.1-7 summarizes the potential impacts of the proposed CO_2 capture project on atmospheric conditions and air quality.

Table II.3.1-7. Summary of Potential Impacts – Atmospheric Conditions and Air Quality

Resource Criteria	Impact
Regulated air pollutants	Negligible impacts
Toxic and hazardous air pollutants	No impacts
Air quality management plans	No impacts
Objectionable odors	No impacts
Other air emissions	Negligible applicable

II.3.1.2.2 Construction Emissions

The only emissions of any consequence associated the construction of the CO_2 capture plant would be from two general types of sources; emissions from materials handling (e.g. earth moving) and emissions from burning fuel (gasoline and diesel) from mobile sources (off-road and on-road vehicles). Each of these source types is discussed below.

Material Handling: The material handling activities would result in emissions of fine particulate (particulate matter 2.5 microns or less, or $PM_{2.5}$). Construction of the carbon capture component would include several different activities, such as site clearing, demolition, excavation, and truck-hauling of material. The types and number of equipment (e.g., bulldozers, dump trucks, excavators, graders, compactors), equipment operational hours, amount of material processed, number of haul trips, and other parameters that may affect emissions would vary from one activity to another. A list of the specific activities is shown below:

- Entrained dust from material delivery trucks traveling on unpaved roads and surfaces in construction areas,
- Entrained dust from construction vehicles traveling on unpaved roads and surfaces in construction areas,
- Entrained dust from heavy construction equipment traveling on unpaved roads and surfaces in construction areas,
- Fugitive dust from heavy equipment construction activities (i.e., bulldozing, grading, scraping), and
- Fugitive dust from handling and truck transport of fill and excavated material (i.e., unloading and loading of material to/from haul trucks).

Mobile Source Emissions: Mobile source emissions are disaggregated into on-road (e.g., cars, trucks, and motorcycles) and non-road emission categories. Emissions from these categories results from fuel burning and, as such, would have emissions of NO_x, VOC, CO, SO_2, and $PM_{2.5}$. Non-road emissions result from the use of fuel in a diverse collection of vehicles and equipment, including vehicles and equipment in the following categories:

- all-terrain vehicles;
- construction equipment, such as graders, track excavators, and back hoes; and
- industrial type equipment, such as fork lifts.

On-road vehicles would be used during all aspects of the construction phase of the project and would result in emissions of NO_x, VOC, CO, SO_2, and $PM_{2.5}$. On-road equipment would include heavy duty diesel vehicles, heavy duty gasoline vehicles, light duty diesel vehicles, and light duty gasoline vehicles.

All of the activities and equipment identified above would result in some emissions. However, each of these activities is for a very limited time period and therefore would result in temporary, negligible impacts to air quality.

II.3.1.2.3 No-Action Alternative
Under the No-Action Alternative, Air Products would not construct the proposed carbon capture facilities at PA1 and PA2. Consequently, emissions from the PA1 and PA2 facilities would remain the same as current emissions. No additional criteria pollutants would be emitted to the atmosphere. Additionally, the approximately one million tons per year of CO_2 that would have been captured by the proposed carbon capture facilities would also continue to be emitted to the atmosphere.

II.3.2 Water and Geologic Resources

II.3.2.1 AFFECTED ENVIRONMENT

II.3.2.1.1 Surface Water
The proposed Carbon Capture project area is located within the Neches-Trinity Coastal Basin (TCEQ 2010a). The project site is situated at an elevation of approximately 2 feet above mean sea level (AMSL) (U.S. Geological Survey [USGS] 1974 and 1975). As shown in Figure II.3.2-1, Alligator Bayou is the nearest stream to the PA1 and PA2 plants (TCEQ 2008). This bayou, considered to be an unclassified freshwater stream, extends roughly north to south for approximately 3.75 miles to the west of the PA1 and PA2 plants. Alligator Bayou is contained within the Port Arthur Hurricane Flood Protection Levee. The proposed CO_2 pipeline lateral, as described below in Section III.3.2, would cross under Alligator Bayou approximately 4,000 feet northwest of the PA2 plant.

Other surface water features in the proposed project area include Taylor Bayou, Salt Bayou, the Sabine Neches Canal, and a series of lakes and ponds (Figure II.3.2-1). Alligator Bayou flows into Taylor Bayou approximately 4,000 feet southwest of the PA2 plant.

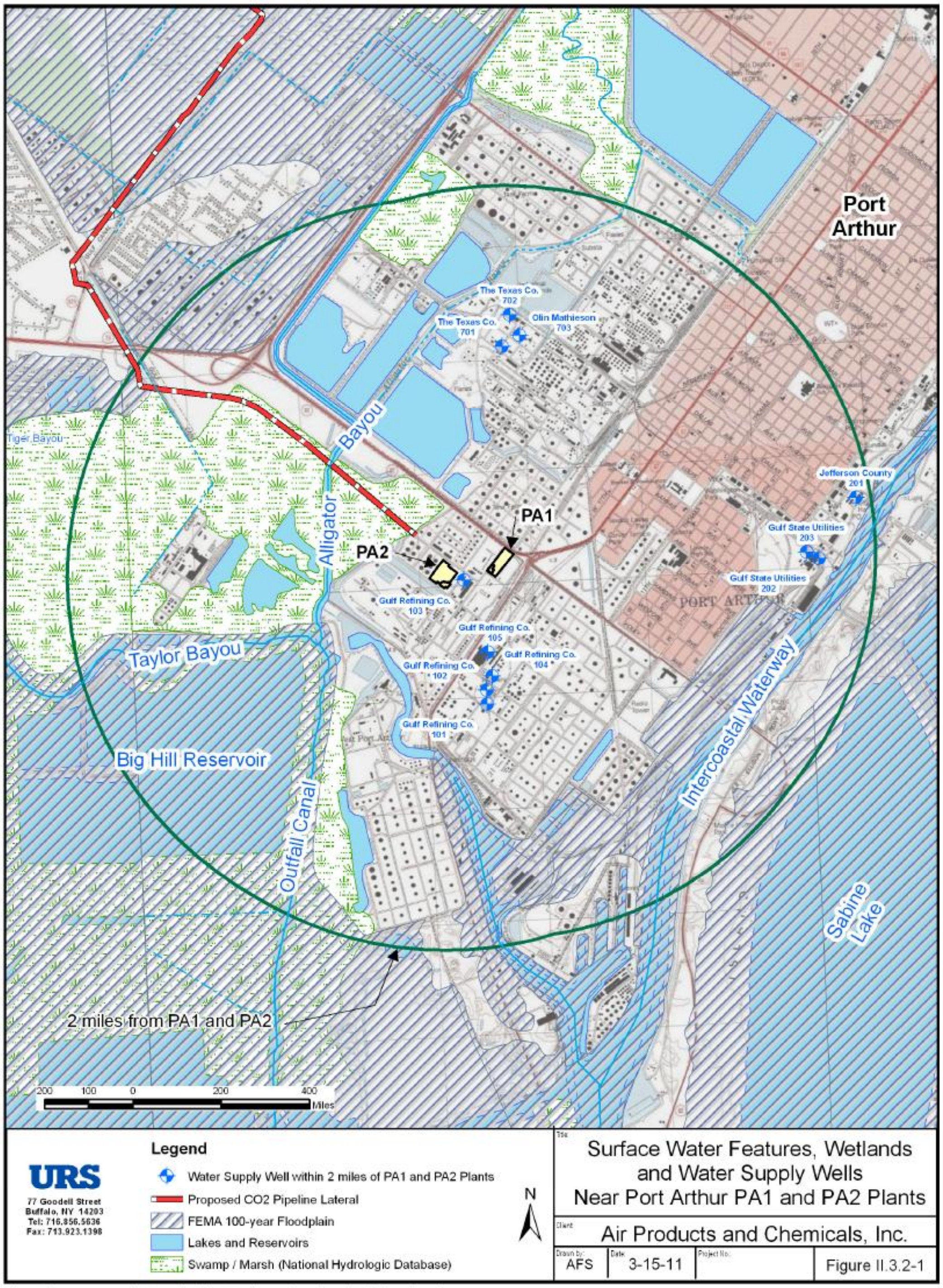
Both freshwater and saltwater conditions occur in the vicinity of the PA1 and PA2 plants. A series of levees and floodwalls surround an approximately 60-square-mile area. These levees and floodwalls were designed to protect Port Arthur and other adjacent communities from potential hurricane flooding conditions. The Jefferson County Drainage District Number 7 (JCDD7) maintains the Port Arthur and Vicinity Hurricane/Shore Flood Protection Project (HFPP). The Port Arthur and Vicinity Hurricane Flood Protection Levee provides protection up to and including a Standard Project Hurricane (SPH), which is a hypothetical hurricane that represents the most severe combination of parameters that are “reasonably characteristic” of a specified geographic region. For this area, the SPH consists of a storm surge of up to 14 feet above National Geodetic Vertical Datum (NGVD).

According to the JCDD7, the project area is within the Industrial Area Watershed and surface runoff generally flows toward the Main Outfall Canal north of the project area.

Alligator Bayou and Taylor Bayou are the nearest surface waterbodies with water quality data. Storm water drainage at the PA1 and PA2 facilities consists of sheet flow to the surrounding Valero Refinery, which completely surrounds the PA1 and PA2 plants. All storm water at the PA1 and PA2 plants flows into the Valero storm water system. All process sewers from Air Products’ existing Port Arthur facilities drain to the surrounding Valero Refinery system as well. The Valero sewer system includes ditches to the east and west of PA2 for storm water collection. The entire Valero refinery is surrounded by grass levees (Air Products 2007).

The TCEQ has designated certain streams, or segments thereof, as “classified” segments to facilitate the development of surface water quality standards (SWQSs) specific to each stream or stream segment. Three designated stream segments are located adjacent to or in the general vicinity of the proposed carbon capture project area: Taylor Bayou (segment 0701), the Gulf Intracoastal Waterway (GIWW) (segment 0702), and Sabine Lake (segment 2412) (USACE 2009). SWQSs for these segments are presented in Table II.3.2-1. The stream segments associated with the project are Alligator Bayou segments 0702A_02, 0702A_03, and 0702A_04 and Taylor Bayou segments 0701_01 and 0701_02. All of these segments are considered a low overall priority. The surface water quality for the segments is presented in Tables II.3.2-1 and II.3.2-2 (TCEQ 2008).

N:\URDD.DWAURSAirPrdPrtArt\GIS\MXDs\PortArthur_WaterWells_20110315.mxd



Locations are approximate and subject to change based on detailed engineering

Sources: Texas Water Development Board, TWDB Wells Database, accessed March 2011.
ESRI ArcGIS Online, accessed March 2011.

Figure II.3.2-1. Surface Water Features, Wetlands and Water Supply Wells near Port Arthur PA1 and PA2 Plants

Table II.3.2-1. Designated Uses and Surface Water Quality Standards in Surface Waterbody Segments Near Carbon Capture Project Area

Waterbody		**Taylor Bayou**	**GIWW**	**Sabine Lake**
Uses	Recreation	CR	CR	CR
	Aquatic	I	H	H,O
	Domestic Supply	N/A	N/A	N/A
Criteria	Chloride (mg/l)	400	N/A	N/A
	Sulfate (mg/l)	100	N/A	N/A
	Total Dissolved Solids (mg/l)	1,100	N/A	N/A
	Dissolved Oxygen (mg/l)	4.0	4.0	4.0
	pH Range (standard units)	6.5-9.0	6.5-9.0	6.0-8.5
	Fecal Coliform (#100/ml)	200	200	N/A
	Temperature (^{0} F)	95	95	95

Source: Title 30 of the Texas Administrative Code (TAC), Chapter 307
Notes: GIWW = Gulf Intracoastal Waterway; CR = Contact Recreation; I = Intermediate aquatic use; H = High aquatic life use; O = Oyster waters; N/A = Not applicable; Alligator Bayou is not included because it is not a defined waterbody segment.

Table II.3.2-2. Surface Water Quality in Waterbodies Near Carbon Capture Project Area

Water Body	**Location**	**Parameters of Concern**
Alligator Bayou		
Segment 0702A_02	Lower portion from State Highway 82 to its confluence with Taylor Bayou	Impaired fish community Toxicity in sediment
Segment 0702A_03	Upper portion from its headwaters at Port Arthur Canal to State Highway 82	Toxicity in water
Segment 0702A_04	Drainage canal leading into Alligator Bayou approximately 0.8 miles north of State Highway 82	Toxicity in water
Taylor Bayou above Tidal		
Segment 0701_01	From saltwater lock to 8 miles upstream	Depressed dissolved oxygen
Segment 0701_02	From 8 miles upstream of saltwater lock to the confluence of North and South Forks Taylor	Depressed dissolved oxygen

(Source: TCEQ 2008)

II.3.2.1.2 Groundwater

The major aquifer beneath the proposed project area is the Gulf Coast aquifer. The Gulf Coast aquifer is divided into four units: the Chicot, Evangeline, Jasper, and Catahoula aquifers (Texas Water Development Board [TWDB] 1995). Recharge to the Gulf Coast aquifer depends primarily on rainfall infiltration, which averages 50 inches annually. The PA1 and PA2 facilities are underlain by the Chicot aquifer, which consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont Formations, as well as overlying alluvial deposits.

The TWDB groundwater database was searched to locate existing public and private groundwater supply wells or springs within a two-mile radius of the proposed project area. These wells are shown on Figure II.3.2-1. The primary uses of the depicted wells are categorized as plugged or destroyed and unused. The existing well shown on Figure II.3.2-1 located nearest to the PA1 and PA2 facilities (Gulf Refining Co. Well No. 103) is listed as destroyed but is depicted on the figure due to it being listed in the TWBD database. All of the groundwater wells depicted on Figure II.3.2-1 are completed into the Chicot aquifer and range in depth from approximately 800 to 1,000 feet (TWDB 2011).

The groundwater quality in the proposed project area is generally good in the shallower portions of the aquifer (TWDB 1995). Regionally, groundwater in the Gulf Coast aquifer has total dissolved solids (TDS) concentrations ranging less than 500 milligrams/liter (mg/l), to a maximum depth of 3,200 feet, in aquifer areas from the San Antonio River Basin up to Louisiana (TWDB 1995). TDS concentrations in groundwater in the Chicot aquifer in the general area of the PA1 and PA2 facilities are typically below 1,000 mg/l. Bicarbonate concentrations in groundwater in the Chicot aquifer in the proposed project area are typically between 200 and 500 mg/l (Mace et al 2006).

II.3.2.1.3 Geology and Soils

The project site and vicinity are underlain by layers of quaternary alluvium, specifically the Beaumont Formation (TWDB 1995). The site is on the eastern margin of the northern part of the Gulf Coast aquifer. The uppermost aquifer present at the site area is the Chicot Formation. No caves, sinkholes, or other karst features have been found in Jefferson County (Elliot 2010). The geologic setting in the area of PA1 and PA2 facilities is very similar to the regional geologic setting and seismic hazard of the area. There are no seismically active fault zones that exist in Texas and the risk of seismic events for the proposed project area is very low (USGS 2008).

Soils underlying the PA1 and PA2 facilities (Figure II.3.2-2) are comprised of the Neel-Urban Land Complex (NuC) soil unit (U.S. Department of Agriculture [USDA] Natural Resources Conservation Service [NRCS] 2006; NRCS 2011a). A significant portion of the soils underlying the PA1 and PA2 facilities consists of fill materials. Soils in the area typically occur on slopes of about 2 to 5 percent and rarely become flooded. The Neel-Urban Land Complex is classified as moderately drained and a potentially highly erodible soil. There are no prime farmlands in the vicinity of the proposed project area. Soils underlying the first portion of the proposed CO_2 pipeline lateral west of the boundary of the Valero Refinery property (Figure III.3.2-3) consist primarily of the Caplen Mucky Peat, having slopes from about 0 to 1 percent, frequently flooded, and tidal; the Harris clay, having slopes from about 0 to 1 percent slopes, frequently flooded, and tidal; and the Neches Coarse Sand, having approximately 2 to 5 percent slopes (CeA, HaA, and NcC units, respectively) (NRCS 2006, NRCS 2011a).

II.3.2.1.4 Floodplains and Wetlands

Floodplains: Executive Order 11988, *Flood Plain Management*, requires that development in floodplains be avoided if practicable. The project area is shown on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel 4803850430B (effective June 1, 1983). The project area is located within a flood control levee area and is classified by FEMA as outside of the 100-year floodplain.

Wetlands: DOE regulations in 10 CFR Part 1022, “Compliance with Floodplain and Wetland Environmental Review Requirements,” implement the requirements of Executive Order 11990, *Protection of Wetlands*. These regulations require, among other things, that the DOE notify appropriate government agencies (e.g., the USACE for wetlands and FEMA for 100-year floodplains) and interested parties of a proposed wetland action; conduct a wetlands assessment to evaluate the impacts of the proposed action to wetlands in an EA or environmental impact statement (EIS); consider alternatives that would avoid or minimize impacts to wetlands; design or modify the action to minimize potential impacts to wetlands; and allow for public review and comment of the analysis.

The project area is within an existing heavily industrialized facility. The site has been previously developed and filled. No wetlands are present on the site. The USFWS National Wetlands Inventory (NWI) also indicates that no wetlands are present on the project site (USFWS 2011a).

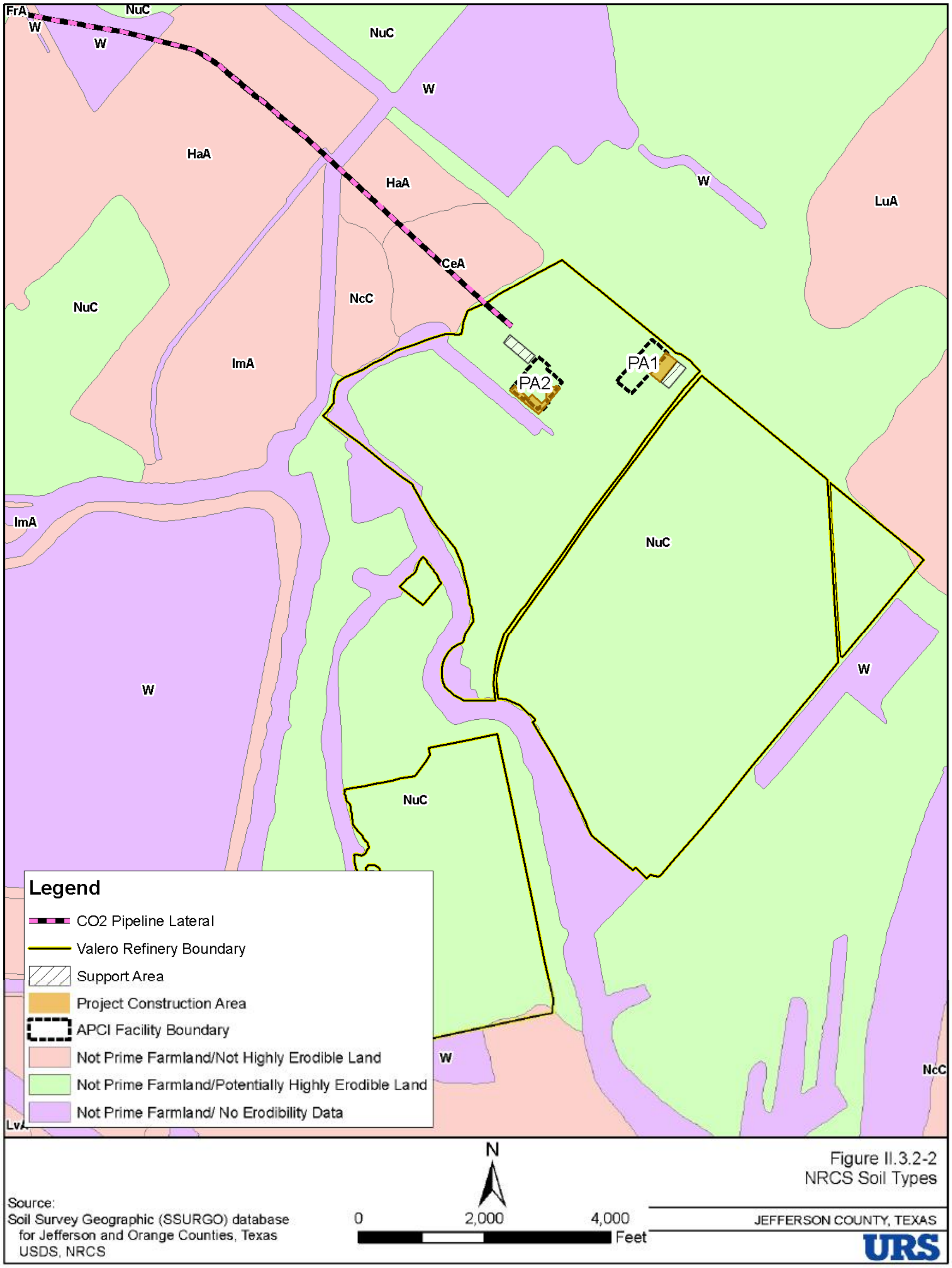


Figure II.3.2-2. NRCS-Classified Soil Types in the Port Arthur PA1 and PA2 Plant Sites Area

II.3.2.2 ENVIRONMENTAL CONSEQUENCES

The proposed carbon capture project is not located in an area of geologic hazards, mapped faults, or prime farmlands, and is not crossed by any existing surface water features, as discussed above in Section II.3.2.1. Construction and operation of the proposed carbon capture facility and appurtenances would not require installation of any wells or withdrawal of groundwater from any existing water-supply wells. Impacts to surface water, groundwater, and geology and soils from the proposed carbon capture project, and mitigations, if warranted, are described in the subsections below.

II.3.2.2.1 Proposed Project

II.3.2.2.1.1 Surface Water

Surface water would not be directly withdrawn for use for construction or operation of the proposed carbon capture facility or its appurtenances.

The proposed carbon capture facility would generate wastewater streams that are similar to those currently generated by the PA1 and PA2 facilities. Typical wastewaters generated from the carbon capture facility are expected to include cooling tower blowdown, condensates, and wash water derived from off-line washing of the gas turbine. If necessary, conditions of the existing Valero Refinery's National Pollution Discharge Elimination System (NPDES) permit(s) would be modified to address changes to the PA1 and PA2 facilities associated with the proposed carbon capture project. Existing general permit requirements established by the State of Texas for hydrostatic testing of pipes and vessels would be applied.

The proposed action would not result in any direct discharge to the nearest waterbodies (Alligator Bayou and Taylor Bayou). The majority of the wastewaters produced by operations would be conveyed to the Valero Refinery wastewater treatment system. Selected wastewaters may be hauled by truck to an offsite wastewater treatment facility. Air Products would select wastewater treatment options during the final design of the carbon capture facility.

During construction and operations, storm water runoff would be controlled by use of best management practices (BMPs) established and currently in use by Air Products at its Port Arthur operations, including the Spill Prevention, Control, and Countermeasure (SPCC) Plan (Air Products 2007). Storm water runoff would be directed to the Valero refinery's storm water system.

BMPs used during construction to minimize the extent and duration of project-related disturbance to surface waterbodies would include the following, as dictated by conditions in the field:

- Use of silt fences, temporary grading to induce positive drainage, and other storm water and sedimentation control techniques to minimize or prevent soils exposed during construction from being transported as sediment or sediment-laden water into any waterbody;
- Construction of temporary berms to contain surface water runoff;
- Limiting use of water for dust control during time of heavy rainfall; and

- Use of secondary containment for any tanks used during construction.

The soils present in the proposed project area are not highly erodible (Section II.3.2.1.3). For this reason, contamination from increased runoff that might occur as a result of local temporary disturbance of ground conditions at the locations of carbon capture project-related construction activities is not expected to be a significant concern.

In summary, the proposed carbon capture project would have negligible impact on existing surface water resources.

II.3.2.2.1.2 Groundwater

No negative impacts to groundwater resources are anticipated to occur as a result of construction and operation of the proposed carbon capture facility and appurtenances. The proposed action is anticipated to have a negligible impact on existing groundwater quality and is not expected to impact existing groundwater withdrawals.

There are no existing, active water supply wells within 150 feet of the proposed carbon capture project area (Section II.3.2.1.2). The absence of water supply wells within 150 feet of the area of the proposed project facility and appurtenances, combined with adherence to Air Products' SPCC Plan procedures regarding spill prevention and process chemicals management, are expected to minimize or eliminate the potential for impacts of the proposed carbon capture project on groundwater resources. None of the water to be used for the proposed project would require constructing new water wells.

Potential impacts to groundwater through infiltration of potential spills or discharges to the ground surface would be avoided or minimized by using existing BMPs contained in Air Products' existing SPCC Plan (Air Products 2007) that specify protocols and procedures for addressing any unplanned incidents such as a spill of fuel or process chemicals.

Under normal construction and operating conditions, the proposed project would not result in any discharges to groundwater. Wastewater generated during construction and operation of the carbon capture facility would be conveyed from Air Products facilities to the Valero wastewater treatment system in a manner similar to that currently done for the PA1 and PA2 facilities, as described in Section II.3.2.1.1.

In summary, the proposed carbon capture project would have no impact on measured ambient groundwater quality in local aquifers, and would have no impact on any regional aquifer management plans or goals.

II.3.2.2.1.3 Geology and Soils

No geologic hazards exist in the proposed project area that would affect the success of the proposed carbon capture project or that would become more hazardous or be aggravated as a result of the project activities. The absence of karst features underlying or within the proximity of the proposed project site indicates that there is no potential for either short-term or long-term geologic impacts to occur during or following construction of the carbon capture facility from subsidence that could be related to the occurrence of any karst features. The low seismicity and lack of mapped fault traces underlying and surrounding the proposed project site indicate that there is minimal potential for geologically-related impacts to occur during or following construction of the carbon capture facility related to the occurrence of any faults and associated seismic activity.

As described in Section II.3.2.1.3, existing soils underlying the proposed site consist of fill and spoils material and some native soils, and none of these soil/fill materials are particularly susceptible to erosion. Clearing of weeds, possible leveling activities at the site, excavating for construction of the foundations of the carbon capture facility's equipment, constructing trenches for connective pipelines and/or utilities placement, and backfilling of required excavations would, depending on location with respect to native soil areas, result in temporary, minor impacts on native soils in one or more areas. There would be no impact to prime farmlands or significant farmlands because those features are not present in the proposed project area.

Mitigation Measures: Although the proposed project area is primarily underlain by fill and spoils backfill materials, some native soils occur in the general vicinity. As a mitigation measure, if areas of native soil are encountered during construction of the carbon capture facility and its appurtenances, the top layer of topsoil would be stockpiled for later use in restoring areas of native soil disturbance at the end of the construction phase.

BMPs contained in Air Products' existing SPCC Plan (Air Products 2007) specifying protocols and procedures for addressing any unplanned incidents, such as a spill of fuel or process chemicals, would be followed during all construction activities related to the proposed carbon capture project. Additionally, storm water BMPs would include such practices as silt fences to reduce soil erosion and siltation basins to trap sediment, as dictated by conditions in the field. Use of these BMPs would avoid or minimize impacts to geology and soils from the proposed project.

II.3.2.2.1.4 Floodplains and Wetlands

Floodplains: Executive Order 11988, *Flood Plain Management*, requires that development in floodplains be avoided if practicable. The project area is outside of the FEMA 100-year floodplain, and the site is also protected by a flood control levee. The project would not be expected to impact site runoff, drainage, or infiltration. No floodplain impacts are anticipated.

Wetlands: No wetlands are present on the project site. A large wetland complex is located to the northwest of the project site. The project would not alter site hydrology or create runoff that could indirectly affect offsite wetlands. No wetland impacts are anticipated.

II.3.2.2.2 No-Action Alternative

Under the No-Action Alternative, as discussed in Section I.2.3.1 above, DOE assumes that Air Products would not construct the proposed carbon capture facility. Therefore, under the No-Action Alternative, no changes or adverse impacts would occur to existing surface water, groundwater, geology, or soil resources.

II.3.3 Land Use

II.3.3.1 AFFECTED ENVIRONMENT

The region of influence (ROI) for land use considerations is a two-mile radius centered on Air Products' PA1 and PA2 plants. The 8.3-acre area that would be used to construct and operate the CO_2 capture facilities is in an area of industrial land use in an unincorporated part of Jefferson County, Texas. The proposed site where the project would be constructed is considered to be a brownfield area due to the previous use as part of earlier refinery activities.

The western boundary of the Port Arthur city limits is located along State Highway 82, adjacent to the east boundary of the PA1 plant. Both the PA1 and PA2 plants are located within the limits of the Valero Port Arthur Refinery. Land uses within one mile of PA1 and PA2 include industrial, open land, and residential land uses.

The City of Port Arthur manages land use through a system of zoning and permits. In general, Port Arthur has experienced out migration for several decades that has left many housing units and commercial buildings empty (U.S. Census Bureau [USCB] 2000).

Many public parks are maintained in Port Arthur. The nearest park to the project site is Carver Terrace Park, at Gulfway Drive and Terminal Road, which is approximately 0.5 miles to the east of the PA1 plant. The closest residential area to the project site is located adjacent to Carver Terrace Park, approximately 0.5 miles to the east of the PA1 plant, within the City of Port Arthur. Industrial development in the area includes the PA1 and PA2 plants, the Valero Port Arthur Refinery, and port activities along the Port Arthur/Sabine Lake waterfront.

Alligator Bayou drains to Taylor Bayou and is located approximately 3,000 feet to the west of the PA2 plant. This area of open water, wetlands, and open land is undeveloped and has limited potential for development due to the marshy conditions and lack of foundation soils.

II.3.3.2 ENVIRONMENTAL CONSEQUENCES

II.3.3.2.1 Proposed Action

As noted in Table II.3.3-1, the proposed project is compatible with the existing land use at the project site and surrounding area. The current land use is industrial as is the future use for the proposed project. Being in an unincorporated part of Jefferson County, there is no zoning on the land that would be used for the proposed action. The City of Port Arthur has a zoning ordinance, but the city is about one mile east of the project site and does not have a direct bearing on the project area. There would be no impact to the implementation of the Port Arthur zoning ordinance.

Table II.3.3-1. Summary of Potential Impacts – Land Use

Resource Criteria	Impact
Existing land use	No Impact
Zoning	No Impact
Land use planning	No Impact

II.3.3.2.2 No-Action Alternative

Under the No-Action Alternative, DOE would not provide funding to Air Products for their proposed project and DOE assumes that Air Products would not construct the proposed carbon capture facility. Therefore, there would be no changes or impacts to land use in the area under the No-Action Alternative.

II.3.4 Biological Resources

II.3.4.1 AFFECTED ENVIRONMENT

This section describes existing biological resources at the proposed project site. It focuses on plant and animal species or habitat types that are typical or are an important element of the ecosystem, are of special category importance, or are protected under state or federal law or statute regulatory requirement.

The study area is within Jefferson County, Texas, in the Sabine Lake Watershed (hydrologic unit code: 12040201). The mean annual temperature is 69 °F, and the average annual rainfall is approximately 50 inches. The subtropical, humid climate features warm, moist summers tempered by Gulf breezes. The growing season averages 225 days a year (Texas State Historical Association 2011).

The project is located within the Western Gulf Coastal Plain Environmental Protection Agency (EPA) Level III ecoregion, as well as the Northern Humid Gulf Coastal Prairies and the Texas-Louisiana Coastal Marshes EPA Level IV ecoregions (USEPA 2011a). The Western Gulf Coastal Plain ecoregion is described as follows:

> *The principal distinguishing characteristics of the Western Gulf Coastal Plain are its relatively flat coastal plain topography and mainly grassland potential natural vegetation. Inland from this region the plains are older, more irregular, and have mostly forest or savanna-type vegetation potentials. Largely because of these characteristics, a higher percentage of the land is in cropland than in bordering ecological regions. Urban and industrial land uses have expanded greatly in recent decades, and oil and gas production is common.*

The USFWS administers the Endangered Species Act of 1973, as amended. This law provides federal protection for species designated as federally endangered or threatened. An endangered species is “in danger of extinction throughout all or a significant portion of its range,” and a threatened species “is likely to become an endangered species within the foreseeable future” (USFWS 1988). Special status species are listed as threatened or endangered, are proposed for listing, or are candidates for listing by the state and/or federal government. In addition, the Migratory Bird Treaty Act provides the USFWS the regulatory authority to manage migratory birds. Further, the Fish and Wildlife Conservation Act encourages federal agencies to conserve and promote the conservation of non-game fish and wildlife habitats to the maximum extent possible within each agency’s regulatory responsibilities. Seven federally listed threatened and endangered species have the potential to occur in Jefferson County (Table II.3.4-1).

Table II.3.4-1. Federally Listed Threatened and Endangered Species Potentially Occurring in Jefferson County, Texas.

Type	Species	Scientific Name	Federal Status
Bird	Bald eagle	*Haliaeetus leucocephalus*	Delisted
Bird	Piping plover	*Charadrius melodus*	Endangered
Reptile	Green sea turtle	*Chelonia mydas*	Endangered
Reptile	Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Reptile	Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Reptile	Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Reptile	Loggerhead sea turtle	*Caretta caretta*	Threatened

Bald eagles are known to occur in quiet coastal areas, rivers, or lakeshores with large, tall trees. Man-made reservoirs have provided excellent habitat. Bald eagles are opportunistic predators feeding primarily on fish, but also eat a variety of waterfowl and other birds, small mammals, and turtles. Carrion is also common in their diet, particularly in younger birds. Bald eagle populations have increased to the extent that they have been delisted from the Federal Endangered Species List. However, the species is protected by the Bald and Golden Eagle Act and the Migratory Bird Treaty Act.

Piping plovers live on sandy beaches and lakeshores. These shorebirds migrate through the Great Lakes along the river systems through the Bahamas and West Indies. They are currently found along the Atlantic Coast from Canada to North Carolina and along the shorelines of Lakes Michigan and Superior. Gulf Coast beaches from Florida to Mexico and Atlantic coast beaches from Florida to North Carolina provide winter homes for plovers. The project area does not include any sandy beaches or lakeshores.

The Atlantic hawksbill sea turtle, green sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle are each listed as either threatened or endangered, both Federally and in the state of Texas. Sea turtles are found only in oceans and coastal areas. The project area does not include these any ocean or coastal areas.

The project area is located within a heavily industrialized existing facility. The site has been previously significantly disturbed and the majority of the site is maintained free of vegetation as is typical for a large refinery. As such, the site does not provide suitable habitat for plant or animal species.

II.3.4.2 ENVIRONMENTAL CONSEQUENCES

II.3.4.2.1 Proposed Project

The project site has been previously developed as an industrial facility. The majority of the site is maintained free of vegetation. Due to the existing development, the site does not provide habitat for plant or animal species. The proposed project would be consistent with the land use at the existing facility. No impacts to biological resources are anticipated as a result of the proposed project.

Federally-listed threatened and endangered species occurring in Jefferson County are: piping plover, Atlantic hawksbill sea turtle, green sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. The bald eagle has been delisted due to recovery. None of these threatened or endangered species, or habitats suitable for these species, are present in the project area. Bald eagles use tall trees near large open bodies of water and piping plovers rely on coastal habitats. The five sea turtle species are found in oceans and shorelines. None of these required habitat types are found in the project area. Therefore, no project-related impacts to threatened or endangered species are anticipated.

II.3.4.2.2 No-Action Alternative

Under the No-Action Alternative, DOE would not provide funding to Air Products for their proposed project and DOE assumes that Air Products would not construct the proposed carbon capture facility. Therefore, there would be no changes or impacts to existing biological resources under the No-Action Alternative.

II.3.5 Historic and Cultural Resources

II.3.5.1 AFFECTED ENVIRONMENT

Cultural resources are defined as historic properties, cultural items, archaeological resources, sacred sites, and artifact collections and associated records as defined by the NHPA; Native American Graves and Repatriation Act; Archaeological Resources Protection Act; Executive Order 13007, to which access is afforded under the American Indian Religious Freedom Act; and 36 CFR Part 79, respectively. The Area of Potential Effect (APE) for cultural resources includes property within and immediately adjacent to the proposed project components, either temporarily during construction or permanently throughout operations. The following Air Products components lie within the fenced perimeter of the Valero Refinery in Jefferson County, as shown on Figure II.2-1: the approximately 630-foot length of pipeline that comprise the southern terminus of the 12.8-mile-long CO_2 pipeline lateral; 1,643 feet of aboveground pipe that would extend from the CO_2 lateral tie-in to PA2; a 2.5-acre expansion of the PA2 footprint; approximately 2,942 feet of aboveground CO_2 pipeline that would connect PA1 to PA2; and a 2.1-acre expansion of the PA1footprint. There would also be two laydown yards and workspaces, one northwest of PA2 that is approximately 1.8 acres in area, and one directly adjacent to PA1 that is approximately 1.6 acres in area. Approximately 2,262 feet of an existing 5-inch diameter liquid butane line would also be relocated during the course of the planned activities.

On April 5, 2011, DOE submitted documentation to the Texas SHPO explaining DOE's conclusion that no cultural resources eligible for listing on the Nation Register of Historic Places (NRHP) would be affected by the above-listed Air Products project components. DOE's determination was based on a study conducted by URS Group, Inc. (URS 2011a), which also was supplied to the SHPO. On May 3, 2011, the SHPO concurred with the DOE's conclusion. The DOE letter and SHPO correspondence is included in Appendix B of this EA.

II.3.5.2 ENVIRONMENTAL CONSEQUENCES

DOE does not expect the carbon capture component of Air Products' project to directly or indirectly impact cultural resources or historic properties. There are no historic properties as defined by the NHPA identified on the Texas Archeological Site Atlas or the National Register of Historic Places within one mile of this project component in Jefferson County.

II.3.5.2.1 Proposed Project

In the event that cultural resources (e.g., human remains, stone tools, prehistoric or historic pottery, remnants of older pipeline construction) are discovered within the Valero Refinery during construction of the carbon capture aspects of the project, work would cease in the area of the discovery and the Texas SHPO would be notified. A qualified archaeologist would evaluate any such discovery and, in consultation with the SHPO, implement appropriate mitigation measures before construction activities would resume.

II.3.5.2.2 No-Action Alternative

Under the No-Action Alternative, DOE would not provide funding to Air Products for their proposed project and DOE assumes that Air Products would not construct the proposed carbon capture facility. Therefore, there would be no changes or impacts to existing cultural resources under the No-Action Alternative.

PART III. CO_2 PIPELINE LATERAL

III.1 INTRODUCTION

This chapter describes the details pertaining to the construction and operation of the CO_2 pipeline lateral in Jefferson County, Texas and evaluates the environmental impacts from the proposed construction and operation of this pipeline. This chapter is organized as follows: introductory discussion (Section III.1), details pertaining to the proposed construction and operation of the CO_2 pipeline lateral (Section III.2), and the affected environment and expected environmental consequences from construction and operation of the CO_2 pipeline lateral and of the No-Action Alternative (Section III.3).

III.2 CO_2 PIPELINE LATERAL DETAILS

The proposed project consists of constructing a new 12.8-mile-long, 8-inch-diameter pipeline lateral that would interconnect with the existing Green Pipeline (a CO_2 pipeline conveyance system owned by Denbury) for injection into the existing West Hastings Field in Brazoria County, Texas.

The proposed CO_2 pipeline lateral, which parallels existing utility corridors along the majority of its route, would be owned and operated by Air Products. Once the CO_2 stream is compressed and dried at the Air Products capture facility, it would enter the CO_2 pipeline lateral at the pipeline tie-in point located on the southeast battery limit (plant south) of Air Products' PA2 plant at Port Arthur.

The proposed routing of the new CO_2 pipeline lateral follows existing pipelines for over 95% of its route. To safely accomplish the installation of the new CO_2 pipeline, the centerline of the CO_2 pipeline would be installed approximately 15 feet from the closest existing pipeline and always to the outside of the existing ROW and away from other existing pipelines. The construction spread would be set up to allow excavated spoil to be piled on the side of the trench between the CO_2 pipeline and the closest existing pipelines. Piling excavated materials between the new and existing pipelines would also keep construction equipment working on open ground and keep the construction equipment from working over top of existing pipelines. This construction philosophy would be followed regardless of whether the pipeline would be installed using an open trench or an HDD construction method.

A One Call notice to the central clearing house for buried utilities starts off the field construction process. Pipeline owners with assets in the area would inspect the route and locate and mark their pipelines. Typically, project specifics are shared and contact information is exchanged. The other pipeline companies' inspectors would not remain onsite but can be contacted as needed. Air Products would perform an electronic pipeline sweep to pick up any other pipelines or buried electric lines which were not picked up by our survey crew or the pipeline owners responding to the One Call.

The CO_2 pipeline lateral would connect with the existing Denbury Green Pipeline at a point near the intersection of West Port Arthur Road and Farm to Market Road 3514. As illustrated in Attachment A, Figure 15 of the Biological Report in Appendix C, a meter station occupying an area of less than 0.1 acres (including a launcher site to be located within the perimeter of the meter station) would be constructed approximately 250 feet south of the pipeline interconnection. The meter station, to be owned and operated by Denbury, is needed to measure the volume of CO_2 passing through the pipeline, to monitor pressure conditions in the pipeline lateral, and to perform routine pipeline maintenance.

Aboveground valves would be installed at several points along the pipeline route. As currently designed, block valves required for safety at water crossings would be placed approximately at mileposts 1.9, 3.5, 7.7 and 10.0. An excess flow valve would be placed approximately at milepost 6.0. A valve riser would also be installed at the interconnect with the Green Pipeline (approximately milepost 12.8). Additionally, an approximately 2,500-square-foot launcher site would be constructed within the ATWS at the south end of pipeline lateral (i.e., approximately milepost 0.0). The number, types, and locations of valves along the proposed pipeline lateral are subject to change based on final engineering and safety analyses.

III.3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

III.3.1 Air Quality

The CO_2 pipeline lateral would be constructed within Jefferson County, Texas. See Section II.3.1.1 for a discussion of air quality in the BPA MSA, which includes Jefferson County.

III.3.1.1 AFFECTED ENVIRONMENT

The CO_2 lateral would be constructed within Jefferson County, Texas. See Section II.3.1.1 for a discussion of air quality in the BPA MSA, which includes Jefferson County.

III.3.1.2 ENVIRONMENTAL CONSEQUENCES

III.3.1.2.1 Proposed Project

There would be no routine emissions associated with the CO_2 pipeline; however, there would be emissions resulting from construction of the pipeline and start-up activities. The following paragraphs address these two issues.

There would be temporary emissions associated with the construction phase of the pipeline. The emissions into the atmosphere from the construction of the pipeline would occur from two general types of sources: emissions from material handling (e.g. dirt moving) and emissions from burning fuel (gasoline and diesel) from mobile sources (off-road and on-road vehicles).

Construction Phase Material Handling: The material handling activities would result in emissions of fine particulate (particulate matter 2.5 microns or less, or $PM_{2.5}$). Construction of the pipeline lateral would include several different activities, such as site clearing, demolition, excavation, and truck-hauling of material. The types and number of equipment (e.g., bulldozers, dump trucks, excavators, graders, compactors), equipment operational hours, amount of material processed, number of haul trips, and other parameters that may affect emissions would vary from one activity to another. A list of the specific activities is shown below:

- Entrained dust from material delivery trucks traveling on unpaved roads and surfaces in construction areas,
- Entrained dust from construction vehicles traveling on unpaved roads and surfaces in construction areas,
- Entrained dust from heavy construction equipment traveling on unpaved roads and surfaces in construction areas,
- Fugitive dust from heavy equipment construction activities (i.e., bulldozing, grading, scraping), and
- Fugitive dust from handling and truck transport of fill and excavated material (i.e., unloading and loading of material to/from haul trucks).

Construction Phase Mobile Source Emissions: Mobile source emissions are disaggregated into on-road (e.g., cars, trucks, and all-terrain vehicles) and non-road emission categories. Emission from these categories results from fuel burning and, as such, would have emissions of NO_x, VOC, CO, SO_2, and $PM_{2.5}$. Non-road emissions result from the use of fuel in a diverse collection of vehicles and equipment, including vehicles and equipment in the following categories:

- logging equipment, such as chain saws;
- agricultural equipment, such as tractors;
- construction equipment, such as dump trucks, trenchers, back hoes, side-booms, and graders; and
- other industrial type equipment, such as fork lifts.

On-road vehicles would be used during all aspects of the construction phase of the project and would result in emissions of NO_x, VOC, CO, SO_2, and $PM_{2.5}$. On-road equipment would include heavy duty diesel vehicles, heavy duty gasoline vehicles, light duty diesel vehicles, and light duty gasoline vehicles.

Emissions from Start-up Activities: During the initial startup of the pipeline, there would be a need to vent the line until product quality is achieved at the Denbury meter station near the interconnect with the Green Pipeline. During this event, approximately 1,260 pounds of CO (over a 5-hour period) would be released to the atmosphere at the meter station. The remainder of the gas that would be vented during startup would be primarily composed of CO_2. Air Products projects that startup emissions would only occur one time (i.e., during pipeline commissioning).

All of the activities and equipment identified above would result in some emissions. However, each of these activities would be for a very short time period (approximately one to two hours) and, therefore, would result in temporary, negligible impacts to air quality.

III.3.1.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that pipeline installation would not occur. Therefore, there would be no impacts to the air quality under the No-Action Alternative.

III.3.2 Water and Geologic Resources

III.3.2.1 AFFECTED ENVIRONMENT

III.3.2.1.1 Surface Water

The proposed pipeline lateral would cross a number of surface waterbodies at various locations along the pipeline alignment. It is anticipated that either open cut (trenching) or HDD methods would be used to cross these waterbodies during pipeline construction. The HDD technique would create lesser impacts to these water features. Table III.3.2-1 lists the surface water features to be crossed by the pipeline lateral. Major surface water features along and in the area surrounding the proposed pipeline lateral alignment are depicted on Figure III.3.2-1. It is anticipated that the HDD methodology of installation would be used to cross open water bodies and wetland areas to the maximum extent practicable.

Table III.3.2-1. Existing Surface Waterbodies along the Proposed Pipeline Lateral Alignment

Waterbody Type	Approximate Location (Mile Post) Along Pipeline Lateral (miles)	Classification / Origin
Alligator Bayou	0.72	Unknown
Drainage Ditch	0.77	Unknown
Pond	0.82	Unknown
Drainage Ditch	1.37	Unknown
Drainage Ditch	1.78	Unknown
Drainage Ditch	1.90	Unknown
Tiger Bayou	2.16	Man-Made
Drainage Ditch	2.44	Man-Made
Drainage Ditch	2.44	Man-Made
Drainage Ditch	2.63	Man-Made
Drainage Ditch	2.64	Man-Made
Drainage Ditch	2.65	Man-Made
Drainage Ditch	2.73	Man-Made
Gulf Canal	3.13	Man-Made
Pond	3.13	Man-Made
Port Arthur Canal	3.22	Man-Made
Drainage Ditch	4.62	Man-Made
Drainage Ditch	4.85	Man-Made
Drainage Ditch	5.35	Man-Made
Drainage Ditch	5.84	Man-Made
Drainage Ditch	6.04	Man-Made
Drainage Ditch	6.34	Man-Made
Drainage Ditch	6.36	Man-Made
Drainage Ditch	6.72	Man-Made
Drainage Ditch	6.83	Man-Made
Drainage Ditch	7.07	Man-Made
Drainage Ditch	7.28	Man-Made
Drainage Ditch	7.33	Man-Made
Drainage Ditch	7.62	Man-Made
Drainage Ditch	7.63	Man-Made
Port Arthur Canal	7.94	Man-Made
Drainage Ditch	7.99	Man-Made
Drainage Ditch	8.02	Man-Made
Pond	8.08	Man-Made
Rhodair Gully	8.28	Natural
Stream	8.90	Man-Made
Drainage Ditch	8.95	Man-Made
Stream	9.54	Man-Made
Stream	9.54	Man-Made
Drainage Ditch	10.07	Man-Made
Drainage Ditch	10.07	Man-Made
Drainage Ditch	10.23	Man-Made
Drainage Ditch	10.23	Man-Made
Drainage Ditch	10.61	Man-Made
Drainage Ditch	10.64	Man-Made
Drainage Ditch	11.95	Unknown
Drainage Ditch	11.95	Unknown
Drainage Ditch	11.97	Unknown
Drainage Ditch	11.97	Unknown
Stream	12.57	Unknown

Note: See Figures 1 through 15 in Attachment A of Appendix C for details.

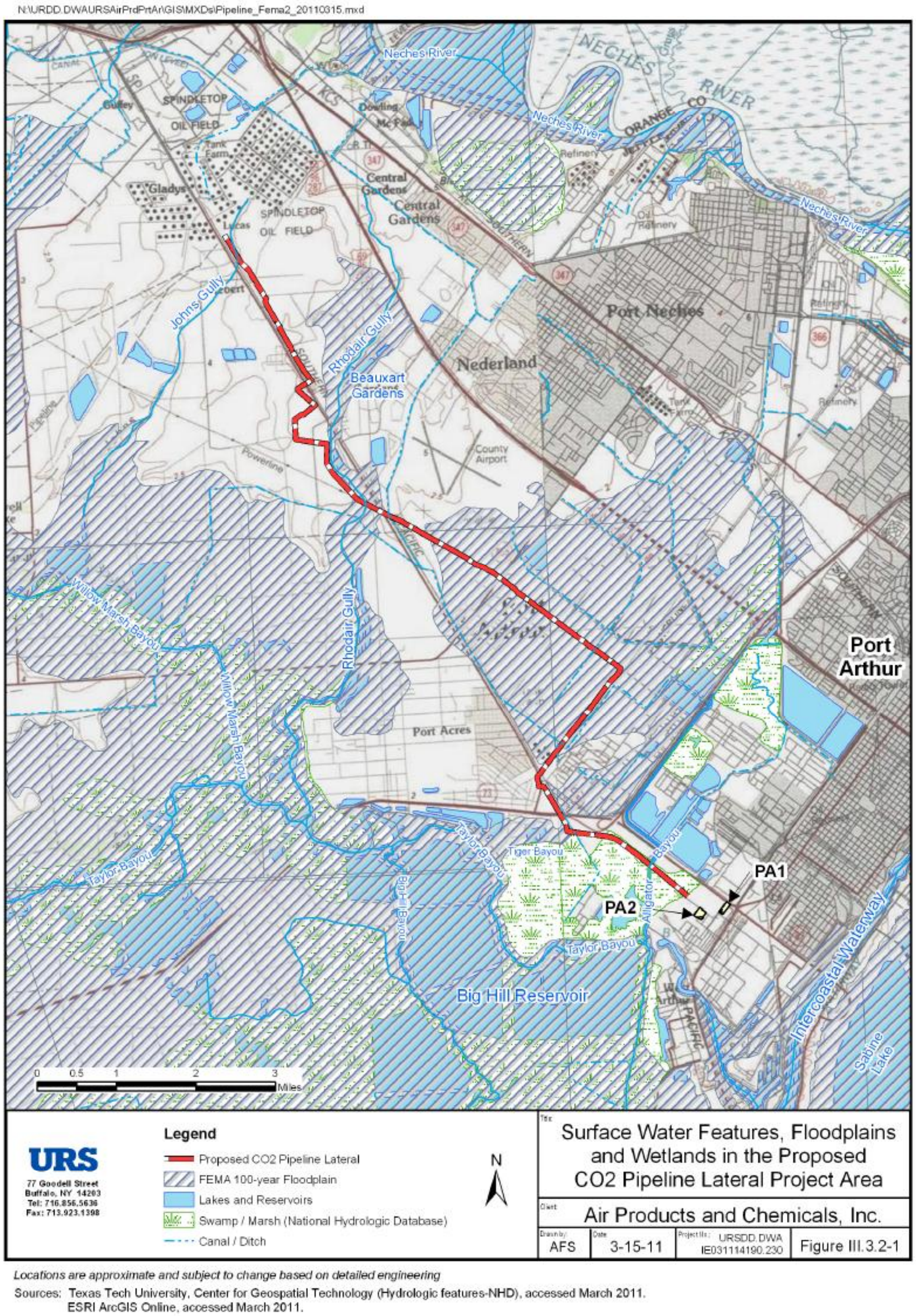


Figure III-3.2.1. Surface Water Features, Floodplains and Wetlands in the Proposed CO_2 Pipeline Lateral Project Area.

Figures 1 through 15 in Attachment A of Appendix C to this EA depict major and minor surface water features (e.g., swales, drainage ditches or channels, streams, and ponds, along with wetlands) along the proposed pipeline alignment.

TCEQ has identified two TCEQ-classified stream segments and one unclassified stream segment that are associated with the proposed project as being impaired. The classified stream segments are Taylor Bayou above Tidal Stream Segment 0701 and Hillebrandt Bayou Stream Segment 0704. The unclassified segment is the Alligator Bayou Stream Segment 0702A (TCEQ 2008). All three segments are considered a low overall priority. These stream segments are described below in Table III.3.2-2.

Table III.3.2-2. Surface Water Quality in the Proposed Pipeline Lateral Area

Waterbody	Location	Parameters of Concern
Taylor Bayou above Tidal Stream Segment 0701	~5 miles south of proposed project	Depressed dissolved oxygen
Alligator Bayou Stream Segment 0702A (unclassified)	~5 miles south of the proposed project	Toxicity in ambient sediment, toxicity in ambient water
Hillebrandt Bayou Stream Segment 0704	~3.5 miles south of the proposed project	Depressed dissolved oxygen

Source: TCEQ 2008

III.3.2.1.2 Groundwater

The major aquifer beneath the proposed project area is the Gulf Coast aquifer. The Gulf Coast aquifer is divided into four units: the Chicot, Evangeline, Jasper, and Catahoula aquifers (TWDB 1995). Recharge to the Gulf Coast aquifer depends primarily on rainfall infiltration, which averages approximately 50 inches annually. The project area is immediately underlain by the Chicot aquifer, which consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont formations, as well as overlying alluvial deposits.

The groundwater quality in the proposed project area is generally good in the shallower portions of the aquifer, with TDS less than 500 mg/l to a maximum depth of 3,200 feet from the San Antonio River Basin up to Louisiana (TWDB 1995). The TWDB was searched to locate public and private groundwater supply wells or springs within a two-mile radius of the proposed project corridor and are shown below on Figure III.3.2-2. The primary uses of the depicted wells are categorized as plugged or destroyed, unused, domestic, industrial or stock. All of these groundwater wells are completed into the Chicot aquifer and range in depth from approximately 20 to 1,200 feet (TWDB 2011).

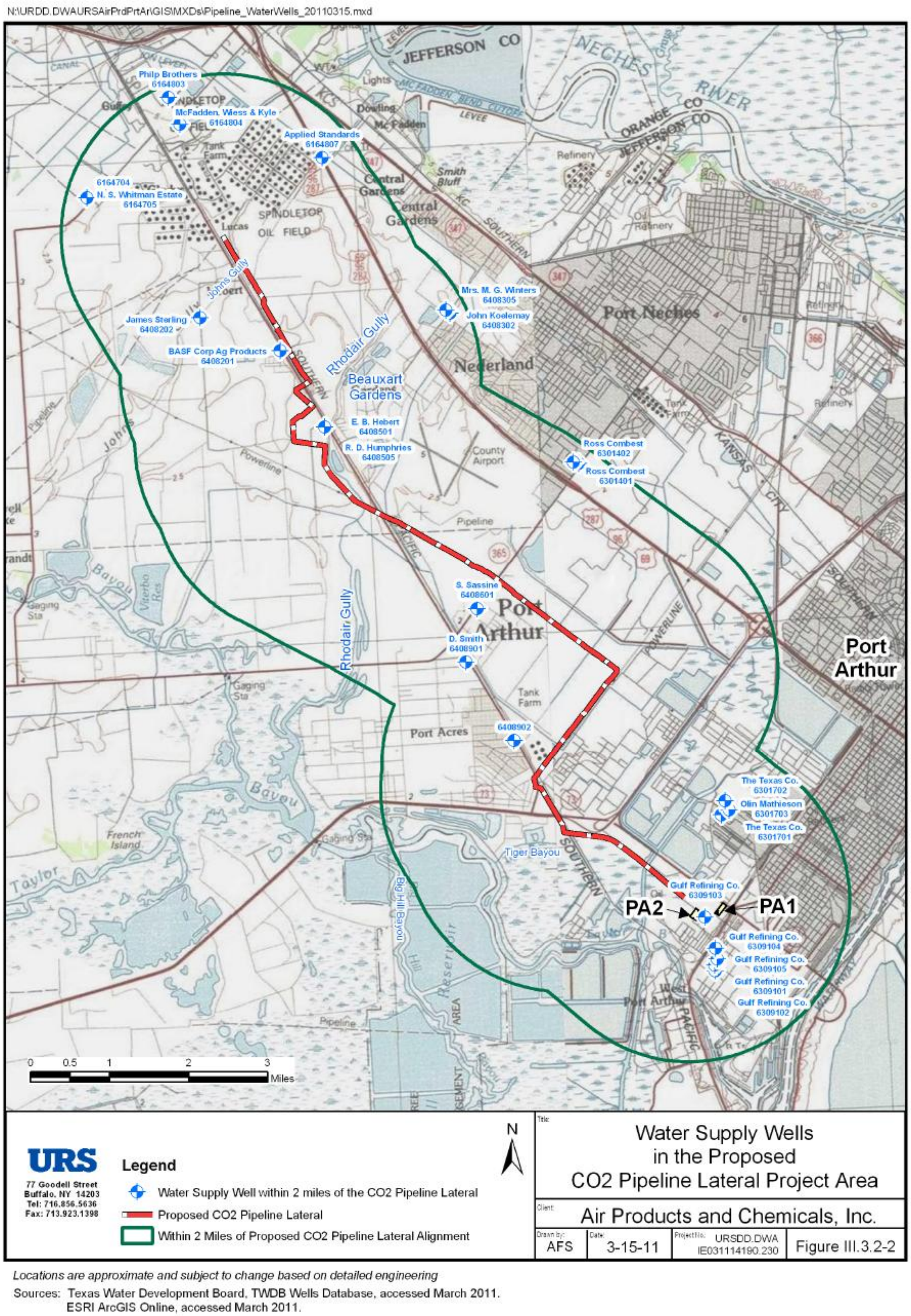


Figure III.3.2-2. Water Supply Wells in the Proposed CO_2 Pipeline Lateral Project Area.

III.3.2.1.3 Geology and Soils

Geology: The CO_2 pipeline lateral project area is located within the Coastal Prairies geologic province. The predominant geologic structure in the Coastal Prairies consists of nearly flat strata. The bedrock consists mostly of Deltaic sands and muds (Bureau of Economic Geology [BEG] 1996). Geologic conditions underlying the proposed pipeline lateral area consist mainly of alluvium, spoils, and fill deposits with the underlying Beaumont Formation. No caves, sinkholes, or other karst features have been found in Jefferson County (Elliot 2010). Ground elevations in the proposed project area range from about 0 to 300 feet AMSL, as measured against the National Geodetic Vertical Datum of 1988 (BEG 1996).

The regional geologic setting and seismic hazard of the area of the proposed CO_2 pipeline lateral is as described below in the following sections. The geologic setting in the area of the proposed CO_2 pipeline lateral is very similar to that described in Section II.3.2.1.3, with the exception being that this area is located somewhat closer to the formation outcrop areas (i.e., it is further up-dip of the PA1 and PA2 locations with respect to the underlying geologic formations). There are no seismically active fault zones that exist in Texas and the risk of seismic events for the proposed project is very low (USGS 2008).

Soils: According to the National Cooperative Soil Survey by the NRCS (USDA Soil Conservation Service 1981, NRCS 2011a), there are 10 major soil types present in the area underlying and adjacent to the proposed CO_2 pipeline lateral alignment. These include the Anahuac-Aris complex, Viterbo silty clay loam, Leton loam, League clay, League-urban land complex, Labelle-Aris complex, Labelle-Levac complex, Beaumont clay, Zummo muck, and Neel-Urban land complex (Figure III.3.2-3). These soil types are characterized as having 0-1 percent slopes, with the exception of the Neel series, which has 2-5 percent slopes, and all are classified as a very poorly to moderate drainage class (NRCS 2006).

- ***Anahuac soils (AsA)*** are moderately well-drained and have very low permeability. These soils are mainly east of the Trinity River. These nearly level to very gently sloping soils form in loamy and clayey sediments on uplands of Pleistocene age. These soils are used primarily for pasture and hayland (NRCS 2006).
- ***The Viterbo series (VtA)*** consists of very deep, somewhat poorly drained, very slowly permeable soils. These soils have aquatic conditions most years. These soils formed in loamy and clayey sediments on nearly level uplands of Pleistocene age. The Viterbo soils are on nearly level uplands. These soils are on the Coast Prairie east of the Trinity River. Viterbo soils are used for pasture or rice production (NRCS 2006).
- ***The Leton series (LwA)*** consists of very deep, poorly drained, slowly permeable soils that form in loamy alluvial deposits. These soils are in relic stream meander depressions on the coastal prairie. They are typically saturated in winter and early spring. Water runs off the surface very slowly. Leton soils are used mainly as pasture lands, but also for production of rice, grain, and sorghum (NRCS 2006).
- ***The League series (LtA, LuA)*** consists of very deep, very slow permeable soils. These soils form in clayey sediments on uplands of the Pleistocene age. These nearly level soils are mostly located on the Coastal Prairies found east of the Trinity River. League soils are used for growing rice and pasture lands (NRCS 2006).

- ***The Labelle series (LcA)*** consists of very deep and poorly drained soils. These soils are of low permeability. Labelle soils form in loamy and clayey sediments on nearly level uplands of Pleistocene Age found east of the Trinity River. These soils are used for cropland and pasture (NRCS 2006).
- ***The Levac series (LdA)*** consists of very deep, very low permeability soils. These soils form in silty and more clayey sediments and have mostly been leveled for rice irrigation on uplands (NRCS 2006).
- ***The Beaumont series (BmA)*** consists of very deep, poorly drained, low permeable soils on low uplands. They form from clayey sediments of the Pleistocene Age in the Coastal Prairie region. The soils are found east of the Trinity River and are used for native pasture or rice production (NRCS 2006).
- ***The Zummo series (ZuA)*** consists of very deep, and very low- permeability soils. These soils formed in clayey sediment in coastal freshwater marshes of the Holocene age. Zummo soils are found on the landward side of low freshwater Gulf Coast marshes. They typically have aquatic conditions all year and are frequently flooded by storm tides. Zummo soils are mainly used for wildlife habitat and range (NRCS 2006).
- ***The Neel series (NuC)*** consists of very deep, moderately drained, clayey soils. They form in clayey deposits dredged from bays and marshes. These gently sloping soils are found on levees and spoil banks in the Gulf Coast Saline Prairies and Gulf Coast Marsh regions. Neel soils are used mainly for grazing and wildlife land (NRCS 2011b; NRCS 2006).

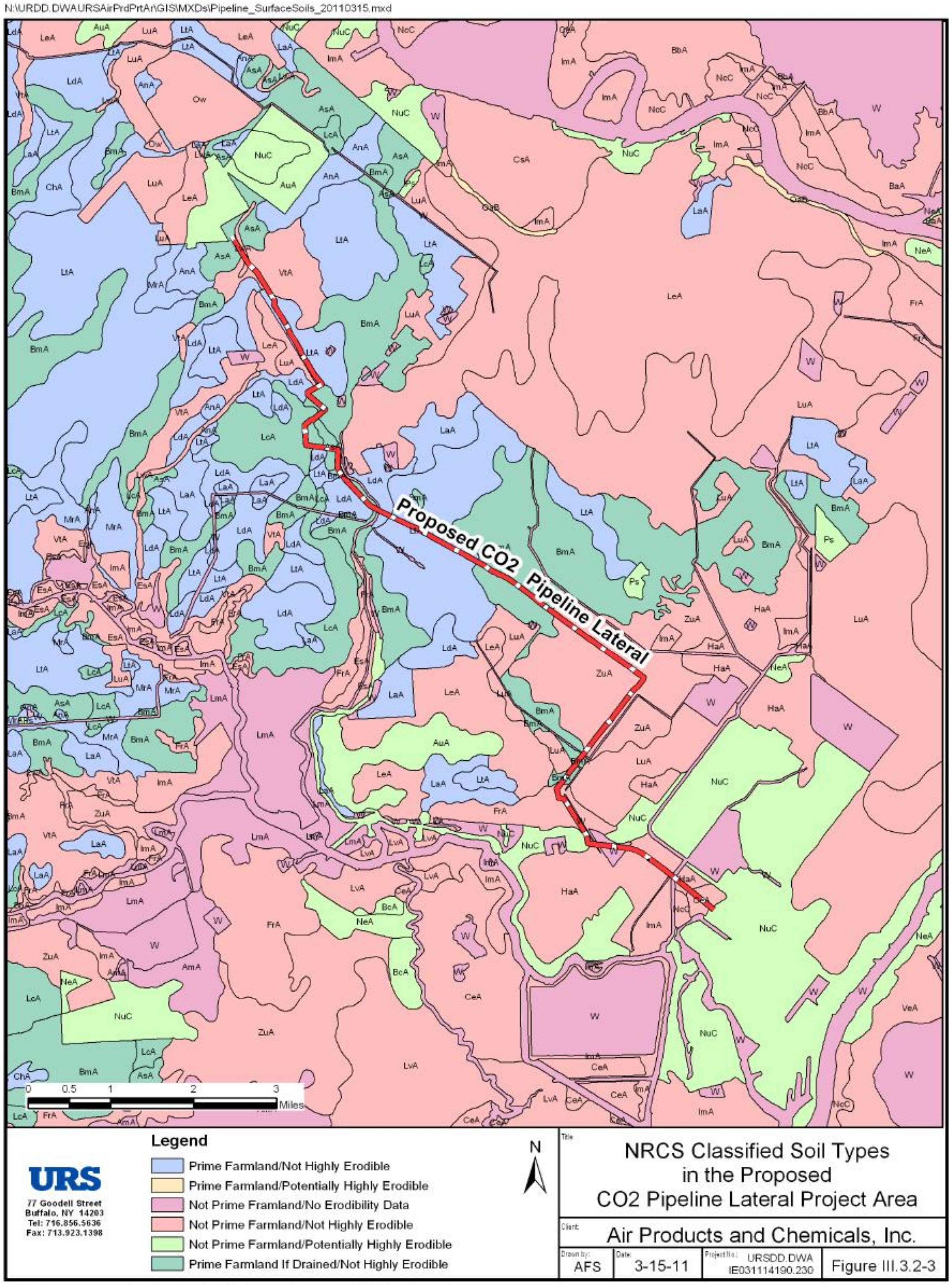
A complete list of the soils types crossed by the proposed pipeline route and crossing distances can be found in Table III.3.2-3. All of the soil types crossed by the proposed route are classified as partially hydric by the NRCS, and consist of sand, silt, clay or mud. None of these soil types are expected to have shallow bedrock.

Two of the soil types, which are crossed for approximately 26% of the total pipeline length, are classified as prime farmland; and three of the soil types, which are crossed for approximately 28% of the total pipeline length, are classified as prime farmland if drained (NRCS 2011a). Assuming a 60-foot-wide surface disturbance width along the pipeline alignment, a total of approximately 22.5 acres of prime farmland soils could be temporarily disturbed during pipeline construction. A large portion of the area categorized by the NRCS was historically prairie. It is currently used as cropland, pasture, or rangeland. The main crops grown in these portions of land are rice and soybeans (NRCS 2006).

Table III.3.2-3. Soil Types along the Proposed Pipeline Route

Description	Sum of Crossing Length (Feet)	Prime Farmland
Anahuac-Aris complex, 0 to 1 percent slopes	3,591	If drained
Beaumont clay, 0 to 1 percent slopes	11,990	If drained
Caplen mucky peat, 0 to 1 percent slopes, frequently flooded, tidal	1,769	No
Franeau clay, 0 to 1 percent slopes, occasionally flooded, tidal	4,584	No
Harris clay, 0 to 1 percent slopes, frequently flooded, tidal	4,788	No
Labelle-Aris complex, 0 to 1 percent slopes	3,448	If drained
Labelle-Levac complex, 0 to 1 percent slopes	4,237	Yes
League clay, 0 to 1 percent slopes	13,439	Yes
Leton loam, ponded, 0 to 1 percent slopes	533	No
Neel-Urban land complex, 2 to 5 percent slopes, rarely flooded, tidal	1,012	No
Viterbo silty clay loam, 0 to 1 percent slopes	2,124	No
Water	2,715	No
Zummo muck, 0 to 1 percent slopes, frequently flooded, tidal	13,580	No

N:\URDD.DWA\URSAirPrdPrtAr\GIS\MXDs\Pipeline_SurfaceSoils_20110315.mxd



Locations are approximate and subject to change based on detailed engineering

Sources: NRCS, Soils Data Mart (http://soildatamart.nrcs.usda.gov), accessed March 2011.
ESRI ArcGIS Online, accessed March 2011.

Figure III.3.2-3. Surface Soils in the CO_2 Pipeline Lateral Project Area.

III.3.2.1.4 Floodplains and Wetlands

A wetland delineation was conducted on the project site between February 14, 2011 and February 26, 2011. These surveys included the identification and delineation of wetlands and other water features in accordance with the protocol outlined in the 1987 USACE *Wetlands Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region*. The study area included a 200-foot-wide corridor centered on the pipeline centerline, a 100-foot-wide corridor centered on the centerline of proposed road improvements, and several ATWS areas. The study area encompassed a total of approximately 364.1 acres. The area that would be impacted by construction activities would be smaller than the study area corridor. The construction corridor would be 60 feet wide and no construction corridor would be required for approximately 4.1 miles of pipeline that would be installed using HDD. The total area of impacts including the construction corridor and ATWS would be approximately 108 acres (including 21 acres that would be avoided by use of HDDs), including wetlands and uplands. As described in Table III.3.2-5, a total of approximately 57 acres of wetlands are located within the proposed pipeline lateral construction corridor and ATWS. Additional details regarding wetland and other Waters of the U.S. in the vicinity of the pipeline lateral are provided in Appendix C.

Floodplains: Executive Order 11988, Flood Plain Management, requires that development in floodplains be avoided if practicable. The project area is shown in FEMA FIRM Panels: 4803850430B effective June 1, 1983; 4803850315B effective June 1, 1983; 4803850295B effective June 1, 1983; and 4803850285C effective November 20, 1991. Approximately 119 acres of the 200-foot pipeline study corridor, less than one acre of ATWS outside the 200-foot corridor, and 17.5 acres of the 100-foot improved access roads study corridor are within the 100-year floodplain. Approximately 4.9 miles of the proposed pipeline centerline is within the 100-year floodplain.

Wetlands: DOE regulations at 10 CFR Part 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements," implement the requirements of Executive Order 11990, Protection of Wetlands. These regulations require, among other things, that the DOE notify appropriate government agencies (e.g., the USACE for wetlands and FEMA for100-year floodplain) and interested parties of a proposed wetland action; conduct a wetlands assessment to evaluate the impacts of that action to wetlands in an EA or EIS; consider alternatives that would avoid or minimize impacts to wetlands; design or modify the action to minimize potential impacts to wetlands; and allow for public review and comment of the analysis.

The acreage of wetlands identified during the wetland delineation conducted from February 14 to February 26, 2011 is shown in Table III.3.2-4. During field surveys, wetlands were classified using the Cowardin classification system (Cowardin, et al. 1979). According to this classification system, two types of wetlands were identified: Palustrine emergent (PEM), and Palustrine scrub-shrub (PSS). PEM wetlands are defined as those wetlands 100 percent dominated by erect, rooted, herbaceous plants. These wetlands are commonly dominated by sedges, rushes, grasses, and various forbs. PSS wetlands are defined as those wetlands dominated by woody vegetation less than 20 feet tall. These wetlands commonly contain grasses, forbs, young pines, and shrubs; and contain less than five percent herbaceous vegetation.

Table III.3.2-4. Acreage of Wetlands within Study Area

Wetland type	Acres in 200-foot wide pipeline corridor	Acres in ATWS	Acres in 100-foot wide road corridor
Palustrine Emergent (PEM)	142	3	4
Palustrine Scrub/Shrub (PSS)	9	0	<1

Note: Actual acreage that would be affected by the construction and pipeline would be less than the 200-foot and 100-foot width ROWs, respectively, as indicated in Attachment B of Appendix C. Drilling techniques and actual impacts during construction may be less than what is indicated in the above table.

III.3.2.2 ENVIRONMENTAL CONSEQUENCES

III.3.2.2.1 Proposed Project

The proposed pipeline lateral would cross under a number of existing surface waterbodies at multiple locations along the pipeline lateral alignment, as discussed in Section III.3.2.1. Construction of the pipeline lateral would not require installation of any wells or withdrawal of groundwater from any existing water-supply wells. Impacts to surface water, groundwater, and geology and soils, and mitigations, if warranted, are described in the subsections below.

III.3.2.2.1.1 Surface Water

A series of different pipeline construction methods may be used to span existing surface water features that would be crossed by the pipeline lateral. It is anticipated that a combination of open cut (i.e., trenching followed by pipeline placement and subsequent backfilling of the trench) and HDD construction techniques would be used during construction of the pipeline lateral. Appropriate local, state, and federal agencies would be consulted prior to initiating construction to ensure that applicable permits and clearances have been secured prior to commencing construction.

Impacts that may affect surface waterbodies include the following:

- For open cut areas, cut and fill operations could temporarily alter natural drainage patterns and runoff rates on a localized scale. Temporary increases in sedimentation and/or temporary displacement of surface waterbodies might also occur.
- Accidental discharge of liquids, such as fuels and/or chemicals from construction equipment used during pipeline construction, as well as solid construction wastes.

Table III.3.2-5 lists the waterbodies that would be crossed by the proposed pipeline lateral and summarizes the anticipated magnitude of temporary impacts to each surface water feature from construction of the pipeline lateral. See Appendix C for details of the impacts avoided, temporary impacts and permanent impacts.

Table III.3.2-5. Potential Impacts to Existing Surface Waterbodies Along the Proposed Pipeline Lateral Alignment

Water Crossing Length (feet)	Impacts Avoided (acres)	Temporary Impacts (acres)	Permanent Impacts (acres)
2483	11.49	45.39	0.29

Because the pipeline lateral would be built below grade, and would cross under all existing surface waterbodies, no long-term impacts to surface waterbodies are anticipated to occur following completion of the pipeline lateral installation and backfilling of the pipeline lateral's open-cut sections to pre-existing grades and contours.

Air Products would implement appropriate BMPs during construction to minimize the extent and duration of pipeline project-related disturbance to surface waterbodies, including streams, canals, floodplain areas and wetlands. BMPs used would include the following, as dictated by conditions in the field:

- Use of silt fences, temporary grading to induce positive drainage, and other storm water and sedimentation control techniques to minimize or prevent soils exposed during construction from being transported as sediment or sediment-laden water into any waterbody.
- Restricting fueling of equipment to areas that are 100 feet or more away from major surface waterbodies and delineated wetlands areas to reduce impacts.
- Parking vehicles and conducting maintenance activities away from waterbodies.
- Use of HDD technology for larger surface waterbody crossings (i.e., longer than nominally 50 feet in most cases – see Appendix C for details) to help avoid impacts to surface waters.
- Prohibiting storage of any hazardous waste materials, chemicals, fuels, or lubricating oils within close proximity of any waterbody or delineated wetland area without appropriate secondary containment.
- Minimizing the width of open cuts to approximately ten feet or less.
- Limit the size of any additional required work areas to the minimum needed in order to allow effective construction of the pipeline at the waterbody crossings.
- Limiting clearing of vegetation from stream banks at waterbody crossings to the extent practicable to minimize the potential for increasing the total maximum daily load (TMDL) of sediments to the waterbody.
- If dewatering is required in open cut trenches, conduct dewatering in a manner that does not cause erosion and does not result in heavily silt-laden water flowing into any waterbody. Dewatering structures and equipment would also be removed as soon as possible after the completion of dewatering activities.

Mitigation Measures: Depending on location-specific restrictions, available space, or regulatory constraints that may exist, one or more mitigation measures may be implemented to minimize impacts to surface water from pipeline construction activities. Mitigation measures that may be implemented include the following:

- Placing spoils derived from construction work at locations of smaller waterbody crossings within the pipeline construction ROW at least ten feet from the water's edge, or in additional specified work areas separated from the surface waterbody;
- If there is no reasonable alternative to maintaining the minimum required buffer distance from waterbodies during refueling, the construction contractor would employ secondary containment methods and would establish other appropriate spill prevention and cleanup measures to minimize potential for any accidental spill-related impacts; and
- When in proximity to any major waterbodies or delineated wetlands for which additional temporary workspace would be necessary for staging, the contractor would adhere to the following guidelines:
    - Locate additional staging areas, additional spoils storage areas, or other additional work areas at least 50 feet away from the edge of the water, unless the adjacent upland area is cultivated cropland or other disturbed land;
    - Minimize the clearing of vegetation between any additional required staging/storage areas and the waterbody or within the ROW of the pipeline; and
    - Establish and clearly mark buffer areas separating waterbodies from designated refueling and staging areas.

III.3.2.2.1.2 Groundwater

No negative impacts to groundwater as a result of the proposed construction and operation of the pipeline lateral are anticipated to occur. As excavation depths required for the pipeline construction typically would not exceed approximately six feet, construction activities associated with the pipeline construction would be limited to surface and very shallow ground layers. Furthermore, hazardous materials, if any, used during construction would be limited and be restricted to certain areas, and appropriate secondary containment measures would be provided in any areas in proximity to floodplains, wetlands, and other surface waterbodies within/along the pipeline corridor. The absence of water supply wells within 150 feet of the pipeline corridor, the use of a SPCC Plan, and the implementation of BMPs for spill prevention and hazardous waste management are expected to minimize or eliminate the potential for impacts of the pipeline construction and operation on groundwater resources. There are currently no plans to withdraw groundwater or to discharge directly to groundwater during construction of the proposed pipeline lateral.

Mitigation Measures: As shown on Figure III.3.2-2, there are no existing water supply wells within 150 feet of the centerline of the proposed pipeline lateral corridor. Available data from the Texas groundwater well database (TWDB 2011) indicates that one water-supply well (BASF Corp AG Products Well 201) may be located approximately 500 feet from the proposed CO_2 pipeline lateral centerline. It is not anticipated, based on the current proposed pipeline alignment, that this well, or any other known existing water-supply well, would be disturbed as a result of construction of the CO_2 pipeline lateral. In the unlikely event that this or any existing supply well were to be directly impacted by the construction activities, resulting in the temporary impairment of the quantity or quality of water available in that well, alternative sources of water would be identified or the owner of the affected well otherwise compensated (e.g., to drill a new well or obtain other water service). If permanent damage to a well were to occur, the well owner would either be compensated for damages or arrangements made for a new water-supply well to be installed for the owner's use.

III.3.2.2.1.3 Geology and Soils

As described in Section III.3.2.1.3, the proposed pipeline lateral alignment does not cross any mapped, areally extensive bedrock areas. Air Products does not anticipate that any blasting would be required for the pipeline installation.

There are no known karst features underlying or within the proximity of the proposed pipeline lateral alignment. There is therefore considered to be no potential for either short-term or long-term geologic impacts to occur during or following construction of the pipeline lateral from subsidence that could be related to the occurrence of any karst features.

The low seismicity and lack of mapped fault traces underlying and surrounding the proposed pipeline lateral area indicate that there is minimal potential for geologically-related impacts to occur during or following construction of the pipeline lateral related to the occurrence of any faults and associated movement that might occur along those faults in response to any seismic activity.

Although the pipeline lateral would transect some areas that are underlain by prime farmlands, croplands, pasture, or rangeland, no significant long-term impacts to these areas are anticipated following completion of the pipeline lateral construction because the pipeline lateral would be built below grade. Short-term impacts to these land areas during pipeline construction are expected to be temporary in duration and localized to the immediate area adjacent to the pipeline alignment (i.e., approximately 30 feet to less than 150 feet on other side of the proposed centerline of the pipeline). Minor to negligible long-term impacts include the conversion of land use for the installation of a meter station and several aboveground valves, as described above in Section III.2.

Construction of the proposed project would involve disturbance of existing soils for part of the pipeline route. Areas of pipeline installation that would be accomplished using HDD would not impact surface soils except for bore pits needed on either end of the HDD crossings to facilitate drilling. As shown in Attachment A, Figures 1 through 15 in Appendix C, approximately 4.1 miles (or 32%) of the 12.8-mile pipeline lateral route will be installed by HDD. For the portions of the route in which the pipeline would be constructed using open cut methods, construction personnel would remove soil to create a trench, stockpile the soil along the trench, and place the soil back into the trench once the pipe is laid. In wetlands and agricultural areas, impacts to soil would be minimized by segregating the topsoil from the underlying soil and placing the topsoil back as the top layer when trench is filled back in. In non-agricultural upland areas, soil segregation would not occur. Impacts to soils would not be significant. Additionally, for a majority of the route, the pipeline parallels existing utility lines, so the soils may have been previously disturbed.

Mitigation Measures: If bedrock requiring blasting is encountered during pipeline construction, the mitigation measures described in Section III.3.2.2.1.2 would be implemented to address any potential impacts to groundwater resources.

III.3.2.2.1.4 Floodplains and Wetlands

Floodplains: Executive Order 11988, *Flood Plain Management*, requires that development in floodplains be avoided if practicable. Due to the project location, the proposed pipeline cannot be built completely outside of the 100-year floodplain. The pipeline would be installed below ground, and only minimal above ground facilities would be constructed, consisting of a meter station, block valves, an excess flow valve, and a launcher site. The meter station (including a launcher site within the perimeter of the meter station) will occupy an area of approximately 43.5 feet by 99 feet (i.e., less than 0.1 acres). The block valve stations will each occupy an area no larger than 15 feet by 25 feet and the excess flow valve will occupy an area no larger than 25 feet by 50 feet (i.e., less than 0.01 acres each). The launcher site will be located with the Valero fenceline (i.e., at approximately milepost 0.0). The pipeline would be installed using open cut methods in some areas and HDD methods in other areas. Portions installed using HDD would not have any floodplain impacts. In areas where open cut methods would be used, a trench would be dug, the pipe installed, and the trench would then be backfilled to recreate preconstruction contours. This would result in no net change in volume within the floodplain (i.e., no loss of flood storage capacity), so no floodplain impacts are anticipated.

ATWS would be used during construction of the pipeline, but no structures would be built or fill placed in these areas. No floodplain impacts are anticipated due to ATWS.

Three of the access roads proposed to be improved are located within the floodplain. At each of these access roads the existing ditches and drainage features would be maintained or replaced, so no changes in water flow patterns are anticipated. These access road improvements would include the placement of rock or gravel fill within the floodplain. The roads would not be widened, so impacts would be limited to the footprint of the existing road. The improvements to these roads are not expected to encourage further development within the floodplain. Consultation has commenced with the local floodplain administrator (Appendix B).

Wetlands: Unavoidable impacts to wetlands that would result from the project would be addressed by obtaining a Nationwide Permit (NWP) 12, which permits certain utility line activities, from the USACE. The USACE regulates impacts to wetlands and other waterbodies under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. The USACE Galveston District has received concurrence from TCEQ and the Texas Railroad Commission (RRC) that actions taken under NWP 12 comply with Texas coastal zone management requirements. Therefore, no documentation other than NWP 12 is required to demonstrate consistency with the Texas Coastal Management Plan.

Air Products anticipates that construction of the pipeline lateral can be completed with impacts to scrub/shrub wetlands located along the ROW minimized to less than 0.1 acres per crossing area, as described in Appendix C. Construction impacts to scrub/shrub wetlands would be avoided by employing HDD construction techniques. However, less than 0.1 acres of scrub/shrub wetlands may be cleared (i.e., converted from PSS to PEM) along certain sections of the permanent ROW to facilitate ROW inspection and maintenance, as described below in Section V.3.2. With the exception of minor, permanent impacts to wetlands in the area where the meter station and six aboveground valves will be constructed, impacts to emergent wetlands from the pipeline construction and ATWS would be temporary and would be minimized and/or mitigated through use of low ground weight equipment or construction mats where soils are saturated and rutting of surface soil would delay reestablishment of vegetation, segregation of organic topsoil, and restoration of the site to preconstruction conditions following construction. Access road improvements would include the placement of rock or gravel fill. The roads would not be widened, so impacts would be limited to the footprint of the existing road and no wetland impacts are anticipated. HDD construction techniques would be used to avoid wetland impacts where practicable. Offsite mitigation would be provided for any permanent wetland impacts exceeding 0.1 acres. If offsite mitigation is necessary, Air Products would obtain USACE approval for the project Mitigation Plan in advance of construction. Based on the current design of the CO_2 pipeline lateral (i.e., as described in Appendix C), Air Products anticipates that no offsite mitigation would be required. USACE's final Section 404 action will indicate if there would be any required wetland mitigation.

III.3.2.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that pipeline installation would not occur. Therefore, there would be no impacts to water resources or soil in the area under the No-Action Alternative.

III.3.3 Land Use

III.3.3.1 AFFECTED ENVIRONMENT

Land surrounding the project corridor consists of pastures, croplands, wetland areas, and residential and commercial land uses. Table III.3.3-1 lists the land use types within the ROW of the 12.8-mile proposed route of the CO_2 pipeline lateral.

Table III.3.3-1. Pipeline Route Land Use

Land Use Type	Percent
Cultivated	2.9%
Developed Open Space	4.6%
Estuarine Emergent Wetland	0.0%
Grassland	2.1%
High Intensity Developed	0.8%
Low Intensity Developed	9.0%
Medium Intensity Developed	2.7%
Palustrine Emergent Wetland	23.4%
Palustrine Forested Wetland	6.4%
Palustrine Scrub/Shrub Wetland	1.9%
Pasture/Hay	38.1%
Scrub/Shrub	6.6%
Water	1.1%

Source: National Oceanic and Atmospheric Administration (NOAA) 2011

Land uses within two miles of the proposed corridor are similar to those in the ROW and are generally agricultural in the northern half and commercial, industrial, and residential in the southern half of the project area. Numerous small creeks and manmade canals, small ponds, and reservoirs are in the vicinity of the proposed corridor. Five residential areas are in the vicinity of the proposed corridor, as follows:

- at the southern end of the project area in Port Arthur;
- east of Terminal Road and east of TX-93 near the intersection with Highway 82;
- immediately south of Farm to Market Road 365, east of TX-93;
- on the west side of the proposed pipeline area; and
- where the proposed corridor crosses TX-93 at the north end of the segment (near Knauth Road).

The proposed route is not located directly in any of these residential areas. Several schools and churches are along the proposed pipeline route, however. The Medical Center of Southeast Texas is roughly one mile east of the proposed pipeline corridor. The Babe Didrikson Zaharias Memorial Golf Course and three other recreational areas are within two miles of the proposed pipeline. The Central Mall is within two miles of the route. The Southeast Texas Regional Airport is approximately one mile east of the proposed corridor and serves commercial and executive flights to major airline hubs within Texas and Louisiana. The Federal Corrections Complex is about 1.3 miles east of the proposed pipeline.

III.3.3.2 ENVIRONMENTAL CONSEQUENCES

III.3.3.2.1 Proposed Project

As noted earlier, the northern end of the proposed pipeline corridor parallels and abuts existing pipeline ROWs. Land surrounding the proposed pipeline corridor includes pastures, croplands, wetland areas, residential, industrial, and commercial land use. Implementation of the proposed project could potentially result in direct impacts to open grasslands and pasture, open water habitat, forested wetlands, scrub-shrub wetlands, emergent wetlands, and crop lands. Construction of the project could temporarily disturb the ROW width of 60 feet by approximately 0.4 miles of cultivated crops, 4.0 miles of various wetland types, 4.8 miles of grassland/pasture, and 3.6 miles of other land use types. Some of these land use types are generalized from the publicly available remote sensing data (NOAA 2011). The detailed field investigations for wetlands indicated no forested wetlands are present in the ROW. The proposed project activities that may also directly impact land use include disruption of land access and alteration of soil make-up.

At least 95% of the pipeline corridor follows existing utility corridors. A 60-foot construction ROW for the project would be established or expanded and has the potential to convert use of some land to a permanent, approximately ten-foot-wide, maintained ROW. During construction of the proposed project, use and access to the land would be temporarily disrupted, particularly with respect to agricultural practices.

The proposed project is expected to have minor, temporary, direct impacts on land use resources due to construction activities and no temporary indirect impacts. The proposed pipeline is expected to have minor long-term (i.e., permanent) direct or indirect impacts. Construction of the project would result in the permanent conversion of some agricultural, wetland, or developed land to permanent ROW, which may be maintained by periodically clearing vegetation from an area up to approximately ten feet in width along the length of the pipeline to facilitate inspection and maintenance. Recognizing that the majority of the pipeline corridor is within existing ROWs, land use in these areas would remain similar to the current land use.

III.3.3.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that pipeline installation would not occur. Therefore, there would be no impacts to land use in the project area under the No-Action Alternative.

III.3.4 Biological Resources

III.3.4.1 AFFECTED ENVIRONMENT

The affected environmental for biological resources in Jefferson County, Texas, including a summary of federally listed threatened and endangered species potentially occurring in Jefferson County, is described in Section II.3.4.1 of this EA.

URS field biologists conducted field surveys and general habitat assessments between February 14, 2011 and February 26, 2011. Field surveys were conducted within the extent of the project area, which included a 200-foot-wide corridor centered on the pipeline centerline, a 100-foot-wide corridor centered on the centerline of proposed road improvements, and several ATWS areas. Surveys were conducted on foot between the hours of 8:00 am and 5:00 pm. Potentially suitable habitats for threatened or endangered species were determined by the presence of diagnostic habitat elements. Observations regarding the presence or absence of wildlife species were made by direct observation and indirect indicators, such as calls, tracks, scat, or other signs.

URS field biologists found no direct or indirect indications of threatened or endangered species along Air Products' proposed pipeline ROW. Additionally, no habitat suitable for the threatened and endangered species listed in Table II.3.4-1 was observed during the field surveys conducted by URS personnel.

The study area does not provide favorable habitat for colonial waterbirds, and no rookery sites were observed within the study area during the survey conducted between February 14, 2011 and February 26, 2011. The Texas Natural Diversity Database (TXNDD) was reviewed to assess the potential for rookeries in the study area. Several observations of rookeries were recorded in the TXNDD near the southern portion of the proposed pipeline lateral. The nearest rookery to the study area indicated by the TXNDD is located approximately 1,000 feet north of the southern terminus (i.e., outside of the study area), and represents an observation from 1989. Three other previously observed rookeries recorded in the TXNDD are located approximately one mile south of the southern portion of the study area.

III.3.4.2 ENVIRONMENTAL CONSEQUENCES

III.3.4.2.1 Proposed Project

The proposed pipeline route parallels existing utility line easements for the majority of its length, and is therefore located in previously disturbed habitat. The habitats that would be impacted are generally low-quality, consisting of invasive plant species and other vegetation typical of recently disturbed or agricultural areas. Impacts to the large, intact wetland area along the southern portion of the route would be minimized, and potentially avoided, using HDD constructions methods, as would all major water crossings.

Construction impacts would be of a relatively short duration and the construction ROW would be restored to preconstruction conditions to the extent feasible following pipeline installation. Larger and more mobile fauna would be capable of avoiding direct mortality from construction activities. Since the area has been previously disturbed, no habitat fragmentation would occur. The plant and animal species found on the site are common and widespread and no rare species are expected to occur.

Federally-listed threatened and endangered species occurring in Jefferson County include the following: piping plover, Atlantic hawksbill sea turtle, green sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. The bald eagle has been delisted due to recovery. None of these threatened or endangered species, or habitats suitable for these species, were observed in the project area. Bald eagles use tall trees near large open bodies of water and piping plovers rely on coastal habitats. The five sea turtle species are found in oceans and shorelines. None of these required habitat types are found in the project area. No State-listed species were observed within the study area, and the habitat types observed were unlikely to support populations of State-listed species. Therefore, no project-related impacts to threatened or endangered species are anticipated.

III.3.4.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that pipeline installation would not occur. Therefore, there would be no impacts to existing biological resources under the No-Action Alternative.

III.3.5 Historic and Cultural Resources

III.3.5.1 AFFECTED ENVIRONMENT

Cultural resources are defined as historic properties, cultural items, archaeological resources, sacred sites, and artifact collections and associated records as defined by the NHPA; Native American Graves and Repatriation Act; Archaeological Resources Protection Act; Executive Order 13007, to which access is afforded under the American Indian Religious Freedom Act; and 36 CFR Part 79, respectively. The APE for cultural resources includes property within and immediately adjacent to the proposed project components, either temporarily during construction or permanently throughout operations. This aspect of the Air Products project would construct a new, approximately 12.8-mile-long, 8-inch-diameter CO_2 pipeline lateral. The pipeline lateral would initiate at the Valero Refinery near Port Arthur and would interconnect with an existing CO_2 pipeline, the Green Pipeline, near Beaumont.

DOE determined that a Phase I cultural resource survey and inventory was appropriate for the proposed CO_2 pipeline lateral component of the Air Products project. DOE sent a letter to the SHPO on January 31, 2011, notifying them of the Air Products project and supplying the required Texas Antiquities Permit application to allow for a survey of the section of pipeline ROW located on state-owned Texas Department of Criminal Justice lands. DOE will submit the results of the completed field study (URS 2011b) to the SHPO concurrently with the publication of this EA. Based on the report's conclusions, DOE determined that no historic properties are present or would be affected by Air Products' project. Copies of related correspondence between DOE and THC are provided in Appendix B of this EA.

III.3.5.2 ENVIRONMENTAL CONSEQUENCES

DOE does not expect the CO_2 pipeline lateral component of Air Products' proposed project to directly or indirectly impact any cultural resources. No cultural resources older than 50 years were identified through the project's Phase I cultural resource field study, and neither the Texas Archeological Site Atlas nor the National Register of Historic Places note any historic properties, as defined by the NHPA, within one mile of this project component.

III.3.5.2.1 Proposed Project

In the event that cultural resources (e.g., human remains, stone tools, prehistoric or historic pottery, remnants of older pipeline construction) are discovered during construction of the CO_2 pipeline lateral, work would cease in the area of the discovery and the Texas SHPO would be notified. A qualified archaeologist would evaluate any such discovery and, in consultation with the SHPO, implement appropriate mitigation measures before construction activities would resume.

III.3.5.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that pipeline installation would not occur. Therefore, there would be no impacts to existing cultural resources under the No-Action Alternative.

PART IV. MONITORING, VERIFICATION, AND ACCOUNTING

IV.1 INTRODUCTION

This chapter describes the details pertaining to the proposed CO_2 sequestration project and the associated MVA program. The program would be implemented at the West Hastings Field to monitor the potential impacts of injection and sequestration of the injected CO_2 at the West Hastings Field CO_2 sequestration location in conjunction with ongoing commercial EOR operations and to evaluate the environmental impacts from the proposed MVA program activities. This chapter is organized as follows: introductory discussion of the proposed CO_2 sequestration and the MVA program activities (Section IV.1), proposed MVA program details (Section IV.2), and the affected environment and environmental consequences for the proposed MVA program (Section IV.3).

IV.2 MVA PROGRAM DETAILS

CO_2 geologic sequestration projects and associated MVA programs conducted at other locations in the U.S. and overseas, together with laboratory testing and model simulations of CO_2 geologic sequestration, have produced considerable data to gain understanding of the physical and chemical processes associated with geologic sequestration of CO_2. Notwithstanding that these processes are relatively well known and understood, a research-focused MVA program would be implemented to verify the containment of the injected CO_2. Additional research would be conducted to help fill remaining gaps in scientific understanding of carbon sequestration to ensure that human health and the environment are protected in the vicinity of the proposed project at a portion of the West Hastings Field. Denbury and its subcontractor(s), would implement a comprehensive MVA program at a portion of the West Hastings Field on behalf of Air Products in conjunction with the injection and sequestration of the CO_2 transported to that location through the Green Pipeline. The proposed host formation and location for injection/sequestration of the CO_2 conveyed from the Air Products Port Arthur facility is the Frio Formation in Blocks B and C at the West Hastings Field. The proposed MVA program is linked to a management process that would provide documentation that the CO_2 injected is stored.

As described in Section II.2, it is currently anticipated that approximately one million tons of CO_2 per year would be supplied by Air Products from Port Arthur in the form of the captured/purified CO_2. Potential fates of this injected CO_2 include the following:

- Sorbed onto rock surfaces within the targeted EOR subsurface geologic formation;
- Retained by capillary forces in pore space within the targeted EOR subsurface geologic formation;
- Trapped by buoyancy forces in stratigraphic or structural compartments within the targeted EOR subsurface geologic formation;
- Recycled, following separation from produced oil, and re-injected for EOR; and/or

- Dissolved in pore water, which includes naturally occurring formation water and water that has been introduced through the historical production and injection activity in the formation.

The West Hastings Field, operated by Denbury, was selected for a demonstration MVA program partly on the basis that this field is currently in the early development stages for commercial EOR operations. With an EOR development schedule that is closely aligned with Air Products' schedule for the Phase 2 demonstration project, the West Hastings Field affords the opportunity to conduct a baseline monitoring program at an early stage in the EOR process. The MVA program consequently includes a monitoring program to characterize subsurface conditions prior to CO_2 injection/sequestration.

Denbury has begun implementing commercial EOR activities in Block A of the West Hastings Field, as shown in Figure IV.2-1. EOR activities in the field are proposed to be implemented in a series of phases (i.e., Phases 1 through 4), with ongoing activities in Block A comprising part of Phases 1 and 2. It is projected that Denbury would commence future CO_2 injection and MVA activities in subsequent blocks (i.e., Blocks B though E) in Phases 3 and 4, as shown in Figure IV.2-1. Phases 1 and 2 are planned to be completed in 2012, with Phase 3 activities in Blocks B and C (under the proposed project) anticipated to occur between late 2012 or early 2013 and 2014, and Phase 4 in the southern block projected to occur after Phase 3 (Hovorka 2010).

It is currently projected that CO_2 from Air Products' Port Arthur CO_2 capture facility would be available for initiation of MVA activities in Blocks B & C at the West Hastings Field beginning in late 2012 or early 2013. A commercial preliminary design has been made and estimates of the CO_2 storage capacity for the reservoir have been determined. Information gained from actual injection into Fault Block A would be utilized to finalize the Fault Block B and C design during 2011and 2012. A final plan for implementing CO_2 injection in Blocks B and C at the West Hastings Field is currently being developed. Consequently, the precise locations and precise spacing and completion intervals of the proposed injection wells are not yet known. A preliminary development plan prepared for Denbury (Hovorka 2010) has proposed reentering and converting selected existing wells, to the maximum extent practicable, for use as either a CO_2 injection well (or as an oil producing well if located within the field of influence of an injection well).

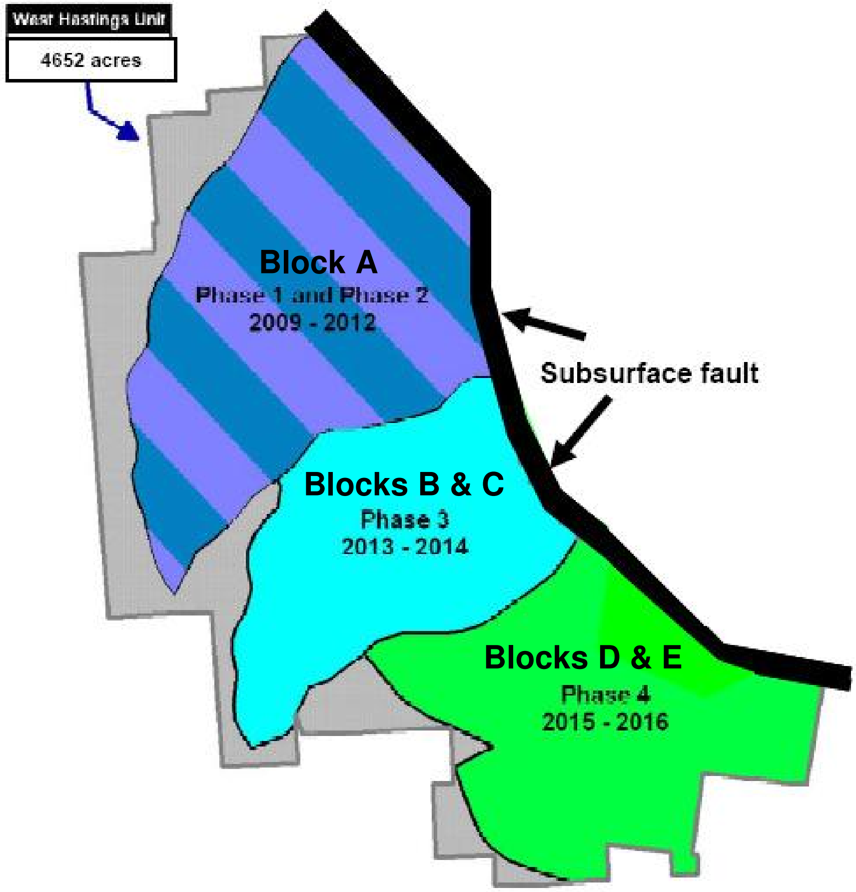


Figure IV.2-1. Proposed Phased Implementation Schedule for CO_2 Injection into the West Hastings Field.

For purposes of this EA, it has been assumed that the preliminary implementation plan described by Hovorka (2010) might occur, recognizing that changes might occur during final design. The preliminary plan proposes developing a series of inverted "9- spot" patterns (with each pattern including one CO_2 injection well surrounded by 8 oil producing wells). The current preliminary plan estimates developing seven such 9-spot patterns in 2013 and seven more such patterns in 2014. The pattern design anticipated in the preliminary plan for Fault Blocks B and C would require a total of 14 CO_2 injection wells and 61 associated producing wells. The preliminary proposed configurations of injection well/producing well patterns in Blocks B and C are shown on Figure IV.2-2. As shown on Figure IV.2-2, according to the current preliminary plan, approximately eight new CO_2 injection wells may need to be installed (with the remaining 6 injection wells consisting of existing active or inactive wells converted to use for CO_2 injection).

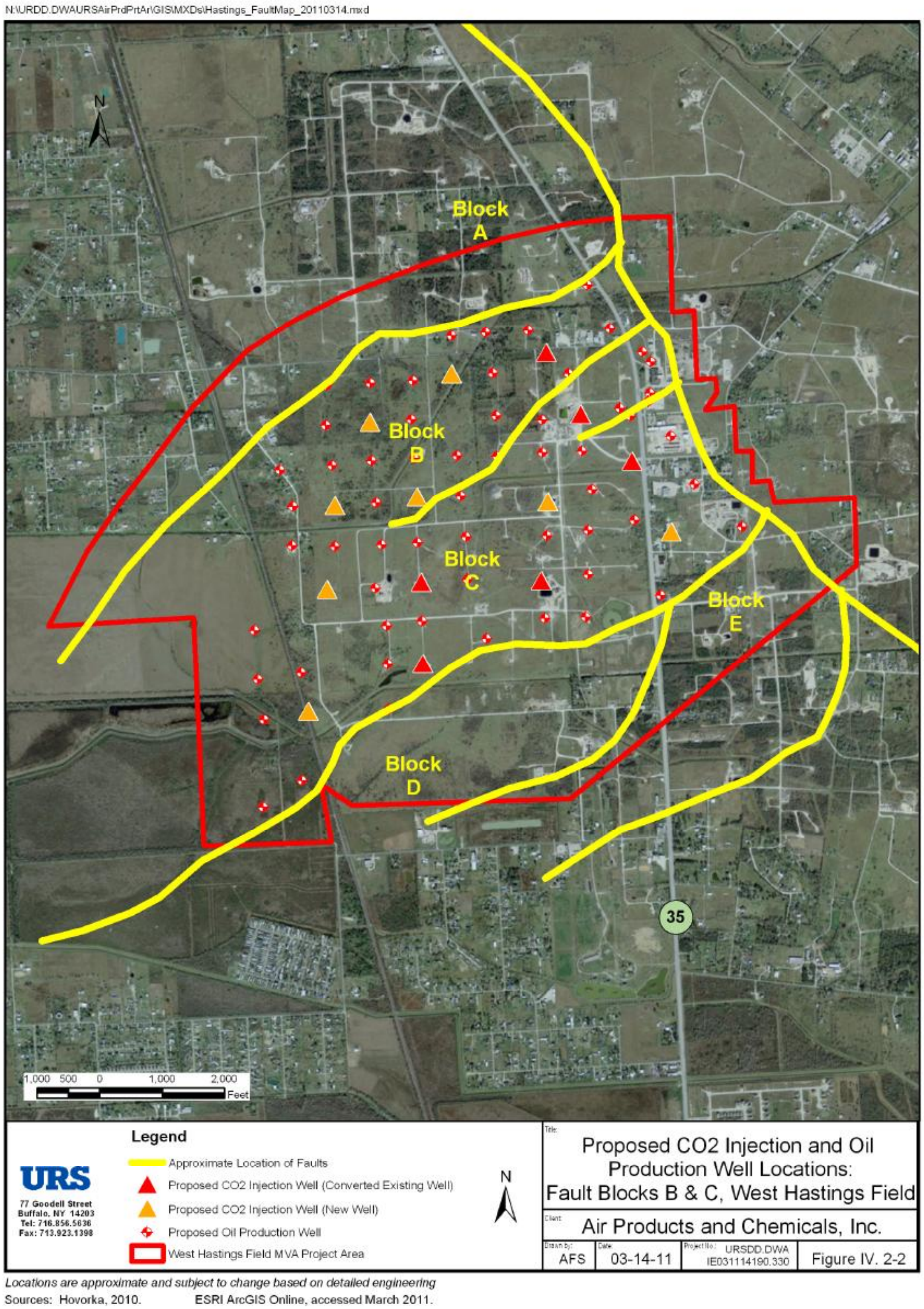


Figure IV.2-2. Proposed CO_2 Injection and Oil Well Locations in Fault Blocks B and C - West Hastings Field

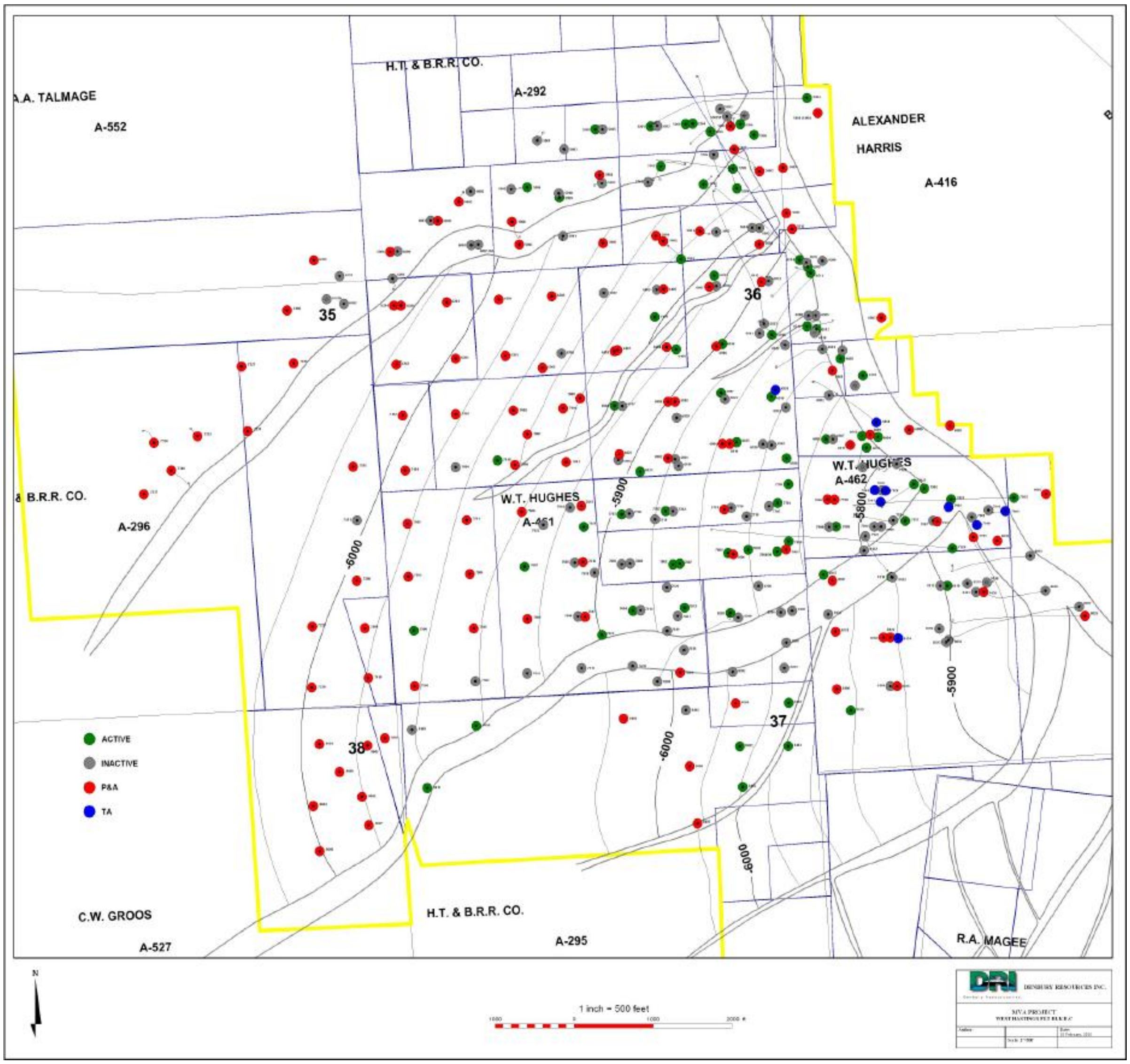
Existing Wells in the West Hastings Field: An inventory of the distribution of wells in the West Hastings Field Fault Blocks B and C shows 72 active wells, 113 inactive but accessible wells, 9 temporarily abandoned (TA) wells, and 110 plugged and abandoned (P&A) wells, as shown on Figure IV.2-3 (Hovorka 2010). Prior to beginning implementation of CO_2 injection, Denbury would review well data for all these existing wells and, as part of their ongoing commercial operations, every active, inactive and P&A well would have its mechanical status defined. Wells deemed as unable to accommodate the pressure increase associated with injection and containment of the CO_2 in the reservoir would be remediated by Denbury prior to initiating CO_2 injection. As shown on Figure IV.2-3, numerous unused wells are therefore available for conversion and use as a CO_2 injection well, production well, or MVA program monitoring or observation well, where cost effective and practicable.

Groundwater monitoring wells would be included in the research MVA program activities. These wells are not required to be authorized under the UIC program. However, if any new groundwater monitoring wells are required, these wells would be drilled by an operator licensed by the Texas Department of Licensing and Regulation under Texas Administrative Code, Title 12, Chapter 1901.

The EPA promulgated new requirements pertaining to geologic sequestration of carbon dioxide in December 2010 (*Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells* (40 CFR Parts 124, 144, 145 and 146), published in the Federal Register, Volume 75, Number 237 on December 10, 2010). These requirements, issued under the Safe Drinking Water Act, established a new class of well, Class VI, to ensure that new CO_2 geologic sequestration wells are appropriately sited, constructed, tested, monitored, and closed (EPA 2010a). EPA'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 programmatic components of the UIC Program are designed to prevent fluid movement into underground sources of drinking water (USDWs) by addressing the potential pathways through which injected fluids can migrate into USDWs. The installation, operation, and eventual closure of existing CO_2 EOR injection wells at the West Hastings Field is currently governed by the UIC permit program administered by EPA, for which governing authority was delegated to the State of Texas (effective April 23, 1982 – 47FR17488). Denbury currently has a Class II Non-Hazardous area permit for CO_2 injection. Denbury proposes to permit any new CO_2 injection wells that would be installed, operated, and eventually closed by Denbury under either a new permit or a modification to the existing permit under existing Class II requirements.

The EPA has also issued a rule on the GHG reporting requirements, under the CAA, Docket ID No. EPA-HQ-OAR-2008-0508-2278, which was published in the Federal Registry, Volume 75, Number 209, on October 30, 2009. The rule requires facilities performing geologic sequestration to report GHG emissions, calculate and monitor emissions, report data and maintain records to enable the EPA to clarify the amount of GHGs sequestered by the facilities to help guide policy decisions and development of futures programs (EPA 2010b).

Depending on conditions at the injection well, producing well, and observation well sites, some site clearing, which is expected to be minor, may be required prior to well conversion/construction activities. Field work related to construction of the injection well surface facilities would include fabrication and/or importation of temporary facilities and improvements placed at the ground surface within an area measuring approximately 150 to 300 feet by 150 to 300 feet in the immediate vicinity of each injection well (Figure IV.2-2). These facilities would support activities required to convert existing wells to injection wells or, if necessary, to construct new injection wells. Similar temporary facilities may be placed in the immediate vicinity of one or more producing or observation wells, depending on the extent of any well conversion work required at each well.



Source: Hovorka 2010

Notes: P&A = Plugged and abandoned well

TA = Temporarily abandoned well

Figure IV.2-3. Existing Oil Field Wells in the West Hastings Field MVA Project Area

During well conversion/construction activities, it is anticipated that personnel and temporary facilities fabricated and/or imported to each injection well, production well, and observation well location could include:

- Pipe tubs/racks (to hold drill pipe and casing);
- Water tanks;
- Fuel trailer;
- Pumps (used to pump drilling fluids/muds during drilling operations);
- Drill rigs;
- Steel pits (a temporary steel containment for holding wellbore fluids);
- Mudlogger (for recording information obtained from examination and analysis of formation cuttings made by the bit and/or drilling mud/drilling fluid circulated out of the hole for assessing presence of oil or natural gas);
- A reserve pit (e.g., an earthen, plastic-lined pit to clean out the mud pump and store excess drilling muds/fluids);
- One or more operations trailers; and
- Temporary office/conference room, and/or communications shack.

At the conclusion of the well conversion/construction work, the majority of the temporary facilities would be removed leaving only an access road and drill pad around each injection wellhead.

MVA Program: The major components of the MVA program at the West Hastings Field include the following (Hovorka 2010):

- **Well Integrity Testing** – The research MVA program would extend the existing commercial well integrity program in place at the West Hastings Field by utilizing experimental logging tools to monitor potential CO_2 migration out of the targeted Frio storage reservoir. A range of groundwater and surface monitoring technologies would be used to monitor idle and P&A wells for potential evidence of leaking (upward migration) of injected CO_2.
- **Fault Monitoring** – Temperature and/or pressure data would be collected from wells that penetrate mapped faults in the West Hastings Field sequestration area to evaluate whether CO_2 flow can be identified up the faults, to confirm confinement of injected CO_2 flow within the Frio storage reservoir.
- **Above-Zone Monitoring** – Approximately three wells would be drilled to measure the pressure in the deepest Miocene-age geologic reservoir to determine the extent of the pressure seal that exists. Above-zone monitoring interval (AZMI)-related research activities would include the use of high-temperature monitoring devices and pressure gauges to monitor the possible migration of CO_2.

- **CO_2 Flood (Injection) Conformance Testing –** A combination of geophysics, seismic arrays and gravity monitoring methods would be used to gather additional data to assist in developing a model to simulate the movement and the location of the injected CO_2.
- **Soil Gas Monitoring –** Monitoring of soil gas, including baseline soil gas monitoring and monitoring for changes in soil gas characteristics above P&A wells following commencement of CO_2 injection activities in Blocks B and C. Research MVA activities would include use of augmented near-surface soil gas/aquifer surveillance methods and evaluation and use of data obtained at other soil gas testing projects for developing final soil gas monitoring strategies.

The proposed MVA program for the West Hastings Field is designed to provide a means for independently testing the performance of the CO_2 injection wells and the geologic containment capacity of Blocks B and C within the West Hastings Field to determine if the commercial approaches and the host geologic injection system are adequate for the purpose of long-term CO_2 storage. The research activities included in the MVA program would supplement privately-funded, ongoing monitoring activities conducted in conjunction with Denbury's commercial EOR operations. Specific components of the preliminary proposed MVA program at the West Hastings Field, together with a summary of Denbury's existing monitoring activities for its ongoing commercial EOR operations, are summarized in Table IV.2-1 below.

Table IV.2-1. Preliminary Proposed MVA Program Activities at West Hastings Field

Denbury's Existing Commercial Operational Activities	MVA Program Activities
Integrity Testing	
• Normal well review and remediation as needed prior to CO_2 injection (CO_2 flood) • Normal well surveillance and remediation procedure for active wells • Normal well surveillance and remediation procedure for P&A wells (volumetric balance) • Learning from experience in Fault Block A, and from well remediation in Fault Blocks B&C • Additional surveillance of idle wells via petrophysical logging • Surveillance of P&A wells via soil gas/casing head gas monitoring • Surveillance of P&A wells (Available or planned Denbury-owned water wells) • Surveillance of P&A wells (if no wells available, drill and complete 100-ft-deep water sampling wells. Verify depths and locations of wells	• Additional surveillance of idle wells in/around the CO_2 flood area via petrophysical logging (i.e., temperature logs and tracer surveys) • Surveillance of P&A wells as needed via soil gas/casing head gas monitoring to develop characterization data. Collect soil gas time lapse data for over two years at soil gas monitoring sites. • Implement augmented near-surface soil gas/aquifer surveillance methods (methane, CO_2, noble gases/isotopes, tracers) • Surveillance of P&A wells as needed via Seeper trace • Surveillance of P&A wells (groundwater monitoring plan via shallow [100-ft-deep] freshwater wells, up-gradient & down-gradient). Verify depths and locations of wells. • Sample available wells to obtain water chemistry and establish best test methods for testing rock/CO_2/water interactions. Established methods would be used to complete wells in USDW interval and monitor for potential CO_2 migration

Table IV.2-1. Proposed MVA Program Activities at West Hastings EOR Project (Continued)

Denbury's Existing Commercial Operational Activities	MVA Program Activities
CO_2 Flood Conformance Monitoring	
• Reservoir characterization • Normal Denbury approach to monitoring flood, including daily monitoring daily of pressure at well head, injection profiles, monitoring oil-producer well fluids at least monthly at test sites • Normal Denbury approach to flood implementation, e.g. if a well would not take the planned flood rate, acidize, re-perforate, or inject at a higher rate in other parts of pattern	• Additional reservoir modeling to confirm CO_2 plume behavior • Augmented measures of conformance – Implement Annual vertical seismic profile (VSP) survey plan in Fault Blocks B&C • Augmented measures of conformance monitoring – Conduct surface & borehole gravity monitoring 3-4 times per year and gravity monitoring plan in Blocks B&C. Install several hundred 2-ft-deep concrete equipment monuments for surface equipment. • Augmented measures of conformance monitoring – Conduct repeat three-dimensional (3-D) seismic profiling • Augmented measures of conformance monitoring – Real-time monitoring of tubing pressure/increased intermittent monitoring of memory-gauge pressure to assess characteristics of the flood • Augmented measures of conformance monitoring - Introduced tracers collected at wellhead, Collect natural geochemical tracers at wellheads • During first year of CO_2 flood, complete approximately two wells outside of flood phase area to monitor the possible migration of CO_2 and monitor elevation of pressure outside of completed injection patterns. Develop Blocks B&C phases from top of structure down-dip. Wells would become active in future phases of development. • Augmented measures of conformance monitoring – Conduct time-lapse surveillance logging in approximately half of the selected injection wells in Block B and C well patterns every half year until flood begins to provide data for comparison with model predictions. Run tracer surveys on half of the injection wells twice per year. Run spinner, temperature, and capacitance tool logs twice per year in oil producers and four times per year in injection wells.

Table IV.2-1. Proposed MVA Program Activities at West Hastings EOR Project (Continued)

Denbury's Existing Commercial Operational Activities	MVA Program Activities
Above-Zone Monitoring Interval Monitoring	
• Identify idle or reentered wells that may need to be permanently decommissioned • Identify wells with mechanical problems that are capable of being remediated and re-plug or remediate prior to start of injection.	• Establish current pressure profile via RFT/perforate existing wells. Test, with the exception of wells completed in the Miocene units, to characterize the pressure field and select locations in the AZMI. Wells completed in the AZMI would be fitted with screens protecting any poorly-consolidated Miocene formation materials from sanding over of well perforations. Evaluate pressures in Miocene wells to gauge containment. Install temperature monitoring equipment and monitor temperature changes. • Install and maintain simple pressure gauges on completed monitoring wells (Sandia-supported activity) • Conduct pressure interference testing to show hydrologic communication and area over which the AZMI provides evidence of containment (Sandia-supported activity). BEG to collect/analyze pre-injection fluids and gases for geochemical samples. • Plug back idle/reenter wells in selected above-zone interval to create monitoring wells • Place instruments in plugged back idle/reentered wells in selected AZMI wells (Detailed plan would be prepared for pressure monitoring in idle perforated wells) • One or more newly-developed tools may be used in a selected number of wells to identify permeability information relevant to potential CO_2 migration through fault zones and fluid changes in AZMI through casing prior to the Block B and C flood (Sandia- supported activity) • Utilize newly-developed tool in up to three wells to identify permeability information relevant to potential CO_2 migration on faults and fluid changes in AZMI through casing prior to the Block B and C flood. (Sandia- supported activity) • Utilize variety of monitoring tools for active temperature stimulation to evaluate potential for natural or anthropogenic fluid migration behind casing of wells. Generated data would establish a baseline to display changes as the field is flooded (Sandia-supported activity) • Identify and install four wells in the USDW interval and monitor for potential CO_2 migration • Geophysical Logging – Conduct time lapse surveillance logging program involving selected idle wells and fault monitoring wells (monitoring wells penetrating or in close proximity to a fault zone) to obtain data to compare to baseline data as field is flooded. • Perform normal well surveillance, including monitoring casing pressures in injection wells and oil producers. Repair wells where integrity has been compromised, if necessary.

Table IV.2-1. Proposed MVA Program Activities at West Hastings EOR Project (Continued)

Denbury's Existing Commercial Operational Activities	MVA Program Activities
Fault Monitoring	
• Characterization of main fault bounding eastern edge of West Hastings Field; • Conduct well logging program in idle wells in Blocks B&C	• Perforate and monitor zones adjacent to the fault in wellbores that intersect the fault plane. Install and maintain simple pressure gauges to monitor for pressure anomalies. Existing wells will be utilized where practicable. • Augmented measures of conformance monitoring - Baseline VSP survey. Current plan is for five 3-D VSP surveys in Fault Blocks B and C to image CO_2 fill-up through reservoir and above/below reservoir and along faults. Seismic monitoring may include Baseline VSP survey plus four repeats in later portion of Phase 2 activities in coordination with gravity logging (Denbury/BEG-supported activity). • Logging-Time lapse surveillance program including 20 selected idle wells and fault monitoring to obtain data to compare to baseline data as field is flooded. Monitor for fluid/temperature changes in fault zone monitoring wells

Notes: P&A = Plugged and abandoned; VSP = Vertical Seismic Profile; RFT = Repeat Formation Test; AZMI = Above-zone monitoring interval; BEG = (Texas) Bureau of Economic Geology; USDW = Underground Sources of Drinking Water

(Source: Adapted from Hovorka 2010)

IV.3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

IV.3.1 Air Quality

IV.3.1.1 AFFECTED ENVIRONMENT

IV.3.1.1.1 Atmospheric Conditions and Air Quality

This section presents a review of air quality issues, including the affected environment and as it pertains to air quality, related to the MVA program in Brazoria County, Texas. The topics discussed include applicable air quality regulations, regional ambient air monitoring, and regional emissions to the atmosphere.

IV.3.1.1.2 Applicable Air Quality Regulations

Applicable air quality regulations are documented in Section II.3.1.1 of this EA.

IV.3.1.1.3 Regional Ambient Air Monitoring

In Brazoria County, the only two pollutants that are monitored are NO_2 and O_3. The monitoring stations are operated by the TCEQ. A map of the stations that monitor criteria pollutants in the Brazoria County is provided as Figure IV.3.1-1.

The monitored values for the area are shown in Table IV.3.1-1. This table shows that the Brazoria County area is in attainment of NAAQS for all pollutants except O_3.

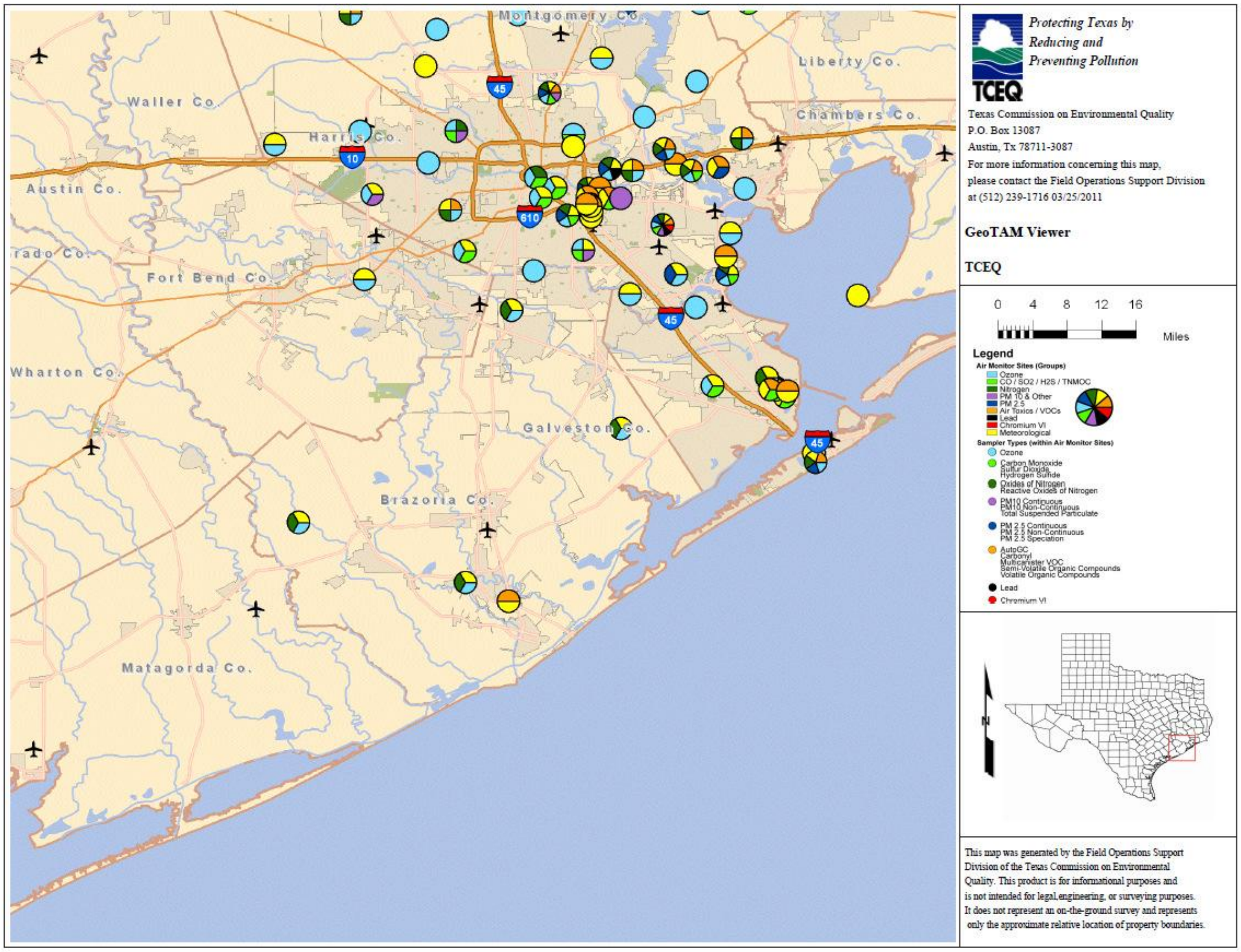


Figure IV.3.1-1 Brazoria County Air Monitoring Station Locations (TCEQ 2011b)

Table IV.3.1-1. Monitored Concentrations for Brazoria County Air Monitoring Station Locations

Compound	Avg. Period	Primary NAAQS	Monitored Concentration	Percent NAAQS
CO ($\mu g/m^3$)	1-hour	40,000	N/A[1]	N/A[1]
	8-hour	10,000	N/A[1]	N/A[1]
PB ($\mu g/m^3$)	Quarterly Average	0.15	N/A[1]	N/A[1]
NO_2 ($\mu g/m^3$)	1-hour	188.6	84.8	45%
	Annual	100	<0.01	<1%
$PM_{2.5}$ ($\mu g/m^3$)	24-hour	35	N/A[1]	N/A[1]
	Annual	15	N/A[1]	N/A[1]
O_3 (ppm)	8-hour	0.75	0.79[2]	101%
SO_2 ($\mu g/m^3$)	1-hour	195	N/A[1]	N/A[1]
	3-hour	1,300	N/A[1]	N/A[1]
	24-hour	365	N/A[1]	N/A[1]
	Annual	80	N/A[1]	N/A[1]

[1] These pollutants are not monitored in Brazoria County. However, TCEQ and EPA have determined that the county is in attainment for the applicable NAAQS.

[2] Based on most recent data available (2010) (Source: TCEQ 2011a)

IV.3.1.2 ENVIRONMENTAL CONSEQUENCES

IV.3.1.2.1 Proposed Project

The only emissions associated with the MVA activities would be from drilling shallow monitoring wells, if required. There would be very minimal emissions once the wells are installed. The emissions into the atmosphere from the well installation would occur from two general types of sources; emission from material handling (e.g. dirt moving) and emissions from burning fuel (gasoline and diesel) from mobile sources (off-road and on-road vehicles). Each of these source types is discussed below.

Material Handling: The material handling activities would result in emissions of fine particulate (particulate matter 2.5 microns or less, or $PM_{2.5}$). Clearing a site for the MVA wells could include several different activities, such as site clearing and excavation. Other emissions may include entrained dust from construction equipment traveling on unpaved roads and surfaces in drilling areas.

Mobile Source Emissions: Mobile source emissions are disaggregated into on-road (e.g., cars and trucks) and non-road emission categories. Emissions from these categories results from fuel burning and as such would have emissions of NO_x, VOC, CO, SO_2, and $PM_{2.5}$. Non-road emissions result from the use of fuel in construction equipment (i.e., if any well pad enhancement is required) and the drilling rig, if required. On-road vehicles would be used during the drilling activities and would result in emissions of NO_x, VOC, CO, SO_2, and $PM_{2.5}$. On-road equipment may include heavy duty and light duty diesel vehicles, and heavy duty and light duty gasoline vehicles.

All of the activities and equipment identified above would result in some emissions. However, each of these activities is for a very limited time period and therefore would result in temporary, negligible impacts to air quality.

IV.3.1.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that MVA activities would not occur. Therefore, there would be no impacts to the air quality under the No-Action Alternative. However, significant commercial EOR development in the West Hastings Field would likely continue with natural CO_2 obtained from the Jackson Dome and other sources rather than CO_2 supplied by Air Products. Denbury is also a subcontractor to another company, Leucadia Corporation, who has requested funding from the DOE for the Lake Charles Petcoke project, which would also use the Green Pipeline and MVA activities under that project may take place at the West Hastings Field independent of whether the Air Products proposed project receives DOE funding.

IV.3.2 Water and Geologic Resources

IV.3.2.1 AFFECTED ENVIRONMENT

IV.3.2.1.1 Surface Water

The West Hastings Field MVA project area would be located on land comprised of relatively flat coastal plain materials. Chigger Creek, a perennial stream, and a tributary to Cowart Creek, an intermittent stream, cross the area within and near the proposed MVA project area (Figure IV.3.2-1). Both Chigger Creek and Cowart Creeks flow toward the east into Clear Creek. Clear Creek flows into Clear Lake, northeast of the MVA project area, which ultimately connects to Galveston Bay (TCEQ 2010b).

The TCEQ periodically monitors water quality in rivers and streams, including Cowart, Chigger, and Clear Creeks. TCEQ records (TCEQ 2008) indicate that impairments for bacteria concentrations have been detected in the following segments of Cowart and Chigger Creeks:

- Chigger Creek (Segment ID 1101B) from the confluence of Clear Creek Tidal to the Brazos River Authority Canal near CR 143 in Galveston County – first listed in 2002.
- Cowart Creek (Segment ID 1102A) intermittent stream with perennial pools from the confluence with Clear Creek in Galveston County to SH 35 in Brazoria County – first listed in 2002.

The TCEQ has initiated TMDL plans to address these and other identified stream impairments in Texas. No other impairments in these two creeks have been noted.

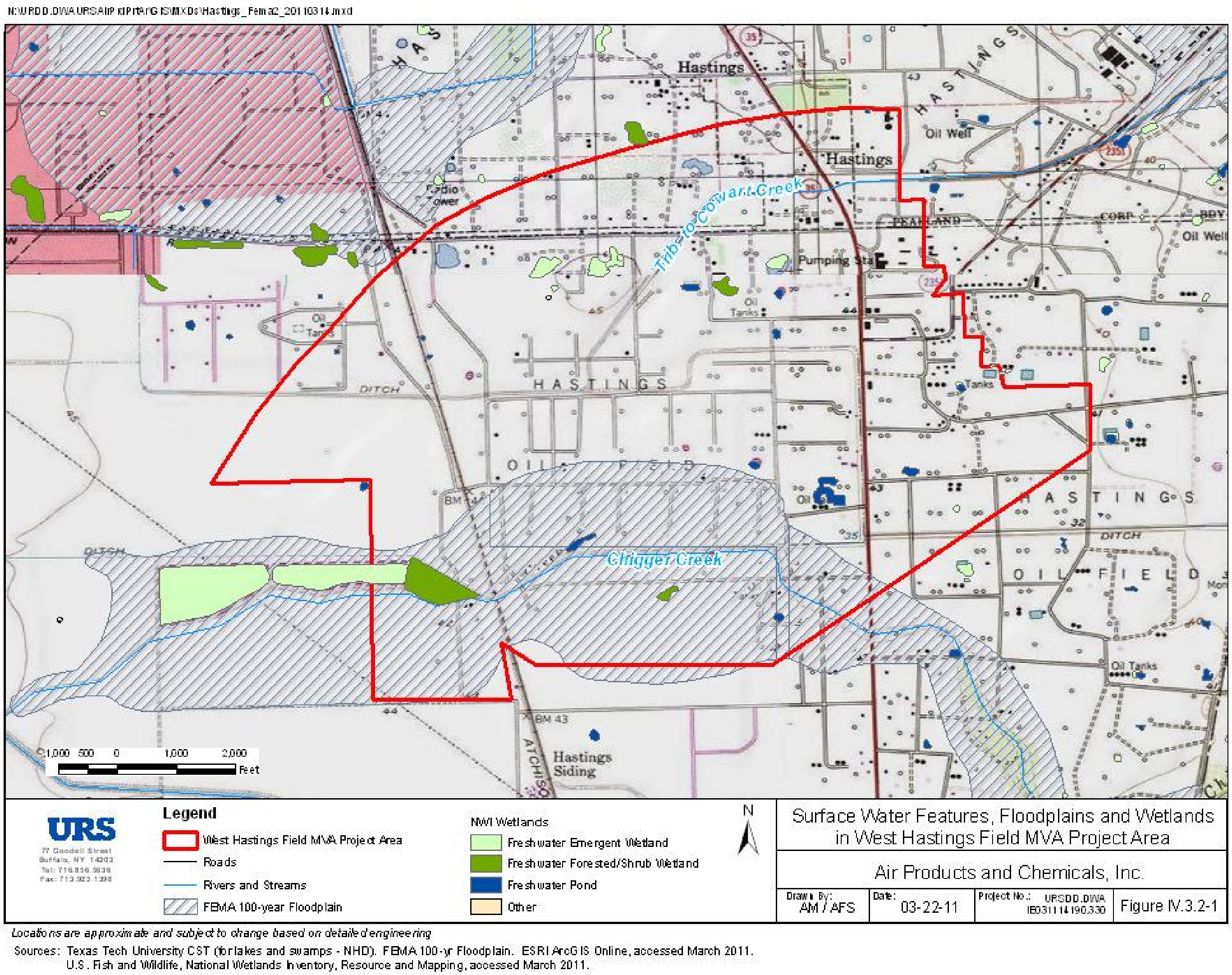


Figure IV.3.2-1. Surface Water Features, Floodplains and Wetlands in West Hastings Field MVA Project Area

IV.3.2.1.2 Groundwater

The Gulf Coastal aquifer system forms a wide belt along the Gulf of Mexico extending from Florida to Mexico. In Texas, the aquifer provides water to all or parts of 54 counties and extends from the Rio Grande northeastward to the Louisiana-Texas border (Mace et al. 2006). The aquifer consists of an assemblage interbedded clays, silts, sands, and gravels of Cenozoic age. These units are locally heterogeneous in nature and are hydrologically connected to form a large, leaky artesian aquifer system (Baker 1979).

Regionally, the aquifer system is comprised of four major hydrostratigraphic components consisting of the following generally recognized water-producing formations, from youngest to oldest:

- The Chicot aquifer, the uppermost groundwater-bearing component of the Gulf Coast aquifer system, which consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont Formations, and/or overlying alluvial deposits;
- The Burkeville confining system, which separates the Jasper aquifer from the overlying Evangeline aquifer, which is contained within the Fleming Formation and/or Goliad sands;
- The Jasper aquifer, primarily contained within the Oakville sandstone stratigraphic unit; and
- The Catahoula Formation, which contains groundwater near the outcrop area northwest of the West Hastings Field area in relatively restricted sand layers.

The Gulf Coast aquifer is recharged primarily by precipitation. Losing streams and irrigation canals provide additional local sources of recharge. Reported recharge rates for the Gulf Coast aquifer range from approximately 0.0004 to 2 inches per year, depending on precipitation amounts, vegetation and land use, irrigation, and soil type (Scanlon et al. 2002).

Air Products' PA1 and PA2 facilities, the area underlying the proposed CO_2 pipeline lateral, and the West Hastings Field MVA project area are all located within the northern part of the Gulf Coast aquifer system. This part of the Gulf Coast aquifer system, which includes the Chicot, Evangeline, and Jasper aquifers, supplies most of the water used for industrial, municipal, agricultural, and commercial purposes for an approximately 25,000-square-mile area that includes the Beaumont, Houston, Huntsville, and Port Arthur metropolitan area (Kasmerak and Robinson 2004).

In Brazoria County, the Evangeline and the Chicot aquifers are the primary sources of groundwater extracted for irrigation, industrial, and public and domestic use. The Chicot and Evangeline aquifers are the only hydrologic units bearing fresh (i.e., TDS less than 1,000 mg/l) or slightly saline water (i.e., TDS between 1,000 and 3,000 mg/l) in Brazoria County. The chemical quality of the water in all the aquifers varies with location. Factors causing this variance include interconnection of the aquifers and the presence of salt domes in or near the aquifers (TWDB 1982).

In Harris and Galveston Counties, north and northwest of the West Hastings Field Area, groundwater withdrawals have occurred since the end of the 19th century. The total groundwater withdrawal rate in this area in 1996 was 463 million gallons per day. Ground subsidence caused by historical groundwater pumping led to the imposition of some pumping restrictions in the late 1970s by the newly created Harris-Galveston Coastal Subsidence District (Kasmerak and Robinson 2004).

Groundwater wells constructed in Brazoria County typical have total depths ranging from about 60 feet to 1,400 feet and groundwater quality is generally good, with TDS ranging from approximately 480 to 950 mg/L. According to the TWDB, a total of 65 public, industrial, irrigation, domestic, plugged or destroyed, dewater, commercial, and unused wells are located within two miles of the proposed West Hastings Field MVA project area. The majority of the wells are for public use and are located in Brazoria County, except for four wells which are located in Galveston County. All of these groundwater wells are completed into the Chicot aquifer and range in depth from approximately 20 to 800 feet. Figure IV.3.2-2 depicts the locations of existing water-supply wells within a two-mile radius surrounding the proposed West Hastings Field MVA project area. The existing well identified on Figure IV.3.2-2 as Pan American Petroleum 0908 is shown as being located approximately 50 feet from a proposed injection well. Well 0908 has been destroyed but is depicted on this figure since it is listed in the TWDB database (TWDB 2011).

The Brazoria County Groundwater Conservation District (BCGCD) was created by Texas statute to maintain and protect the groundwater resources of Brazoria County (BCGCD 2008). The BCGCD was confirmed by county voters in November 2005 and proactively addresses groundwater issues by working with groundwater users to manage and plan for groundwater use. According to BCGCD rules, all monitoring wells similar to those to be used for MVA activities are exempted from registration and permitting.

IV.3.2.1.3 Geology and Soils

Regional Geologic Setting: Sediments of the Gulf Coast aquifer were deposited in a fluvial-deltaic or shallow-marine environment (Baker 1979; Mace et al. 2006). Repeated sea-level changes and basin subsidence caused the development of cyclic sedimentary deposits composed of discontinuous sand, silt, clay, and gravel deposits extending across the Gulf Coast Basin from the Texas-Mexico border to just west of the Texas-Louisiana border. In the Texas Gulf Coastal Plain, the resulting sedimentary sequences exhibit considerable heterogeneity (Kasmarek and Robinson 2004; Mace et. al 2006).

Multiple sandstones within the Oligocene-age Frio Formation are productive within the West Hastings Field and would be the host geologic unit (reservoir) for CO_2 injection. Two sandstones of the upper Frio Formation were previously tested and found favorable for monitoring and for sequestration by the Texas Bureau of Economic Geology's Frio brine pilot test east of Houston, Texas. The Frio Formation underlying the West Hastings Field is composed of a number of sandstones separated by shales (Figure IV.3.2-3). Sands in the Frio Formation in the West Hastings Field are typical of most sandstones along the Texas and Louisiana Gulf Coast, where porosities are in the 28% to 32% range and permeabilities are high, in the 200 to 2000 millidarcy (md) range (Hovorka 2010). Based on a stratigraphic and hydrogeologic cross section of the

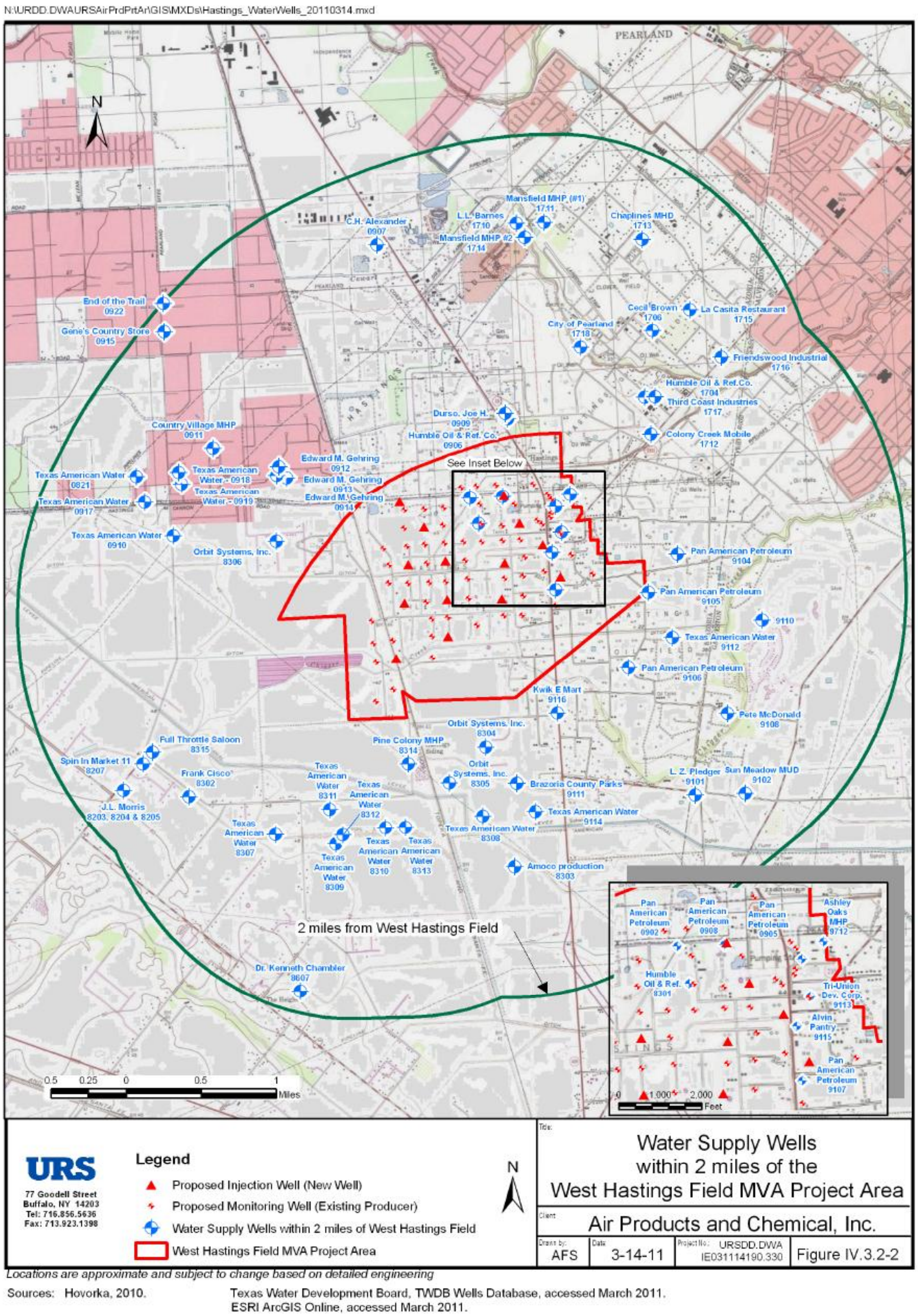


Figure IV.3.2-2. Water Supply Wells within Two Miles of the West Hastings Field

Gulf Coast region (Baker 1979) and information from Denbury, it is estimated that the top of the Frio Formation is approximately 5,500 feet below ground surface in the area of the West Hastings Field.

The Oligocene-age Anahuac Formation provides confinement at the top of the reservoir (Figure IV.3.2-3). This unit is a regionally extensive transgressive dark mudstone and is greater than 500 feet thick (Hovorka 2010; Mace et al. 2006). The seal properties of the Anahuac Formation were studied as part of the Frio Brine pilot study near Dayton, Texas (Hovorka et al. 2005; NETL 2009) and results of that study demonstrate that this formation serves as an excellent seal.

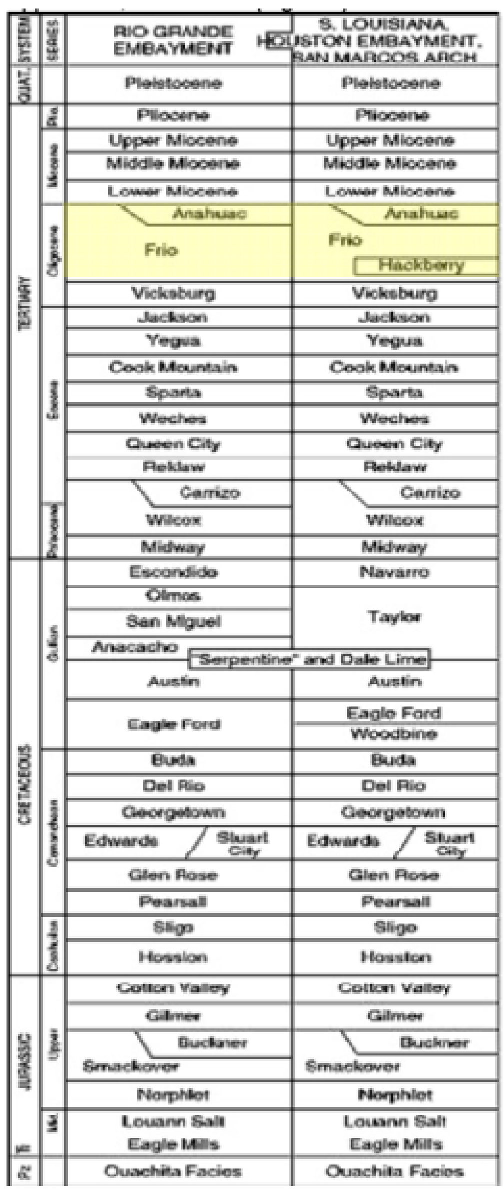


Figure IV.3.2-3. Generalized Stratigraphic Section – Gulf Coastal Plain

Miocene strata overlying the Frio Formation, such as the Burkeville confining system within the Fleming Formation, provide additional seals above the injection reservoir for containing the injected CO_2. The Burkeville is composed of many individual layers, but because of its relatively large percentage of silt and clay when compared to the underlying Jasper aquifer and overlying Evangeline aquifer in the Coastal Plain aquifer system, the Burkeville functions as a confining unit. The thickness of the Burkeville typically ranges from about 300 to 500 feet, with the maximum thickness exceeding 2,000 feet (Baker 1979).

Numerous salt domes (diapirs) have been mapped in the northern part of the Gulf Coastal aquifer system area. The salt originated from Jurassic-age salts, has risen through the overlying strata. In some areas, the salt domes have penetrated the aquifers. These widely distributed salt domes increase the heterogeneity of the hydraulic characteristics of the aquifers (Kasmarek and Robinson 2004).

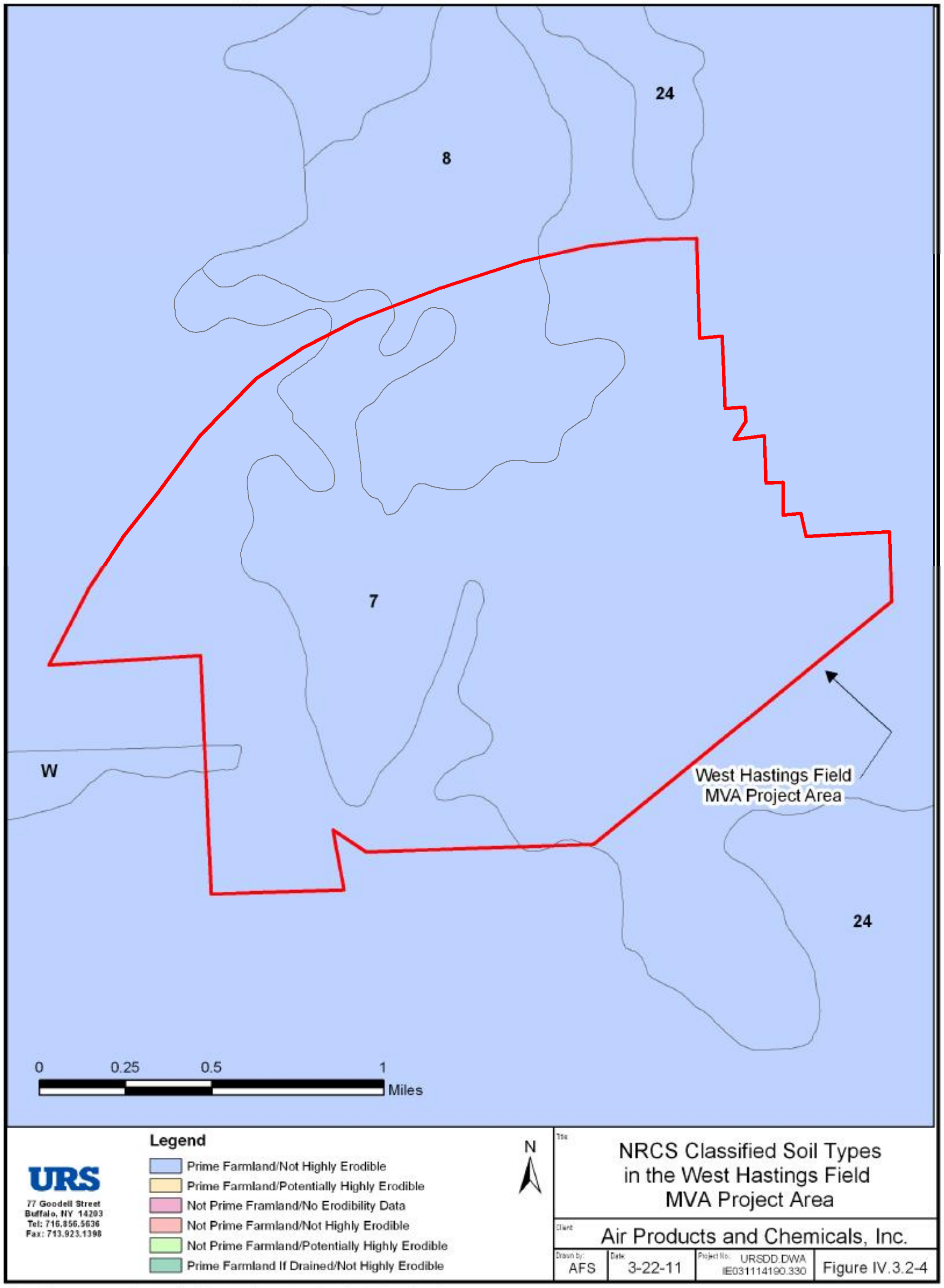
Structural Setting and Seismicity: Growth faults are common throughout the unconsolidated sediments of the northern part of the Gulf Coastal aquifer system area and traces of some of these faults have been mapped and named. Based on the study of well logs and seismic-line data, these faults have been delineated to depths of 3,000 to 12,000 ft below land surface. The presence of most of these faults is associated with natural geologic processes (Kasmarek and Robinson 2004).

The proposed MVA project area and surrounding areas are considered to be areas of low seismic hazard. USGS-generated seismic hazard maps (USGS 2008; USGS 2011a) produced based on historical earthquake locations and recurrence rates of ground ruptures, that show estimated ground-shaking hazards, indicate a probable peak ground acceleration, expressed as percent gravity (g), within the MVA project area and surrounding region of 4 percent gravity (4% g) with regard to horizontal motion with a 2 percent probability of exceedance within a 50-year period. For context, buildings that are not earthquake-resistant undergo structural damage when the peak ground acceleration exceeds 10% g (USGS 2011b). The risk of seismic events occurring within the proposed MVA project area is therefore very low. The largest earthquake known to have occurred in Texas was a Magnitude 5.80 earthquake, which occurred in 1931 near Valentine, Texas, over 600 miles west of the Proposed MVA project area.

Geology of MVA Project Area: The geosphere (geologic reservoir) in the vicinity of the Hastings Field, as described above, is compartmentalized into a set of contiguous, large-scale, fault-segregated geologic blocks (Figure IV.2-2). A subsurface fault exists within the Hastings Field area that trends northwest-southeast along a line that approximately follows Texas Highway 35 between Pearland and Alvin. In 1958, the trace of this fault was selected as a line dividing the West Hastings and East Hastings Fields. A series of cross faults (Figure IV.2-2) further compartmentalize the West Hastings Field into geologic areas (i.e., blocks).

Soils: According to the National Cooperative Soil Survey by the NRCS (USDA Soil Conservation Service 1981; NRCS 2011a), there are three major soil types present in the Hastings Field area. These include the Bernard clay loam (7), Bernard-Edna complex (8), and the Lake Charles clay (24), as shown in Figure IV.3.2-4. Although Figure IV.3.2-4 depicts the soil as prime farmland, a more accurate depiction is presented in USDA 1981.

N:\URDD.DWA\URSAirPrdPrtAr\GIS\MXDs\Hstings_SurfaceSoils_20110322.mxd



Locations are approximate and subject to change based on detailed engineering

Sources: NRCS, Soils Data Mart (http://soildatamart.nrcs.usda.gov), accessed March 2011.
ESRI ArcGIS Online, accessed March 2011.

Figure IV.3.2-4. NRCS-Classified Soil Types in West Hastings Field MVA Project Area.

Both the Bernard clay loam and Bernard-Urban land complex are primarily used as cropland and pastureland (USDA 1981). The Lake Charles clay is primarily used for cropland, pastureland, and rangeland (USDA 1981). All three soil types are characterized as having slopes ranging from 0 to 1 percent and all are classified as a somewhat poorly to moderate drainage class. Such characteristics indicate that these soils have a very limited susceptibility to erosion.

The Hastings Field consists of approximately 25 square miles of rural farmlands, suburban areas, and residential neighborhoods. The proposed CO_2 injection area is less than four square miles in size and is located between Alvin and Pearland, Texas on State Highway 35. A large portion of the entire 25-square-mile Hastings Field area is dedicated to pasture hay and cultivated crops on land that has been converted over time from the Bluestem Grassland, the original prairie grassland occupying the region. The Hastings Field has been in production since 1934, in co-existence with the surrounding developed farmlands and residential and suburban neighborhoods areas.

IV.3.2.1.4 Floodplains and Wetlands

Floodplains: The project area is shown on the following FEMA FIRM Panels: 48039C0135I, revised September 22, 1999; 48039C0045J, revised September 22, 1999; 48039C0065J, revised September 22, 1999; and 48039C0175I, revised September 22, 1999. The southern approximately one-third of the project area is located within the 100-year floodplain, and one existing well and one proposed well site would be within the 100-year floodplain of Chigger Creek.

Wetlands: The NWI indicates that several wetlands are present within the West Hastings Field MVA area (USFWS 2011a). However, none of the existing or proposed well sites are within areas classified as wetlands by the NWI.

IV.3.2.2 ENVIRONMENTAL CONSEQUENCES

IV.3.2.2.1 Proposed Project

This section evaluates and discusses the potential environmental consequences of implementing the proposed CO_2 sequestration and the MVA program at the West Hastings Field on surface water, groundwater, and geologic resources, including soils. Elements considered when assessing the potential impacts on these resources at the CO_2 injection locations and at those locations where MVA program activities would be performed are as follows:

- The location and extent of land disturbed during construction activities and operations associated with the CO_2 sequestration system and the MVA program components; and
- Potential impacts on water quality and geologic and soil resources resulting from MVA program field activities related to the assessment of potential migration of CO_2 from one or more of the injection wells to surface water, groundwater, and/or soils.

The impact analysis for geologic resources evaluated effects on geologic attributes, including access to mineral or energy resources, potential for destruction of unique geologic features, and/or potential for mass movement induced by construction. The impact analysis also evaluated regional geologic conditions, such as earthquake potential. The impact analysis for soil resources evaluated effects on specific soil attributes, including the potential for soil erosion and compaction by construction activities and the potential, if any, for destruction/disturbance of prime farmland.

Experience gained at other CO_2 geologic sequestration projects indicates that the most probable pathway or pathways for potential migration of CO_2 injected into the subsurface at the West Hastings Field could be as follows (e.g., Hovorka 2010; NETL 2009):

- Unexpected defects in well seals due resulting from undetected construction flaws or seal damage;
- Migration through a (permeable) fault zone due to an increase in reservoir pressure; and/or
- Other unexpected out-of -compartment (out-of-reservoir) migration of CO_2 and/or brine [if any], as a result of elevated reservoir pressure, through some other pathway not otherwise controlled as part of the CO_2 injection program.

Unintended upward leakage, if any, of CO_2 along cementation defects in the annulus around a well casing, for example, could act as a potential pathway for "short-circuiting" of CO_2 intended for containment within the reservoir. Potential migration channels behind (along the outside of) well casings, if present, could also provide avenues for potential CO_2 and/or brine displacement from deeper to shallower formations. Such well seal/casing-related failures, if present, could increase corrosion of, and shorten the lifetime of seals and/or casings in abandoned wells.
One or more geologic avenues for CO_2 leakage are, at least in theory, also plausible, including leakage along a (permeable) fault zone and/or leakage resulting from the heterogeneous nature of the geologic strata overlying the injection reservoir.

As discussed in Sections IV.3.2.2.1.1 through IV.3.2.2.1.3 below, the probability of significant impacts occurring to surface water , groundwater, or geologic/soil resources from injection of CO_2 into the Frio Formation beneath the West Hastings EOR Field is anticipated to be low. The purpose of the MVA program to be implemented in conjunction with the CO_2 injection program at the West Hastings EOR Field is to assess the nature and extent of such impacts, if any, and to provide additional data to further demonstrate the technical feasibility of long-term sequestration of CO_2 in geologic formations similar in characteristics to the Frio Formation at the West Hastings EOR Field.

IV.3.2.2.1.1 Surface Water
Several site-specific natural features, operational factors, and technological considerations associated with the proposed MVA program at the West Hastings Field suggest that there would be minimal impact to shallow groundwater and to the ground surface/surface water. These factors include, but are not limited to: (1) the depth of the proposed injection reservoir and the thickness, the demonstrated effective sealing capability of geologic units overlying the injection reservoir, and the characteristics of the geologic sequences underlying the host injection reservoir; (2) the technological maturity of the well construction methods, and (3) existing characteristics of the fault zone that bounds the eastern edge of West Hastings Field.

The research MVA portion of the West Hastings Field (i.e., Fault Blocks B and C) is isolated from the existing commercial EOR operations by bounding geologic faults. These faults are believed to extend vertically into the shallow aquifer intervals; however, this will be investigated further in the research MVA activity. Investigation of possible impacts to surface water from EOR activity will be limited to the research MVA area.

Separation of the EOR sequestration effort in Blocks B and C of West Hastings Field will be feasible because of the existence of bounding faults described above. As a consequence, the impacts of the existing/ongoing EOR to overlaying surface water in adjacent blocks will be considered outside the scope of this EA.

It is not expected that drilling and monitoring activities related to West Hastings Field MVA program activities would impact Cowart or Chigger Creeks, including potential flood-prone areas that may be associated with these creeks. Other MVA program monitoring activities, such as seismic profile surveys and well integrity testing, are likewise not expected to result in any permanent impacts on these surface water features.

Existing bacteria impairments reported for segments of Chigger Creek and Cowart Creek in the West Hastings Field MVA project area primarily result from discharge of domestic wastewater and nonpoint source runoff from agricultural areas. The proposed MVA program activities would not create discharges to these waterbodies and would not include activities that would cause bacterial contamination.

Fresh and/or saline dewatering of wells that may be required of the MVA activities related to this project would be minimal or would be comparable to that from Denbury's commercial EOR operations even if the MVA project is not conducted. This wastewater would be captured from the wells, transported by pipeline, and re-injected into permitted Class II wells operated by Denbury at the West Hastings Field (Hovorka 2010).

Research activities undertaken as part of the MVA program associated with this project would not involve the removal or injection of any materials that would result in changes in surface runoff or result in significant effluent releases. Drilling activities associated with the MVA program would have no discharges and would not require NPDES permitting. Construction activities associated with oil and gas exploration, production, processing and treatment, and transmission facilities are generally exempt from NPDES construction requirements.

The soils present at the West Hastings Field are not highly erodible (Section IV.3.2.1.3). For this reason, contamination from increased runoff that might occur as a result of local temporary disturbance of ground conditions at the locations of MVA activities is not expected to be a significant concern.

Best Operating Practices and Mitigation Measures: Denbury currently applies a series of best management (best operating) practices and policies in its ongoing construction and operational activities undertaken in the East and West Hastings Fields in order to minimize waste generation and minimize discharge of any pollutants in storm water runoff. These practices and policies are proscribed in Denbury's current *Waste Management/Minimization Plan* that provides guidance regarding the proper management and minimization of each type of waste stream generated by Denbury. Drilling activities, if any, that would be conducted in preparation for implementation of the MVA activities would be conducted in accordance with that *Waste Management/ Minimization Plan* to minimize potential impacts resulting from any wastes generated from these activities.

To reduce or eliminate the need for additional well drilling, Denbury would examine existing water wells in the West Hastings Field MVA project area to determine whether they can be used for CO_2 injection, oil production, or groundwater monitoring. If new wells would be required, existing drill pads would be used, if possible.

All MVA activities would be temporary and impacted areas would be protected, maintained, and restored in accordance with best practices and policies currently employed by Denbury for similar its ongoing oil field operations.

IV.3.2.2.1.2 Groundwater

This section evaluates the potential for MVA activities in the Frio Formation to induce changes in USDWs in the West Hastings Field area. The USDW in the West Hastings Field area is defined by the RRC as the subsurface zone at elevations above the elevation corresponding to a depth of 1,650 feet below the ground surface (Hovorka 2010). Based on a stratigraphic and hydrogeologic cross section of the Gulf Coast region (Baker 1979) and information from Denbury, it is estimated that the top of the Frio Formation is approximately 5,500 feet below ground surface in the area of the West Hastings Field.

MVA activities such as possible drilling of new monitoring wells or possible injecting of tracers would be unlikely to increase the potential of CO_2 migration outside of the Frio formation. The pressures exerted by such activities would not create the forces necessary to overcome formation pressures and the pressures created by the EOR CO_2 flood. Relatively slow leakage from one or more injection wells or sealed P&A, observation, or oil-producing wells might occur if any casing and/or cement placed in/around a well or well annulus were to provide less than 100% sealing effectiveness. However, such casing/annular seal issues associated with wells in the injection area, if any, would likely to be detected ahead of time by the Well Integrity Testing program and corrected prior to the use of the well for monitoring.

As discussed above, the research MVA portion of the West Hastings Field (i.e., Fault Blocks B and C) is isolated from the existing commercial EOR operations by bounding geologic faults. These faults are believed to extend vertically into the shallow aquifer intervals; however, this will be investigated further in the research MVA activity. Investigation of possible impacts to surface water from EOR activity will be limited to the research MVA area.

Separation of the EOR sequestration effort in Blocks B and C of West Hastings Field will be feasible because of the existence of bounding faults described above. As a consequence, the impacts of the existing/ongoing EOR to overlaying groundwater in adjacent blocks will be considered outside the scope of this EA.

The proposed MVA program activities would not require substantial volumes of water. These activities therefore should not have any direct impact the supply of water resources in the West Hastings Field area.

The proposed project would result in temporary increase in water usage due to the drilling of monitoring wells as part of the MVA program activities. Changes to water quality and quantity would, however, likely be negligible. Full recovery of the groundwater resource would likely occur in a reasonable time following completion of monitoring well construction work and MVA program monitoring activities.

As described above, MVA activities would be conducted in accordance with Denbury's *Waste Management/ Minimization Plan* and best operating practices and other policies utilized by Denbury during normal oil exploration, development, and production operations to comply with all applicable regulations and minimize potential impacts.

Mitigation Measures: If new wells would be required for monitoring, drilling would be performed at existing well pads, if at all possible. To reduce or eliminate the need for additional well drilling for monitoring/observation wells, Denbury would examine existing water wells in the West Hastings Field MVA project area to determine whether they can be used for groundwater monitoring. Any new wells drilled would require only temporary placement and use of drilling equipment. MVA program activities would be temporary and impacted areas would be protected, maintained, and restored in accordance with best practices employed for similar ongoing oil field operations.

IV.3.2.2.1.3 Geology and Soil

Geological factors to consider when assessing the possibility for migration of injected tracers or solutions in the Frio Formation at the West Hastings Field into other geologic formations include:

- Existence and number of intervening confining layers that occur between the injection zone and the other formation;
- Thickness of these confining layers;
- Permeability and porosity of the confining layers;
- Potential for fracture to occur in the confining layers; and
- Presence, distribution, aperture (opening) size, and interconnectedness of faults and fractures within and around the injection zone.

For reasons described in Section IV.3.2.2.1.2 above, the likelihood of significant advective-diffusive migration of injection-generated solutions into overlying geologic formations is considered to be relatively low at the West Hastings Field. The potential for migration of acidic solutions to other geologic formations through fault pathways would be closely monitored as part of the MVA program activities. Hovorka (2010) reports that the major east-bounding fault at West Hastings Field appears to fall into the category of a fault that acts as a barrier to flow, as large volumes of buoyant fluids (oil) are known to have been trapped against it, and notes that this is a typical response in large throw faults of the Gulf Coast (i.e., where ductile shale is smeared along the fault zone, providing a seal). Alternatively, if a fault or fracture system were instead to act as a conduit to flow, unintended migration of injected tracers or acidic solutions away from the intended interval may be facilitated by permeable faults, if present. For example, Hovorka (2010) notes that faults with smaller throw, such as parts of the cross faults, may not completely seal. In such a case, the potential for conduit-flow would depend on the geometry, permeability, and degree of interconnectedness of such fault/fracture-related conduits within the injection zone and the overlying and surrounding geologic formations. The research MVA program would include a focus on monitoring of faults to determine if flow can be identified along the fault using existing well penetrations. Localized temperature and or pressure perturbations in the vicinity of the monitored faults would be investigated as a potential indicator of preferential fluid migration within the fault zone (Hovorka 2010). Data obtained from this research activity would be used to assess the potential for other geologic impacts such as subsidence or increase in seismicity in the West Hastings Field area.

The base of the Frio Formation is defined by additional shale-sandstone sequences (Hovorka 2010). These sequences are expected to provide a lower seal against potential downward migration of tracers or other solutions into underlying geologic formations.

Given the low topographic relief at the West Hastings Field, there would be essentially no potential for landslides to occur as a result of the proposed implementation of the MVA program activities.

Drilling operations related to the MVA program would be temporary and would not result in permanent changes in geologic or soil conditions. In most cases, MVA activities would be conducted in or around existing idle or P&A wells owned by Denbury. The drilling of small-diameter, shallow subsurface (i.e., less than approximately 20 feet in depth) boreholes, and their subsequent use for soil-gas testing, would likely use small, temporary, truck-mounted equipment that would result in negligible impacts on soils over and above levels already observed as a result of ongoing commercial activities at the West Hastings Field. The research activities undertaken as part of the MVA program associated with this project would not involve the removal or injection of any materials that would result in geologic subsidence.

Denbury would use best operating practices and policies, adhere to Denbury's existing *Waste Management/ Minimization Plan*, and would implement mitigation measures as described in Section IV.3.2.2.1.2 above in order to minimize potential impacts on geologic and soil resources.

The following soils types occur within the West Hastings Field MVA area: Bernard clay loam; Bernard-Edna complex; and Lake Charles clay, 0 to 1 percent slopes. All of the soil types within the project area are classified as prime farmland and as partially hydric by the NRCS (NRCS 2011a).

Construction of wells would impact soils in the immediate vicinity of the wells and pads. The project would not change land use and would only impact a small total area. Some soil would be converted to impervious surfaces to provide pads for the wells; however, these impervious surfaces would be small and would not be expected to significantly impact surface water infiltration. There would be little potential for adverse impacts to area surface water as a result of construction. The soils are classified as prime farmland soil; however, they do not have the potential to support agriculture because of the existing oil field. No impacts to soils are anticipated as a result of the proposed project.

IV.3.2.2.1.3 Floodplains and Wetlands

Floodplains: Executive Order 11988, *Flood Plain Management*, requires that development in floodplains be avoided if practicable. One existing well and one proposed well site would be located within the FEMA 100-year floodplain of Chigger Creek. Due to the location of the project, the wells cannot be located outside of the 100-year floodplain. However, the wells would not be expected to cause any changes in the flow of surface water, flood storage capacity, infiltration, or runoff at the site. The wells and surrounding pads would be small and would constitute only a minimal fill within the floodplain. No floodplain impacts are anticipated as a result of the project.

Wetlands: The NWI indicates that several wetlands are present within the West Hastings Field MVA area, mainly in the vicinity of Chigger Creek. Project wells and construction areas would be located outside of wetland areas and best management practices would be utilized to prevent runoff from entering wetlands outside of construction areas. No impacts to wetlands are anticipated as a result of the proposed project.

IV.3.2.2.2 No-Action Alternative

DOE assumes for purposes of this EA that Air Products' proposed project would not proceed without DOE financial assistance. Under this No-Action Alternative, the MVA activities discussed above would not take place. Therefore, there would be no impacts to water resources and soils related to MVA activities under the No-Action Alternative. However, significant commercial EOR development in the West Hastings Field would likely continue with natural CO_2 obtained from the Jackson Dome and other sources rather than CO_2 supplied by Air Products. Denbury is also a subcontractor to another company, Leucadia Corporation, who has requested funding from the DOE for the Lake Charles Petcoke project, which would also use the Green Pipeline and MVA activities under that project may take place at the West Hastings Field independent of whether the Air Products proposed project receives DOE funding.

IV.3.3 Land Use

IV.3.3.1 AFFECTED ENVIRONMENT

While the overall extent of the Hastings Oil Field consists of approximately 25 square miles of rural farmlands, suburban areas, and residential neighborhoods, the proposed project area is less than four square miles located between Alvin and Pearland, Texas on State Highway 35. The Hastings Oil Field was discovered in 1934 and oil production continues to be a primary land use in the area (Texas State Historical Association (TSHA) 2010a). The project area contains approximately 80 active, 100 inactive, and 110 P&A wells, as well as a number of temporarily abandoned (TA) Wells.

According to the 2001 USGS Land Use Survey (USGS 2011), a large portion of the area is dedicated to pasture hay and cultivated crops. The majority of the remaining area is in open space and low intensity development. Pockets of medium intensity and high intensity development are located in the area, primarily along and just east of State Highway 35. Only small, scattered areas of deciduous forests and shrub/scrub areas remain. Cowart Creek is located in the northeastern section of the area and Chigger Creek flows through the southern edge. Both streams are small tributaries of Clear Creek approximately 3.5 miles to the east of the site.

State Highway 35 runs north-south through the eastern portion of the project area, and County Road 128 (Hastings Cannon Road) runs east-west along the northern portion of the project area. Numerous smaller county and private roads provide access to the site. A spur of the Burlington Northern (Atchison Topeka and Santa Fe) Railroad also intersects the project area to the west. A large high-power transmission line is located southwest of the project site.

An extensive network of large oil and gas pipelines exists in this part of the North Gulf Texas coastal area and many run within a few miles of the project area. Pipelines are owned and operated by the following companies in the West Hastings Field: BP Pipelines, Conoco Phillips, Enterprise Products, Exxon Mobil GGS, Kinder Morgan, Tejas, Texas Eastern Transmission, TexCal Energy, and several others. A large network of smaller gathering pipelines also services the existing well sites in the Hastings Field. High pressure and low pressure gas collection lines, production water and salt water lines, and power lines service the area, as well.

IV.3.3.2 ENVIRONMENTAL CONSEQUENCES

IV.3.3.2.1 Proposed Project

Denbury's existing EOR operations, which are not included in this proposed project, include drilling and/or reworking a large number of wells in the Hastings Field that are or would be used for injection of CO_2, production of oil and gas, testing, water production, and brine disposal. All activities related to the commercial operations at the West Hastings Field project site would be permitted by the RRC and used for EOR operations being conducted by Denbury. EOR operations and commercial monitoring activities would be conducted by Denbury regardless of the implementation of the research MVA activities.

All research MVA activities would be consistent with the current oil and gas production land use within the West Hastings Field. MVA activities would be conducted in existing idle wells within the project area or may require only minor, temporary drilling of shallow groundwater and soil-gas testing boreholes. If new wells are required, existing well pads would be used, if possible, to reduce or eliminate changes in land use.

IV.3.3.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that MVA activities would not occur. Therefore, there would be no impacts to land use under the No-Action Alternative. However, significant commercial EOR development in the West Hastings Field would likely continue with natural CO_2 obtained from the Jackson Dome and other sources rather than CO_2 supplied by Air Products. Denbury is also a subcontractor to another company, Leucadia Corporation, who has requested funding from the DOE for the Lake Charles Petcoke project, which would also use the Green Pipeline and MVA activities under that project may take place at the West Hastings Field independent of whether the Air Products proposed project receives DOE funding.

IV.3.4 Biological Resources

IV.3.4.1 AFFECTED ENVIRONMENT

This section describes existing biological resources at the proposed project site. It focuses on plant and animal species or habitat types that are typical or are an important element of the ecosystem, are of special category importance, or are protected under state or federal law or statute regulatory requirement.

The study area is within Brazoria County, Texas, which is in the West Galveston Bay Watershed (hydrologic unit code: 12040204). The mean annual rainfall is approximately 50 inches and the mean annual temperature is 69 °F. Soils in the county are chiefly alluvial loams and clays and are highly productive when well drained. The growing season averages 309 days a year (TSHA 2011).

The project is located within the Western Gulf Coastal Plain EPA Level III ecoregion, as well as the Northern Humid Gulf Coastal Prairies EPA Level IV ecoregion (USEPA 2011a). The principal distinguishing characteristics of the Western Gulf Coastal Plain are its relatively flat coastal plain topography and mainly grassland potential natural vegetation. Inland from this region, the plains are older, more irregular, and have mostly forest or savanna-type vegetation potentials. Largely because of these characteristics, a higher percentage of the land is in cropland than in bordering ecological regions. Urban and industrial land uses have expanded greatly in recent decades, and oil and gas production is common.

As discussed above in Section II.3.4.1, the USFWS administers the Endangered Species Act of 1973, as amended. This law provides federal protection for species designated as federally endangered or threatened. Nine federally listed threatened and endangered species have the potential to occur in Brazoria County, as listed in Table IV.3.4-1.

Table IV.3.4-1. Federally Listed Endangered and Threatened Species Potentially Occurring in Brazoria County, Texas.

Type	Species	Scientific Name	Federal Status
Bird	Bald Eagle	*Haliaeetus leucocephalus*	Delisted
Bird	Piping Plover	*Charadrius melodus*	Endangered
Bird	Brown pelican	*Pelecanus occidentalis*	Delisted
Bird	Whooping Crane	*Grus americana*	Endangered
Reptile	Green sea turtle	*Chelonia mydas*	Endangered
Reptile	Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Reptile	Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Reptile	Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Reptile	Loggerhead sea turtle	*Caretta caretta*	Threatened

Bald eagles are known to occur in quiet coastal areas, rivers, or lakeshores with large, tall trees. Man-made reservoirs have provided excellent habitat. Bald eagles are opportunistic predators feeding primarily on fish, but also eat a variety of waterfowl and other birds, small mammals, and turtles. Carrion is also common in the diet, particularly in younger birds. Bald eagle populations have increased to the extent that they have been delisted from the Federal Endangered Species List. However, the species is protected by the Bald and Golden Eagle Act and the Migratory Bird Treaty Act.

The brown pelican can be found in coastal areas like sandy beaches and lagoons. It can also be found around waterfronts and marinas. Brown pelicans eat marine fish and crustaceans. Brown pelican populations have increased to the extent that they have been delisted from the Federal Endangered Species List.

Whooping cranes are a long-lived species and current estimates suggest a maximum longevity in the wild of at least 30 years. Whooping cranes currently exist in the wild at three locations and in captivity at 12 sites. The July 2010 total wild population was estimated at 383. There is only one self-sustaining wild population, the Aransas-Wood Buffalo National Park population, which nests in Wood Buffalo National Park and adjacent areas in Canada, and winters in coastal marshes in Texas at Aransas. The total population of wild and captive whooping cranes in July, 2010, was 535 (USFWS 2011b).

Piping Plovers live on sandy beaches and lakeshores. These shorebirds migrate through the Great Lakes along the river systems through the Bahamas and West Indies. They are currently found along the Atlantic Coast from Canada to North Carolina and along the shorelines of Lakes Michigan and Superior. Gulf Coast beaches from Florida to Mexico, and Atlantic coast beaches from Florida to North Carolina provide winter homes for plovers. The project area does not include any sandy beaches or lakeshores.

The Atlantic hawksbill sea turtle, green sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle are each listed as either threatened or endangered, both Federally and in the state of Texas. Sea turtles are found only in oceans and coastal areas. The project area does not include these any ocean or coastal areas.

IV.3.4.2 ENVIRONMENTAL CONSEQUENCES

IV.3.4.2.1 Proposed Project

The site has been previously developed as an oil field, and is therefore located in previously disturbed habitat. The habitats that would be impacted are generally low- to medium-quality, typical of disturbed areas.

Construction impacts would be of a relatively short duration and small spatial extent. Larger and more mobile fauna would be capable of avoiding direct mortality from construction activities. Since the area has been previously disturbed no habitat fragmentation or changes in land use would occur. The wells and pads would result in a loss of habitat. The loss of habitat would not adversely impact any plant or animal species, as the proposed project site is small, located in a disturbed area, isolated from large tracts of undisturbed habitat. The plant and animal species found in this type of habitat are common and widespread and no rare species are expected to occur.

Federally-listed threatened and endangered species occurring in Brazoria County are: piping plover, whooping crane, Atlantic hawksbill sea turtle, green sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. The bald eagle and brown pelican have been delisted due to recovery. Bald eagles use tall trees near large open bodies of water; piping plovers and brown pelicans rely on coastal habitats; and whooping cranes utilize large coastal wetlands. The five sea turtle species are found in oceans and shorelines. None of these required habitat types are found in the project area. Habitat types found in the project area are unlikely to support populations of State listed species. Therefore, no project-related impacts to threatened or endangered species are anticipated.

IV.3.4.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that MVA activities would not occur. Therefore, there would be no impacts to existing biological resources under the No-Action Alternative. However, significant commercial EOR development in the West Hastings Field would likely continue with natural CO_2 obtained from the Jackson Dome and other sources rather than CO_2 supplied by Air Products. Denbury is also a subcontractor to another company, Leucadia Corporation, who has requested funding from the DOE for the Lake Charles Petcoke project, which would also use the Green Pipeline and MVA activities under that project may take place at the West Hastings Field independent of whether the Air Products proposed project receives DOE funding.

IV.3.5 Historic and Cultural Resources

IV.3.5.1 AFFECTED ENVIRONMENT

Cultural resources are defined as historic properties, cultural items, archaeological resources, sacred sites, and artifact collections and associated records as defined by the NHPA; Native American Graves and Repatriation Act; Archaeological Resources Protection Act; Executive Order 13007, to which access is afforded under the American Indian Religious Freedom Act; and 36 CFR Part 79, respectively. The APE for cultural resources includes property within and immediately adjacent to the proposed project components, either temporarily during construction or permanently throughout operations. The Air Products project would involve a MVA program within the West Hastings Oil Field in Brazoria County, Texas, as described above.

On April 5, 2011, DOE submitted documentation to the Texas SHPO, explaining DOE's conclusion that no cultural resources eligible for listing on the NRHP would be affected by the MVA project component. DOE's determination was based on a study conducted by URS (URS 2011a), which also was supplied to the SHPO. On May 3, 2011, the SHPO concurred with the DOE's conclusion. The DOE letter and SHPO correspondence are included in Appendix B of this EA.

IV.3.5.2 ENVIRONMENTAL CONSEQUENCES

DOE does not expect the MVA component of Air Products' proposed project to directly or indirectly impact cultural resources or historic properties. There are no historic properties as defined by the NHPA identified on the Texas Archeological Site Atlas or the National Register of Historic Places within one mile of these project components in Brazoria County.

IV.3.5.2.1 Proposed Project

In the event cultural resources (e.g., human remains, stone tools, prehistoric or historic pottery, remnants of older pipeline construction) are discovered during conversion of the existing wells or the drilling of new well sites, work would cease in the area of the discovery and the Texas SHPO would be notified. A qualified archaeologist would evaluate any such discovery and, in consultation with the SHPO, implement appropriate mitigation measures before construction activities would resume.

IV.3.5.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that MVA activities would not occur. Therefore, there would be no impacts to existing cultural resources under the No-Action Alternative. However, significant commercial EOR development in the West Hastings Field would likely continue with natural CO_2 obtained from the Jackson Dome and other sources rather than CO_2 supplied by Air Products. Denbury is also a subcontractor to another company, Leucadia Corporation, who has requested funding from the DOE for the Lake Charles Petcoke project, which would also use the Green Pipeline and MVA activities under that project may take place at the West Hastings Field independent of whether the Air Products proposed project receives DOE funding.

PART V. COMBINED PROJECT IMPACTS

Part V of the Environmental Assessment addresses Socioeconomics, Environmental Justice, Human Health and Safety, Resource Commitments, Cumulative Impacts and Conclusions.

V.1 SOCIOECONOMICS

This section describes the socioeconomic conditions and impacts that would be created in the project area as a result of the proposed project.

V.1.1 Affected Environment

Information on low-income populations was evaluated from USCB data using a statistical poverty threshold, which is based on income and family size. "Poverty areas" are defined as those areas where 20 percent or more of the residents have incomes below the poverty threshold. "Extreme poverty areas" are areas where 40 percent or more of the residents are below the poverty level (CEQ 1997).

The proposed project site is in Jefferson and Brazoria Counties, in southeast Texas. Based on 2010 census data, the populations of Jefferson and Brazoria Counties are 252,273 and 313,166 persons, respectively. These data indicate essentially no growth in Jefferson County and 30 percent growth in Brazoria County since 2000, as listed in Table V.1.1-1.

Table V.1.1-1. Population for Cities and Counties

Geographical Area	2000 Census Population	Estimated 2010 Population	Percent Change from 2000 to 2010
Port Arthur	57,755	53,814	-7
Beaumont	113,866	118,296	4
Nederland	17,422	17,547	1
Jefferson County	252,051	252,273	0
Alvin	21,475	24,236	13
Pearland	37,640	86,706	130
Brazoria County	241,767	313,166	30

Source: USCB 2000; USCB 2011a

Employment figures for Jefferson and Brazoria Counties reflect the urban/suburban nature of the areas. These counties hosted approximately 177,500 non-farming jobs in 2009 (USCB 2011b). The Beaumont/Port Arthur area is located in Jefferson County. This area's labor force had an unemployment rate of 11.6 percent (not seasonally adjusted) in January 2011, which was about 3 percent higher than the state's rate of 8.5 percent for the same month (Texas Workforce Commission [TWC] 2011). Jefferson County and Brazoria County had unemployment rates of 12.0 and 9.5 percent, respectively.

The 2008 per capita income in Jefferson County of about $36,071 and in Brazoria County of about $36,699 was about 95 and 97 percent, respectively, of the state of Texas per capita income (Bureau of Economic Analysis [BEA] 2010). In 2008, about 16 percent of Jefferson County residents and 10 percent of Brazoria County residents were living in poverty (USCB 2011b). Within the region of influence, Port Arthur has the highest poverty rate of 23 percent (USCB 2011a). Section V.2 discusses racial and ethnic populations and the low-income population in more detail in relation to environmental justice.

V.1.2 Environmental Consequences

V.1.2.1 Proposed Project

The proposed project would create about 189 direct temporary jobs during the 19-month construction phase. During the operations phase, about 14 new jobs would be created, as listed in Table V.1.2-1. Direct socioeconomic changes as a result of the proposed project would be temporary during the construction phase and minor during the operations phase. The proposed project would not result in workers moving to the area except for temporary construction workers. There would likely be very minor changes to population, infrastructure demand, or the level of social services. In addition, vendors and equipment suppliers would benefit from capital orders for equipment and supporting components and systems.

Table V.1.2-1. Estimated Employment.

Project Component	Estimated Construction Jobs Created	Duration	Estimated Operations Jobs Created	Duration
Carbon Capture	85*	19 months	5	Into the foreseeable future
Pipeline	90	4 months	1 to 2	Into the foreseeable future
MVA	14	4 months	7	Up to 4 years

* The estimated average number of construction jobs for the carbon capture component is 85 jobs over the 19-month construction period. The peak number of construction jobs for the carbon capture component during the 19-month construction period is estimated at 161 jobs.

V.1.2.2 No-Action Alternative

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that proposed project activities would not occur. Therefore, construction activities would not take place and no socioeconomic impacts would occur under the No-Action Alternative.

V.2 ENVIRONMENTAL JUSTICE

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (59 FR 32, 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 CEQ guidance document, "Environmental Justice: Guidance Under the National Environmental Policy Act", directs that a minority population should be identified where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population of the larger surrounding area (CEQ 1997). The term "minority population" includes persons who identify themselves as black, Asian or Pacific Islander, Native American or Alaskan Native, or being of Hispanic origin. "Race" and "ethnicity" are terms that refer to U.S. Census respondents' self-identification of racial or ethnic background.

The region of influence for the analysis is Jefferson County and Brazoria County because workers are expected to be drawn from a range of communities within the counties, to the extent feasible.

In 2010, the Jefferson County population was 52 percent white, 34 percent black, and 3 percent Asian. Persons of Hispanic or Latino origin made up 17 percent of the population as shown in Table V.2-1. In 2010, the Brazoria County population was 70 percent white, 12 percent black, and 6 percent Asian. Persons who declared themselves to be of Hispanic or Latino origin made up 28 percent of the population (USCB 2011a).

Table V.2-1. Population and Low Income Characteristics

Category	Port Arthur	Jefferson County	Alvin	Pearland	Brazoria County	State of Texas
White	36%	52%	79%	62%	70%	71%
Black or African American	41%	34%	3%	17%	12%	12%
Native American	>1%	>1%	>1%	>1%	>1%	1%
Asian	6%	3%	1%	12%	6%	3%
Other	19%	8%	>1%	6%	9%	12%
Hispanic or Latino Origin	30%	17%	1%	21%	28%	32%
Families below Poverty, 1999	23%	16%	NA [a]	5%	10%	16%

Source: USCB 2011a, USCB 2011b

[a] Families below poverty for Alvin, Texas are not available from the USCB.

Table V.2-1 lists racial and ethnic data about persons in Jefferson County, Brazoria County and cities near the project, and for comparison, the state of Texas. Port Arthur has large ethnic minority populations; persons of African American ethnicity made up about 41 percent of the city's residents in 2010. For comparison, Jefferson County has 34 percent of black or African American ethnicity and Brazoria County has 12 percent. All the government units except the City of Alvin are higher than the statewide average of 12 percent. The aggregate percent of all racial minorities (black, American Indian or Alaskan Native, Asian, or of two or more races) was 45 percent in Jefferson County, 27 percent in Brazoria County, and 16 percent in Texas. Hispanics may be of any race, so are included in applicable race categories. Neither racial nor ethnic minority persons would experience adverse socioeconomic impacts from the proposed projects.

Consideration of the potential consequences of the proposed project 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.

Low Income Populations

Within Jefferson County, 16 percent of the population is below the low income threshold. Similarly, within Brazoria County, 10 percent of the population is below the low income threshold. If the counties had more than 20 percent of the population in the low income category, the counties would be considered to be low income areas. Some places within Jefferson County have a higher percentage of low income populations, such as Port Arthur, which has a rate of 23 percent. On a county basis, the proposed project would have no impact on low income populations.

Minority Populations

A similar analysis was conducted to determine if minority populations would receive disproportionate and adverse impacts. Jefferson County has a 45 percent minority population, while Brazoria County has a 27 percent minority population.

Port Arthur has a 68 percent minority population (USCB 2000). For comparison purposes, the state of Texas has 28 percent minority populations. In general, the impacts from the proposed project would have roughly an equal impact on minority and non-minority populations for those resource areas that have a large ROI, such as all of Jefferson and Brazoria Counties. Air emissions would be limited to the levels allowed by a TCEQ permit and would not be disproportionate or severe for minority populations. The reduction in CO_2 emissions that would result from the proposed project would benefit minority and other populations in a similar manner.

V.3 HUMAN HEALTH AND SAFETY

V.3.1 AFFECTED ENVIRONMENT

A variety of human health risks to workers and members of the public are present whenever an industrial operation is constructed and operated. Air pollution can cause human health problems such as breathing problems; throat and eye irritation; cancer; birth defects; and damage to immune, neurological, reproductive, and respiratory systems. 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. In addition, Occupational Safety and Health Administration (OSHA) regulations specify appropriate protective measures for workers.

Spills from the construction of the proposed project and its operation could also be 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 and extent of pollution.

CO_2 leaks are a concern to human health and safety within the project area from a potential accidental release. CO_2 is heavier than ambient air, colorless, and odorless, which makes it an invisible hazard (DOE 2007). Since it is denser than ambient air, leaked CO_2 would typically pool in hollows and confined spaces until dispersed by wind or other ventilation methods (DOE 2007; Intergovernmental Panel on Climate Change [IPCC] 2005). CO_2 under pressure or at high concentration levels can cause suffocation and permanent brain injury from lack of air (DOE 2007). Headache, impaired vision, labored breathing, and mental confusion also can occur from CO_2 exposure. The pressure drop from CO_2 leaks from process vessels (including 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 2007).

In the years from 1994 through 2006, 31 CO_2 pipeline accidents were reported in the United States, but no injuries or fatalities (DOE 2007). Some historical causes of CO_2 pipeline incidences are relief valve failure (4 failures); weld, gasket, and 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 U.S. was 0.0002 per mile per year (IPCC 2005). This rate of failure is comparatively small. For comparison with natural gas pipelines, see Table V.3-1.

Table V.3-1. Comparison of Natural Gas Pipelines to CO_2 Pipelines from 1995 to 2005

Category	**Natural Gas**	**CO_2**
Miles of Pipeline	304,001 (in 2003)	3,300
Number of Incidents	960	12
Property Damage per Incident	$484,000	$42,000
Injuries from Incidents	82	0
Fatalities	29	0

Source: DOE 2007

Construction work within existing utility ROWs poses risks due to possible rupture of natural gas lines or inadvertent contact with buried electrical lines. Pipeline rupture types of accidents are classified as “outside force” initiating events and are included in the numbers presented in Table V.3-1. All buried electrical lines and pipelines in the proposed ROW for the pipeline lateral would be identified before commencement of construction to assure pipeline and electrical line clearances are sufficient and would not pose a hazard to construction workers involved with the installation.

V.3.2 ENVIRONMENTAL CONSEQUENCES

The workers on the project would be subject to the same types of health risks that are generally associated with their professions (DOE 2007). The most fatalities of any industry in the private sector in 2008 occurred in the construction industry with 404 deaths in 2008 (BLS 2009a). The construction incident rate of total recordable cases of non-fatal occupational injuries and illnesses in 2008 was 4.7 per 100 full-time workers (BLS 2009b).

Air Products' proposed project would include construction and operation of a CO_2 capture, compression, and dehydration facility, pipeline installation, collection and transportation of CO_2, and drilling of monitoring and observation wells associated with MVA activities at an existing oil field, as discussed above in Parts II though IV). These could all present risks to human health and safety. The materials and equipment used for construction and operation would meet prescribed standards.

The equipment that would be used for the implementation of the proposed project represents only minimal risks to human health and safety under normal operating conditions (DOE 2007). Thus, if BMPs, maintenance, and regulations are followed, the equipment would 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 would be implemented. Measures to avoid the equipment failure caused by high pressure would be executed (DOE 2007). Air Products' and Denbury's safety procedures would be updated as necessary for the new project components.

Air emissions from the proposed project are not anticipated to be regionally significant, as discussed above in Sections II.3.1.2, III.3.1.2, and IV.3.1.2. Thus, the impacts to human health from air emissions would not be expected to exceed the significance thresholds. 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 natural gas burning from the dehydration reboiler and cogeneration unit would produce air pollutants in the amounts estimated in Section II. The amounts of pollutants that would be emitted are less than the threshold for a full air permit and would therefore be protective of human health.

The only new hazardous or toxic material used in the proposed project is TEG. Other hazardous or toxic materials used in the proposed project are currently in use at the Air Products facility, such as CO_2, syngas, gasoline, diesel fuel, and natural gas. Therefore, if safety procedures and BMPs were 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 2007). Under normal conditions, hazardous and toxic materials can be used safely when appropriate safety precautions are followed (DOE 2007).

The design of the proposed project's MVA plan would be to detect, any unintended CO_2 emissions and to quantify the amount of emissions that may be detected. The Anahuac Formation above the Frio and the Vicksburg unit below present at the proposed injection site make groundwater contamination highly unlikely (Hovorka 2010). With monitoring and adherence to BMPs, the risk from unintended CO_2 emissions would be low. Denbury would take appropriate actions to address unexpected releases of CO_2 from their ongoing EOR operations.

The CO_2 pipeline lateral from the CO_2 capture facilities to the Green Pipeline would be similar to most CO_2 pipeline systems except the diameter would be smaller (i.e., 8 inches). The carbon steel pipe segments are nominally 40 feet (approximately 12 meters) long with welded seams. Stainless steel would not be 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 CO_2 pipeline lateral would be installed primarily underground. Line markers would be used to locate the pipeline, and the location would be entered into the Air Products database of plant facilities and information. Having the pipeline location information known in the database would help reduce the risk of accidents from construction and operation of other onsite activities. With the potential risk for CO_2 leaks, implementing the BMPs would reduce the consequences of any incidents. Any additional necessary monitoring identified in the planning and design process would be initiated. Too much pressure would cause automatic venting of the compressor and injection system to reduce the safety risks from equipment malfunction.

As required by DOT 195, Air Products will inspect the surface conditions of our CO_2 pipeline ROW at least 26 times per year. The inspections will be done by walking, driving, or flying. Lightweight off-road vehicles or walking will be used on ground patrols for areas which cannot be viewed from an existing road. Pipeline inspection and monitoring would reduce the risks of failures and thus the possible effects to human health. One of the major concerns regarding pipeline safety is water and other contaminants causing corrosion leading to pipe failure (DOE 2007). However, the CO_2 would be dried and removed of contaminants, which reduces the risk from pipeline failure.

In the event of a substantial CO_2 release, employees would have been informed and regarding appropriate evacuation procedures following Air Products and Denbury safety plans and adhering to the training provided beforehand. Further, modeling of atmospheric dispersion and CO_2 concentration distribution around the project site and vicinity of atmospheric CO_2 releases would have been conducted during the design in order to develop and implement additional emergency response plans that may be needed 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 2007). Protective equipment such as hard hats, safety shoes, hearing protection (earplugs), and safety glasses would be worn in accordance with applicable industry standards and regulations. 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 procedures would minimize occupational hazards (DOE 2007).

The risks to human health and safety from a rapid release of CO_2 as a result of activities associated with the proposed project would depend on the quantity released, conditions (such as wind direction and speed) at the time of the release, and the land terrain and constructed features (DOE 2007). 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 breathing the air (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 the injection site (IPCC 2005; Heinrich et al. 2004). Once the release is over, no lingering effects would occur (IPCC 2005; Heinrich et al. 2004). In addition, the oil and gas industry employs engineering and administrative controls to minimize these types of hazards (IPCC 2005). Therefore, while the risk of accidents exists, the risks to human health and safety, with the proper response plans and monitoring, would be below the significance threshold.

A meter station would be constructed and operated as part of the CO_2 pipeline lateral near the connection with the Green Pipeline. The station and related valves would be a permanent part of the ongoing CO_2 pipeline lateral operations. The overall amount of land that would be occupied by the meter station will be less than 0.1 acre, as indicated in Appendix C.

Currently, Denbury's staff handles and transports CO_2 and has experience with high-pressure pipelines and CO_2 at supercritical conditions through the operation of the Green Pipeline and EOR injection at the West Hastings Field. Air Products' and Denbury's safety procedures would be updated as necessary for the new project components. Workers would also be trained on safety procedures, especially ones related to handling of high pressure CO_2. Additionally, the proposed project 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 2007). Decommissioning of any of the components of the project would represent types of risks similar those during the construction phase. Thus, with proper safety procedures, the impact to human health and safety would be minimal. 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.

V.3.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, Air Products would not receive funds from DOE for the overall project and DOE assumes that proposed project activities would not occur. Therefore, there would be no construction, operation, or decommissioning of the CO_2 capture facility, the CO_2 pipeline, and the MVA activities at sequestration project site. The risks listed in the previous section would not occur, which would mean no impacts to human health and safety under the No-Action Alternative.

V.4 RESOURCE COMMITMENTS

V.4.1 Relationship between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

CEQ regulations that implement the procedural requirements of NEPA require consideration of the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity (40 CFR 1502.16). Construction and operation of the carbon capture facilities, the CO_2 pipeline lateral, and the MVA activities would require short-term use of land and other resources. Short-term use of the environment, as used here, is use during the life of the carbon capture operations, whereas long-term productivity refers to the period of time after the equipment has been decommissioned and removed. The short-term use of the project site and other resources for Air Products' proposed project would not impact the long-term productivity of the area. When it is time to decommission and remove the equipment, the land and facilities occupied by those facilities could be used for other industrial purposes, or the land could be reclaimed and revegetated to resemble pre-disturbance conditions.

V.4.1.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

There would be an irretrievable commitment of the land and facilities at the proposed project site. Valero had previously used the parcel of property proposed for use by the carbon capture facilities as part of their oil refining activities. Similarly, the pipeline lateral would occupy land primarily within an existing pipeline and utility corridor. A commitment of land in the MVA area was made when the oil field wells and equipment were installed in the West Hastings Field. No new land areas would be committed by the EOR operation.

V.4.1.3 UNAVOIDABLE ADVERSE IMPACTS

Construction and operation of the CO_2 capture facilities, the CO_2 pipeline lateral, and the MVA activities would cause unavoidable impacts to soils in the immediate area. DOE anticipates such impacts would be minimized by adherence to the BMPs of Air Products and its subcontractor, Denbury. An example is that the ground conditions would be restored to approximate pre-existing conditions by conserving topsoil, and replacing it to revegetate construction areas after the pipeline construction is completed. Likewise, minor impacts to certain wetlands and floodplains would be unavoidable. These impacts also would be minimized by following BMPs, adhering to the requirements of the USACE permit and by using less disruptive construction techniques, such as HDD construction methods for major waterbody and wetland crossings.

V.5 CUMULATIVE IMPACTS

CEQ regulations stipulate that the cumulative impacts analysis in an EA consider the potential environmental impacts resulting from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7). Because the impacts of the proposed project generally would be minor and localized, DOE focused this evaluation of cumulative impacts on activities immediately surrounding the proposed project site and other past, present, and reasonably foreseeable future actions in Jefferson County and Brazoria County, Texas. Conditions resulting from past and ongoing activities are included in the descriptions of the affected environment in Parts II, III, and IV of this EA. The following sections describe present actions (Section V.5.1), reasonably foreseeable future actions (Section V.5.2), and the incremental cumulative impacts of installation and operation of the proposed project (Section V.5.2).

V.5.1 Present Actions

To identify present actions in and around the proposed project facilities and operations in Jefferson and Brazoria Counties, DOE primarily considered information in local media outlets and on the planned expansion and development in those counties. Larger industrial projects or operations are summarized below.

- Port activity at Port Arthur related to oil and gas activities and loading/unloading of other cargo.
- Oil and gas production, gathering pipelines, transportation (pipelines), refining, and distribution in Jefferson County and Brazoria County, Texas.
- Bryan Mound Strategic Petroleum Reserve Storage Site in Brazoria County, Texas.
- Big Hill Strategic Petroleum Reserve Storage Site near Beaumont in Jefferson County, Texas.
- Denbury's Green Pipeline became operational in late 2010 and conveys CO_2 from the Jackson Dome in Mississippi through a 24-inch diameter line from near Donaldsonville, Louisiana to multiple oil fields along the southeast Texas Gulf Coast, including the West Hastings Field. Two projects are proposed to connect to the Green Pipeline with a pipeline lateral: (1) Air Products' proposed project (i.e., as described in this EA), and (2) the Leucadia Corporation Lake Charles Petcoke Syngas project.

V.5.2. Reasonably Foreseeable Future Actions

The following projects have been announced and may be developed at some time in the future. DOE does not make any assurances that these projects would actually happen as planned and proceed through the final construction phase, so the cumulative effect of the combined projects may be less than if all projects become operational.

- TX Energy Industrial Gasification Facility near Beaumont, Texas. The facility would utilize gasification technology with petroleum coke (petcoke) as the feedstock to produce synthesis gas, which is a mixture of CO and H_2 commonly referred to as syngas, and molten sulfur. The majority of the CO_2 produced from clean-up of the raw syngas would be captured and transferred from the facility via a newly constructed pipeline spur (no longer than two miles) to a new pipeline for use in EOR; CO_2 not captured would be vented.
- Sempra LNG plans to build the Port Arthur liquefied natural gas (LNG) terminal along the Port Arthur Ship Canal in Texas. The site is part of nearly 2,800 acres of land owned

by Sempra Energy. The Port Arthur LNG terminal would be capable of delivering between 1.5 and 3 billion cubic feet (Bcf) per day of natural gas. The Port Arthur LNG project would include two unloading docks for ships and three to six full containment storage tanks and associated equipment in order to transform the LNG back to its gaseous state.

- The TransCanada Keystone XL pipeline system would provide a link to secure growing supplies of Canadian crude oil with the largest refining markets in the United States, significantly improving North American security supply. The proposed Keystone Gulf Coast Expansion Project is an approximate 1,661-mile, 36-inch crude oil pipeline that would begin at Hardisty, Alberta and extend southeast through Saskatchewan, Montana, South Dakota and Nebraska. It would incorporate a portion of the Keystone Pipeline (Phase II) through Nebraska and Kansas to serve markets at Cushing, Oklahoma before continuing through Oklahoma to a delivery point near existing terminals in Nederland, Texas to serve the Port Arthur, Texas marketplace.

V.6 CONCLUSIONS

DOE's proposed action would provide Air Products with $284 million in financial assistance in a cost-sharing arrangement to facilitate the capture of approximately one million tons of CO_2 per year at two existing SMR plants; construction of a 12.8-mile-long CO_2 pipeline lateral; and performance of MVA activities to monitor the potential impacts of injection and sequestration of the injected CO_2 in a geologic formation. The proposed project would perform these MVA activities at the West Hastings Field, the destination for the CO_2. DOE concludes the following about the potential environmental impacts of its proposed action and Air Products' proposed project.

- Construction and operation of the CO_2 capture facilities, CO_2 pipeline lateral, and MVA activities would result in no impact to minimal impacts on land use; environmental justice; health and safety; biological resources; cultural resources; geologic and soil resources; and water resources.
- The proposed project would have minor, temporary impacts to wetlands and stream crossings resulting from the construction of the CO_2 pipeline lateral in Jefferson County and potentially resulting from construction of a few of the monitoring wells to be installed at the south end of the West Hastings Field.
- The proposed CO_2 capture facility would generate criteria pollutants subject to an air permit(s) issued by the TCEQ, resulting in minor impacts to air quality in the area. However, Air Products' proposed project would capture greater than 90 percent of the CO_2 from the process gas stream used in Air Products' Port Arthur, Texas H_2 production facilities, resulting in a minor, positive impact to air quality due to GHG reduction, which would otherwise continue to be vented to the atmosphere.
- The overall project would create approximately 189 construction jobs with an average duration of approximately 4 to 19 months and 14 operational jobs that would last indefinitely as the operation would continue beyond the timeframe when DOE funds have been expended, resulting in a minor economic benefit in Jefferson and Brazoria Counties.

V.7 REFERENCES

Air Products 2010. "*Environmental Information Volume for Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production, Part 4: Environmental Information Volume for Denbury Onshore, LLC CO_2 Sequestration Monitoring, Verification, and Accounting, Hastings Field, Texas*". April, 2010.

Air Products 2007. *Spill Prevention Control and Countermeasure Plan*, Air Products, LLC, Port Arthur Facility (PAI and PAII). October, 2007.

ATSDR(Agency for Toxic Substances and Disease Registry) 1996. ToxFAQsTM: Automotive Gasoline. http://www.atsdr.cdc.gov/toxfaqs/tfacts72.pdf (accessed April, 2011)

Baker, E.T. 1979. *Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas*. Texas Department of Water Resources Report 236. July, 1979.

BCGCD (Brazoria County Groundwater Conservation District) 2008, Rules adopted May 8, 2008, (accessed March, 2011)

BEA (Bureau of Economic Analysis) 2010. Per capita personal income, CA1-3 – Personal income summary. Regional Economic Information System. Bureau of Economic Analysis. April, 2010.

BEG (Bureau of Economic Geology) 1996. Physiographic Map of Texas. *http://www.beg.utexas.edu/UTopia/images/pagesizemaps/physiography.pdf*. (accessed March 21, 2011)

BLS (U.S. Bureau of Labor Statistics) 2009a. Census of Fatal Occupational Injuries Summary, 2008. http://www.bls.gov/news.release/cfoi.nr0.htm. (accessed April, 2011)BLS (U.S. Bureau of Labor Statistics) 2009b. Incidence Rates of Total Recordable Cases of Nonfatal Occupational Injuries and Illnesses by Quartile Distribution and Employment Size, Private Industry, 2008. Accessed April 2011 at http://www.bls.gov/iif/oshwc/osh/os/ostb2075.txt

CEQ (Council on Environmental Quality) 1997, Environmental Justice: Guidance Under the National Environmental Policy Act (http://ceq.hss.doe.gov/nepa/regs/ej/justice.pdf)(accessed March, 2011)

Cowardin, L.M.; Carter,V.; Golet, F.C.; and LaRoe, E.T. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior – Fish and Wildlife Service, Office of Biological Services. Washington, D.C. http://repositories.tdl.org/tamug-ir/bitstream/handle/1969.3/20139/2360-classification%20of%20wetlands%20and%20deep-water%20habitats%20of%20the%20United%20States.pdf?sequence=1(accessed March 21, 2011)

Denbury (Denbury Resources Inc.) 2011a. "*The Green Pipeline Project*". http://www.denbury.com/index.php?id=51(accessed March 4, 2011)

Denbury (Denbury Resources Inc.) 2011b. "*February 3, 2011 News Release: Denbury Reports Year-End Proved Oil and Gas Reserve*". http://phx.corporate-ir.net/phoenix.zhtml?c=72374&p=irol-newsArticle&ID=1523651&highlight (accessed March 4, 2011)

Denbury (Denbury Resources Inc.) 2011c. "*January 3, 2011 News Release: Denbury Completes Sale of its Interests in Encore Energy Partners LP; CO_2 Injections Commence at Hastings Field*". http://phx.corporate-ir.net/phoenix.zhtml?c=72374&p=irol-newsArticle&ID=1511921&highlight=(accessed March 4, 2011)

Denbury (Denbury Resources Inc.) 2010a. "*November 4, 2010 News Release: Denbury Resources Announces Third Quarter Results*". http://phx.corporate-ir.net/phoenix.zhtml?c=72374&p=irol- newsArticle&ID=1491887&highlight=(accessed March 4, 2011)

Denbury (Denbury Resources Inc.) 2010b. "*Fall Analyst Meeting, November 18, 2010*". http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9NDA0OTIyfENoaWxkSUQ9NDEzNjA4fFR5cGU9MQ==&t=1(accessed March 4, 2011).

Denbury (Denbury Resources Inc.) 2010c. "*2009 Annual Report*". Accessed March 4, 2011 at http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9NDA5NzF8Q2hpbGRJRD0tMXxUeXBlPTM=&t=1.

Elliot, W.R. 2010. *Overview of Texas Caves & Karst*. Texas Speleological Survey. http://www.utexas.edu/tmm/sponsored_sites/tss/cavesandkarst/index.html (Website last updated on September 8, 2010) (accessed March, 2011)

ESRI ArcGIS http://www.esri.com/products/index.html (accessed March,2011)

Executive Order 12898, "*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*" 59 Federal Register at 7630. February 11, 1994.

Harris-Galveston Coastal Subsidence District. U.S Geological Survey (USGS) Scientific Investigations Report 2004–5102, 111 pp. http://www.twdb.state.tx.us/gam/glfc_n/glfc_n.asp (accessed March 2011)

Hovorka, S.D.; Collins, D.; Benson, S.; Myer, L.; Bryer, C.; and Cohen, K. 2005. *Update on the Frio Brine pilot: Eight Months After Injection*. In Proceedings of the Fourth Annual Conference on Carbon Capture and Sequestration (Alexandria, VA), May 2-5, 2005

Hovorka, S.D. 2010. *Final MVA Plan and Detailed Budget* [for Denbury Onshore, LLC]. Gulf Coast Carbon Center, Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Austin. Prepared for Denbury Onshore, LLC. April 11, 2010.

IPCC (Intergovernmental Panel on Climate Change) 2005. Hendrich et al 2004; IPCC Special Report on Carbon Dioxide Capture and Storage. http://www.ipcc.ch/publications_and_data/publications_and_data_reports_carbon_dioxide.htm.(accessed on February 2010)

Kasmarek, M.C. and Robinson, J.L. 2004. *Hydrogeology and Simulation of Ground-Water Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas*. In cooperation with the Texas Water Development Board and the Harris-Galveston Coastal Subsidence District.

Mace, R E.; Davidson, S.C.; Angle, E.S.; and Mullican,W.F; 2006 (Editors). *Aquifers of the Gulf Coast of Texas.* Texas Water Development Board Report 365. February, 2006

NETL (National Energy Technology Laboratory) 2009. *Best Practices for: Monitoring, Verification, and Accounting of CO_2 Stored in Deep Geologic Formations*. DOE/NETL-311/081508. January, 2009

NOAA (National Oceanic and Atmospheric Administration) 2011,Coastal Geospatial Data Project, Land Use/ Land Cover Type/ Class GIS file. *http://coastalgeospatial.noaa.gov/data_gis.html* (accessed March,2011)

Scanlon, B.R.; Dutton, A.; and Sophocleous, M. 2002. *Groundwater Recharge in Texas.*

TCEQ (Texas Commission on Environmental Quality) 2011a. *Compliance with Eight-Hour Ozone Standard*. http://www.tceq.state.tx.us/cgi-bin/compliance/monops/8hr_attainment.pl. (accessed April, 2011)

TCEQ (Texas Commission on Environmental Quality) 2011b. *GeoTAM, Geographic Texas Air Monitoring, TCEQ*. http://gis3.tceq.state.tx.us/geotam/index.html. (accessed April 2011).

TCEQ (Texas Commission on Environmental Quality) 2011c. *Introduction to Air Quality Modeling: Emissions Modeling*. http://www.tceq.texas.gov/airquality/airmod/overview/am_ei.html#bio. (accessed April 2011).

TCEQ (Texas Commission on Environmental Quality) 2010a. *Atlas of Texas Surface Waters: Neches River Basin, Neches–Trinity Coastal Basin, and Portion of Bays and Estuaries*. http://www.tceq.texas.gov/publications/gi/gi-316/index.html (Website last modified on June 17, 2010) (accessed March, 2011)

TCEQ (Texas Commission on Environmental Quality) 2010b. *Atlas of Texas Surface Waters: Houston Area and Portions of Bays and Estuaries.* http://www.tceq.texas.gov/publications/gi/gi-316/index.html (Website last modified on June 17, 2010) (accessed March, 2011)

TCEQ (Texas Commission on Environmental Quality) 2008. 2008 Texas Water Quality Inventory and 303(d) List. http://www.tceq.texas.gov/assets/public/compliance/monops/water/08twqi/2008_303d.pdf. (accessed April 18, 2011)

Texas Tech University Center for Geospatial Technology 2011a. (Hydrogeologic Features-NHD) (accessed March, 2011).

Texas Tech University 2011b. (CST for Lakes and Swamps -NHD) FEMA 100-Year Floodplain (accessed March, 2011).

TSHA (Texas State Historical Association) 2011. The Handbook of Texas Online. *http://www.tshaonline.org/handbook/online* (accessed March 18, 2011).

TWDB (Texas Water Development Board) 2011. *Texas Groundwater Electronic Database: State Wells.* Available at: http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWDatabaseReports/Database%20Reports/Jefferson/Record%20of%20Wells.pdf. (accessed March 17, 2011)

TWDB (Texas Water Development Board) 1995. *Aquifers of Texas*. *Report 345*. http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/Individual%20Report%20htm%20files/Report%20345.htm (accessed March, 2011)

TWDB (Texas Water Development Board) 1982. *Ground-Water Resources of Brazoria County, Texas*. Report 163. Reprinted December 1982, 40 pp. URL: http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/R163/R163_text.pdf (accessed March, 2011)

TWC (Texas Workforce Commission) Texas Workforce 2011 Press Release: *Texas Employers Add 44,100 Jobs in January, March 10, 2011*. Available at: http://www.twc.state.tx.us/news/press/2011/031011epress.pdf (accessed March, 2011)

URS (URS Group, Inc.) 2011a. *Air Products and Chemicals, Inc. (APCI) Port Arthur CO_2 Project: Valero Refinery, Jefferson County and West Hastings Oil Field, Brazoria County, Texas. Assessment of Project Activities Impacting Historic Properties*. Letter report by Rob Lackowicz on File, Texas Historical Commission, Austin, Texas.

URS (URS Group, Inc.) 2011b. *Phase I Cultural Resources Investigation, Air Products and Chemicals, Inc. - Port Arthur (TX) CO_2 Pipeline Project in Jefferson County, Texas*. Report by Hilary Dafoe and Rob Lackowicz on File, Texas Historical Commission, Austin, Texas.

USACE (U.S. Army Corps of Engineers) 2009. Final Environmental Assessment for Emergency Repairs to the Port Arthur and Vicinity Hurricane/Shore Flood Protection Project, Port Arthur, Jefferson County, Texas. Galveston District. May 2009. : www.swg.usace.army.mil/items/PortArthurFinalEA.pdf. (accessed March, 2001)

USACE (U.S. Army Corps of Engineers) 1987. Wetlands Delineation Manual. *http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf* (accessed May 15, 2010)

USCB (U.S. Census Bureau) 2011a. 2010 Census Redistricting Data (Public Law 94-171) Summary File GCT-PL1, Brazoria County, Texas

USCB (U.S. Census Bureau) 2011b. 2010 Census Redistricting Data (Public Law 94-171) Summary File GCT-PL1, Jefferson County, Texas

USCB (U.S. Census Bureau) 2000. Profile of General Demographic Characteristics: 2000.Table DP-1. *http://censtats.census.gov/pub/Profiles.shtml.*(accessed March, 2010)

USDA-NRCS (U.S. Department of Agriculture,Natural Resources Conservation Service) 2011a. “Web Soil Survey.” http://websoilsurvey.nrcs.usda.gov (accessed March 17, 2011)

USDA-NRCS (U.S. Department of Agriculture, Natural Resources Conservation Service) 2011b. Soil Survey Geographic (SSURGO) Database. http://soils.usda.gov/survey/geography/ssurgo/. (accessed March,2011)

USDA-NRCS (U.S. Department of Agriculture, Natural Resources Conservation Service) 2006. Soil Survey of Jefferson and Orange Counties, June 2006, 439 pp. URL: http://soildatamart.nrcs.usda.gov/Manuscripts/TX623/0/Manuscript.pdf (accessed March,2011)

USDA (U.S. Department of Agriculture) Soil Conservation Service 1981. *Soil Survey of Brazoria County, Texas*. URL:

http://soildatamart.nrcs.usda.gov/Manuscripts/TX039/0/brazoria.pdf (accessed March,2011)

USDOE (U.S. Department of Energy) 2010a. “Secretary Chu Announces Nearly $1 Billion Public-Private Investment in Industrial Carbon Capture and Storage”. US Department of Energy Press Release, June 10, 2010. http://www.energy.gov/9065.htm (accessed March 4, 2011)

USDOE (U.S. Department of Energy) 2010b. “Large-Scale Industrial CCS Projects Selected for Continued Testing”. US Department of Energy Press Release, June 10, 2010. http://www.netl.doe.gov/publications/press/2010/10017-DOE_Selects_Industrial_CCS_Project.html (accessed March 7, 2011)

USDOE (U.S. Department of Energy) 2007. National Energy Technology Laboratory. 2007. Carbon Sequestration Program Environmental Reference Document. http://www.netl.doe.gov/technologies/carbon_seq/refshelf/nepa/index.html (accessed March 7, 2011)

USDOE (U.S. Department of Energy) 2003. Final Environmental Assessment for Pilot Experiment for Geological Sequestration of Carbon Dioxide in Saline Aquifer Brine Formations. http://gc.energy.gov/NEPA/nepa_documents/ea/ea1482/EA-1482.pdf (accessed March 7, 2011)

USDOE (U.S. Department of Energy) 1999, *Carbon Sequestration—Research and Development.* http://www.fe.doe.gov/coal_power/sequestration/reports/rd/index.shtml (accessed February, 2011)

USEPA (U.S. Environmental Protection Agency) 2011a. Ecoregion Maps and GIS Resources. *http://www.epa.gov/wed/pages/ecoregions.htm* (accessed March 18, 2011)

USEPA (U.S. Environmental Protection Agency) 2011b. AirData : Access to Air Pollution Data. *http://www.epa.gov/air/data/index.html* (accessed April 2011)

USEPA (U.S. Environmental Protection Agency) 2010a. *Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells*. Federal Register**,** Vol. 75, No. 237, December 10, 2010

USEPA (U.S. Environmental Protection Agency) 2010b. *Mandatory Reporting of Greenhouse Gases.* Federal Register, Vol. 75, No. 209, October 30, 2009

USFWS (U.S. Fish and Wildlife Service) 2011a. National Wetlands Inventory. *http://www.fws.gov/wetlands/Data/mapper.html* (accessed March 18, 2011)

USFWS (U.S. Fish and Wildlife Service) 2011b. Whooping Crane Species Profile. *http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B003* (accessed March 18, 2011)

USFWS (U.S. Fish and Wildlife Service) 1988. Endangered Species Act of 1973, as amended through the 100th Congress. U.S. Department of the Interior. Washington, D.C.

USGS (U.S. Geological Survey) 2011a. *USGS Earthquake Hazards Program – Texas Seismic Hazard Map*http://earthquake.usgs.gov/earthquakes/states/texas/hazards.php. (accessed March,2011)USGS (U.S. Geological Survey) 2011b. *USGS Earthquake Hazards*

Program- Historic Earthquakes: Near Valentine, Texas. Accessed March 2011 at: http://earthquake.usgs.gov/earthquakes/states/events/1931_08_16.php

USGS (U.S. Geological Survey) 2008. *Documentation for the 2008 Update of the United States National Seismic Hazard Maps*. Open-File Report 2008–1128. U.S. Geological Survey, Reston, Virginia: 2008.

USGS (U.S. Geological Survey) 1974. *USGS 7.5 Minute Topographic Map - Port Arthur South*

USGS (U.S. Geological Survey) 1975. *USGS 7.5 Minute Topographic Map - Port Arthur North*

APPENDIX A

DISTRIBUTION LIST

Federal Offices

U.S. Environmental Protection Agency,
Region 6
Mr. Michael P. Jansky, Review Coordinator
Office of Planning & Coordination
1445 Ross Ave., Mail Code 6EN-XP
Dallas, Texas 75202-2733

U.S. Department of Energy
Mr. Mike Haggerty
Freedom of Information Act Reading Room
1000 Independence Ave., SW, 1G-033
Washington, D.C. 20585

U.S. Army Corps of Engineers
Galveston District, Regulatory Branch
Ms. Elizabeth Shelton
P.O. Box 1229
Galveston, TX 77553-1229

Department of the Interior
U.S. Fish & Wildlife Service
Ms. Edith Erfling, Field Supervisor
17629 El Camino Real #211
Houston, TX 77058-3051

Native American Indian Tribes

Alabama-Coushatta Tribe of Texas
Alton LeBlanc, Tribal Administrator
571 State Park Road
Livingston, Texas 77351

Kickapoo Traditional Tribe of Texas
Mr. Juan Garza, Jr. (Chairman)
HCR 1 Box 9700
Eagle Pass, TX 78852

Coushatta Tribe of Louisiana
Kevin Sickey, Chairman
1940 C C Bel Road
Elton, LA 70532

State and Local Offices

The Honorable Rick Perry
Governor of Texas
Office of the Governor
P.O. Box 12428
Austin, TX 78711-2428

Ms. Denise Stines Francis
State Single Point of Contact
Governor's Office of Budget, Planning,
and Policy; State Grants Team
P.O. Box 12428
Austin, TX 78711

Mr. Toby Baker
Governor's Advisor for Natural Resources
and Agriculture
P.O. Box 12428
Austin, TX 78711

Mr. Terry Zrubek
Governor's Advisor – Water
P.O. Box 12428
Austin, TX 78711

Texas Historical Commission
Debra Beene, Section 106 Reviewer
1511 Colorado St.
Austin, TX 78701

Railroad Commission of Texas
P.O. Box 12967
Austin, TX 78711-2967

Texas Commission on Environmental Quality
Donna G. Phillips, Area Director
5425 Polk St., Ste. H
Houston TX 77023-1452

Non-Government Organizations

National Audubon Society
Phil Wallis, Vice President
1201 Pawlings Road
Audubon, PA 19403

National Audubon Society
Michelle P. Scott, General Counsel
225 Varick Street, 7^{th} Floor
New York, NY 10014

Sierra Club
Mr. Ed Hopkins
408 C Street, NE
Washington, DC 20002

National Wildlife Federation
Mr. Jim Lyon, Sr. V. President for Conservation
901 East Street, NW, Suite 400
Washington, DC 20004

Eric Glitzenstein
Meyer, Glitzenstein & Crystal, LLP
1601 Connecticut Ave., NW, Suite 700
Washington, DC 20009-1056

APPENDIX B

AGENCY CONSULTATIONS AND PUBLIC COMMENTS

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

U.S. DEPARTMENT OF ENERGY

February 17, 2011

Mr. Steve Parris, Field Supervisor
U. S. Fish and Wildlife Service
Clear Lake ES Field Office
17629 El Camino Real #211
Houston TX 77058-3051

Re: Request for Project Review - "Pipeline" Portion of Proposed Project
Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)

Dear Mr. Parris:

The U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL), is proposing to provide a financial assistance grant to Air Products and Chemicals (APCI). Federal funding may be committed by NETL (DOE's proposed action) in the amount of approximately $253 million of American Recovery and Reinvestment Act of 2009 (ARRA) funds for implementation of APCI's Proposed Project in Jefferson and Brazoria Counties, Texas. Total Project costs are estimated to be approximately $430 million.

The proposed project will involve the capture and sequestration of carbon dioxide (CO_2) from existing steam methane reformers in Port Arthur, Texas, starting in November 2012, and transport the captured CO_2 to oil fields in eastern Texas by pipeline where it will be used for enhanced oil recovery. This project is known as the Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (APCI's Proposed Project). APCI's Proposed Project involves an integrated carbon capture, transport, injection, sequestration, and monitoring program that will capture approximately one million tons per year of CO_2 from two Port Arthur, Texas plants (PA1 and PA2). The project is subdivided into four major components:

1) CO_2 capture, concentration, and purification at PA1 and PA2 primarily at the Valero refinery;
2) transport of CO_2 within Jefferson County, Texas through a new 12.5-mile-long, 8-inch-diameter pipeline lateral that will interconnect with an existing CO_2 pipeline system for injection into a depleted oil field, the Hastings Field, in Brazoria County, Texas, for enhanced oil recovery;
3) a new 7-mile-long, 10-inch-diameter hydrogen (H_2) pipeline lateral that will be collocated with the first 7 miles of the CO_2 pipeline lateral; and
4) implementation of a comprehensive monitoring, verification, and accounting (MVA) program to monitor the impacts of injection and sequestration of the injected CO_2 at the Hastings Field.

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507
Fred.Pozzuto@netl.doe.gov • Voice (304) 285-5219 • Fax (304) 285-4403 • www.netl.doe.gov

The pipeline laterals, which parallel existing utility corridors along the majority of their route, will be owned and operated by APCI. A map showing the proposed pipeline route is provided in Attachment 1. The CO_2 pipeline lateral will connect to a trunk pipeline, called the Green Pipeline, which is owned and operated by Denbury Onshore, LLC (Denbury). Denbury, which is partnering with APCI to implement APCI's Proposed Project, also owns and operates the Hastings Field and will conduct the Hastings Field MVA program.

According to the U.S. Fish and Wildlife Service (USFWS) online database (Attachment 2), Federally-listed threatened and endangered species within Jefferson County include bald eagle (*Haliaeetus leucocephalus*; delisted), piping plover (*Charadrius melodus*), and five sea turtle species. APCI's Proposed Project will not impact marine or shoreline habitats and no impacts to these species or their critical habitat are anticipated as a result of the Project.

Biological surveys along the proposed pipeline route are scheduled to take place in February 2011. DOE requests that USFWS provide site-specific information within Jefferson County concerning natural resources, including threatened and endangered species, species of special concern, critical habitats, or any other significant biological resources (i.e., unique or sensitive habitats, nature preserves, migratory bird fallout areas, etc.) that might be located within the vicinity of the proposed pipeline corridor. DOE also requests guidance from USFWS concerning any potential seasonal threatened and endangered species surveying recommendations, or seasonal constraints on construction, which is currently expected to commence in the first or second quarter of 2012. Any information you provide will assist the DOE in the preparation of an environmental assessment (EA) and fulfillment of its responsibilities under the Endangered Species Act.

In the near future, DOE will submit a separate letter to TPWD requesting informal consultation on the APCI's Port Arthur, Texas CO_2 capture facilities (*at Valero's Refinery*) and the Hastings Field MVA aspects of the Project. DOE will also provide you a copy of the Draft EA, once completed (*est. June 2011*), where you may again respond to any specific concerns you may have. All correspondence(s) with your office will be included in an appendix to the EA.

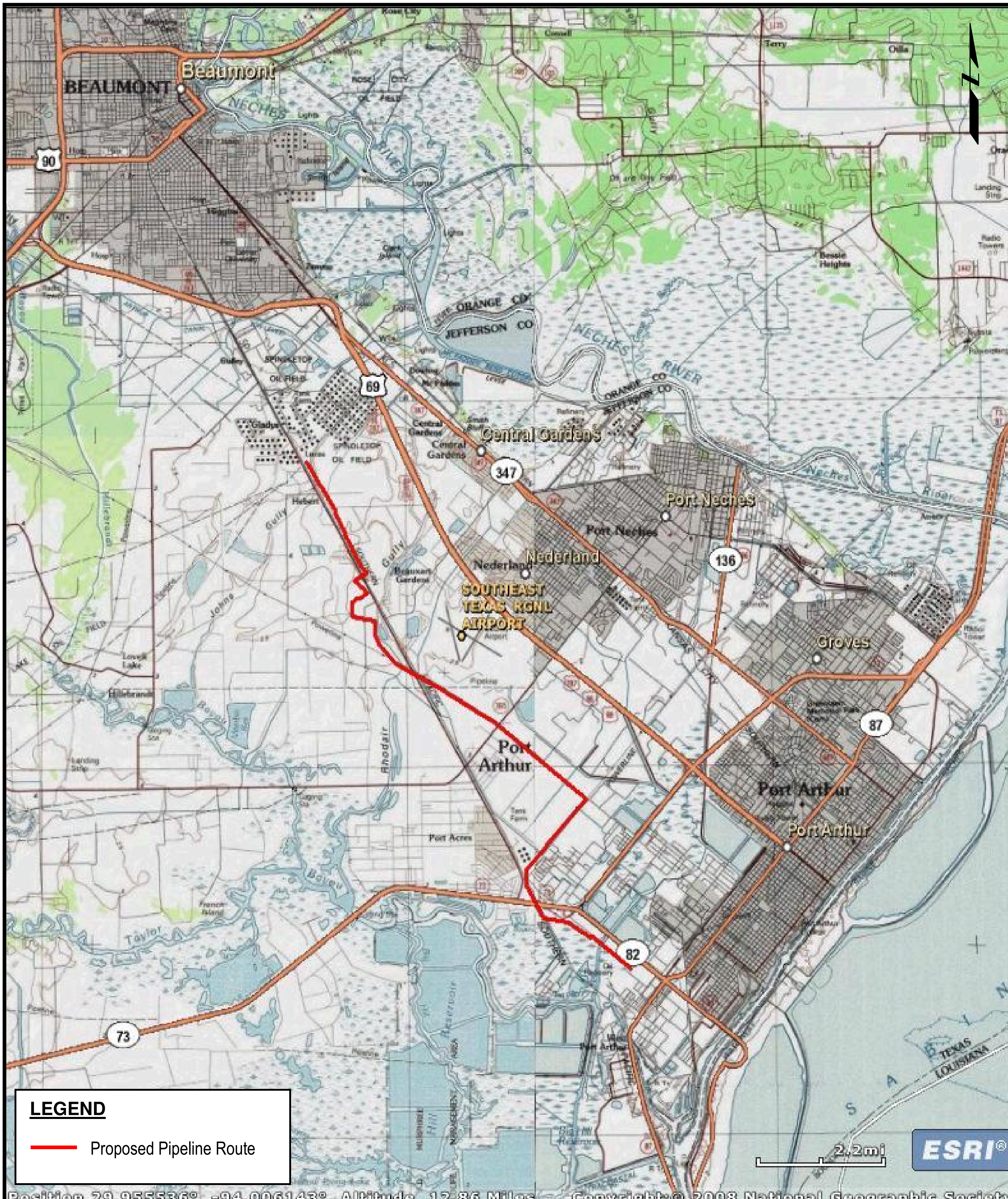
If you have any questions or require clarification, please telephone me at (304) 285-5219 or e-mail me at fred.pozzuto@netl.doe.gov. Thank you in advance for your consideration.

Sincerely,

Fred E. Pozzuto
Environmental Manager / NEPA Compliance Officer

Attachments: 1. Project Location
2. USFWS Endangered Species List

Cc: APCI (Messrs. Frisby, Fisher, Houser, and Kisenbauer)
URS (Messrs. Conwell and Boers)



CLIENT	Air Products and Chemicals, Inc. (APCI)			TITLE	Project Location
PROJECT	Port Arthur (TX) CO_2 and H_2 Pipelines			URS	URS Proj. 25014716
REVISION NO		DES BY			ATTACHMENT 1
SCALE	As Shown	DR BY	AB	1/28/2011	
FILE		CHK BY	PC	2/2/2011	

U.S. Fish & Wildlife Service

Endangered Species List

Back to Start

List of species by county for Texas:

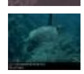
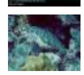
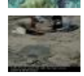
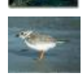
Counties Selected: Jefferson

Select one or more counties from the following list to view a county list:

Anderson
Andrews
Angelina
Aransas
Archer

View County List

Jefferson County

Common Name	Scientific Name	Species Group	Listing Status	Species Image	Species Distribution Map	Critical Habitat	More Info
bald eagle	*Haliaeetus leucocephalus*	Birds	DM				P
green sea turtle	*Chelonia mydas*	Reptiles	E, T				P
hawksbill sea turtle	*Eretmochelys imbricata*	Reptiles	E				P
Kemp's ridley sea turtle	*Lepidochelys kempii*	Reptiles	E				P
leatherback sea turtle	*Dermochelys coriacea*	Reptiles	E				P
loggerhead sea turtle	*Caretta caretta*	Reptiles	T				P
piping Plover	*Charadrius melodus*	Birds	E, T				P

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882

June 17, 2011

Fred Pozzuto
U.S. Department of Energy
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880 MS B07
Morgantown, West Virginia 26507-0880

Dear Mr. Pozzuto:

Thank you for the opportunity to review and comment on the May 2011 Draft Environmental Assessment (DEA) for *Air Products and Chemicals, Inc. Recovery Act: Demonstration of CO2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Lange Scale Hydrogen Production*. The Department of Energy (DOE) proposes to fund a demonstration project that would use captured carbon dioxide to enhance oil recovery at the West Hastings Field.

The U.S. Fish and Wildlife Service (Service) provides the following comments in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. 661-667 (e)), the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), the National Environmental Policy Act (42 U.S.C. 4321 et seq.) and the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703 et seq.).

In order for the Service to adequately review the project for impacts to fish and wildlife and their habitat, the following issues should be evaluated and included throughout the development of the final environmental assessment.

Threatened and Endangered Species

According to Section 7(a)(2) of the Endangered Species Act, it is the responsibility of each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species. Based upon an inventory of listed species and other current information, the federal action agency determines if any endangered or threatened species may be affected by the proposed action. The Service's Consultation Handbook (http://endangered.fws.gov/consultations/s7hndbk/s7hndbk.htm) is available online for further information on definitions and the Section 7 process.

Colonial Waterbirds

The DEA does not evaluate the project's potential impacts on colonial waterbird species and on rookery sites. Twenty-three species of colonial waterbirds nest along the Texas Coast on beaches, dredge spoil islands, gravel-parking lots, and in fresh and brackish wetlands. The Texas Colonial Waterbird Society and its partners survey the known nesting sites annually. The survey results can be obtained from the Texas Parks and Wildlife Department at (361)-576-0022. However, since additional rookery nesting sites may occur in the proposed project area, we recommend conducting surveys prior to the commencement of construction.

Pipeline Corridors, Compressor Stations, and Metering Facilities

Alternative routes and directional drilling should be evaluated and the least environmentally damaging route/method should be selected. Previous pipeline projects have used bright lighting on associated above ground pipeline structures such as meter stations, compressor stations, connection stations, main line valve stations, and other small facilities associated with the pipeline projects. We recommend all bright lighting associated with these above ground structures be down-shielded to significantly reduce disturbance to resident and migratory birds and other resident wildlife. In addition, security lighting for on-ground facilities and equipment should be down-shielded to keep light within the boundaries of the each site.

The Service recommends including the enclosed pipeline conditions, jointly developed by the Galveston, Texas District of the U. S. Army Corps of Engineers and the associated resource agencies, in any necessary permits. These conditions were developed to reduce a project's impacts to sensitive habitats or along new rights-of-way.

Thank you for the opportunity to comment on this project. If you need any additional information, please contact staff biologist Donna Anderson at 281/286-8282 ext. 225.

Sincerely,

Edith Erfling

Edith Erfling
Field Supervisor

Enclosure

USACE Pipeline Conditions developed by USACE, USFWS, NOAA, & TPWD

These special conditions can be used to address impacts to non-forested wetlands along pipeline routes.

1. The permittee must notify the U.S. Army Corps of Engineers (USACE) Galveston District, Regulatory Branch, Compliance Section Chief (Compliance) in writing within 7 days of the completion of the pipeline construction. The permittee must restore all impacted jurisdictional waters of the U.S. including wetlands within the permit area, to pre-project contours and elevations within 30 calendar days of completion of the pipeline construction.

2. The permittee will conduct four separate reports that will be used to compare pre- and post-construction site conditions, including one pre-construction report and three restoration reports. All reports will use geographical information system (GIS)/Remote Sensing analysis based on aerial imagery and ground surveys of the project site according to the "Protocols for Data Submission" (Protocol), which is described in the attachment. The restoration reports must compare pre- and post-construction conditions in the permit area, present conclusions on the success or failure of the restoration activities, and include a proposal to bring the project into compliance, if restoration is not successful. Reports will include the following:

a. The **first** report will be conducted before pipeline construction begins. The permittee will conduct aerial and ground surveys as part of the GIS analyses of the permit area (including any proposed temporary work areas) according to the attached Protocol.

b. The **second** report will be an initial restoration report and submitted to Compliance within 60 calendar days of the completion of pipeline construction. This second report will be based on post-construction aerial and ground surveys conducted after the completion of the pipeline construction. Should some wetland areas not be restored satisfactorily, remedial action, such as planting, addition of fill material, or additional mitigation, may be required, at the discretion of Compliance.

c. The **third** report will be a supplemental restoration report submitted to Compliance one year after the completion of pipeline construction. This third report will be based on post-construction aerial and ground surveys conducted one year after the completion of the pipeline construction (or the end of first growing season, whichever comes first). The third report must be submitted 60 days after the surveys are conducted. The re-vegetation of disturbed areas should be at least 30% of the pre-construction aerial coverage of non invasive, native vegetation, to be considered on target for eventual restoration. Should some wetland areas not be restored satisfactorily, remedial action, such as replanting, addition of fill material, or additional mitigation, may be required, at the discretion of Compliance.

d. The **fourth** report will be a supplemental restoration report submitted to Compliance within two years after the completion of pipeline construction. The fourth report must be submitted 60 days after the two year time limit. This fourth report will be based on a post-construction aerial and ground surveys conducted two years after the completion of the pipeline construction (or the end of second growing season, whichever comes first). The re-vegetation of disturbed areas should be 100% of the pre-construction aerial coverage with non-invasive, native vegetation, to be considered on target for complete restoration. Should some wetland areas not be restored satisfactorily, remedial action, such as replanting, addition of fill material, or additional mitigation, may be required, at the discretion of Compliance.

Protocols for Data Submission (Protocol)

a. Aerial Imagery Protocol: The first report must utilize recent aerial imagery (within the last five years) of the permit area and an area 300-foot-wide on each side of the permit area. The second report must utilize aerial images taken within two months of project completion. The third image must be taken approximately one year after pipeline construction is complete. The fourth image must be taken approximately two years after pipeline construction is complete. The aerial imagery must be color infrared, ortho-corrected, with a maximum of 6-inch pixel size, and +/- 1 meters spatial accuracy, presented at a scale of 1 inch = 200 feet.

b. Ground Survey Protocol: Each restoration reports will include GIS analysis of the permit area, accompanied by a ground survey that includes sample points with geographic coordinates, a wetland data sheet percent of relative vegetation cover, and elevations for each change in plant community (described in the USACE 1987 Wetland Delineation Manual) throughout the entire permit area. The survey coordinates must have sub-meter accuracy; data must be recorded and submitted in NAD 1983 UTM zones and coordinates.

c. GIS/Remote Sensing Analysis Protocol: Each report must include aerial imagery of the permit area, and an area 300-foot-wide on each side of the permit area with a GIS analysis of the aerial imagery. Survey reports will assess all existing plant communities, open water, and special aquatic sites (in acres) within the entire permit area. The GIS analysis must be submitted in the reports as an 8 ½ by 11-inch hard copy. Upon request by Compliance, the permittee shall submit the GIS analysis in Arcview Shapefile format with Federal Geographic Data Committee (FGDC) compliant metadata, and all raster imagery in GEoTiff format with FGDC compliant metadata, on a CD-ROM.

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

U.S. DEPARTMENT OF ENERGY

February 15, 2011

Ms. Kathy Boydston
Texas Parks and Wildlife Department
Wildlife Division
Wildlife Habitat Assessment Program
4200 Smith School Road
Austin, TX 78744-3291

Subject: Request for Project Review – "Pipeline" Portion of Proposed Project
Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)

Dear Ms. Boydston:

The U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) is proposing to provide a financial assistant grant to Air Products and Chemicals, Inc. (APCI). Federal funding may be committed by NETL for APCI's Proposed Project and the federal action (i.e., DOE's Proposed Action) is to provide approximately $253 million of American Recovery and Reinvestment Act of 2009 (ARRA) funds to implement APCI's Proposed Project in Jefferson County and Brazoria County, Texas.

The proposed project will involve the capture and sequestration of carbon dioxide (CO_2) from existing steam methane reformers in Port Arthur, Texas, starting in November 2012, and transport the captured CO_2 to oil fields in eastern Texas by pipeline where it will be used for enhanced oil recovery. This project is known as the Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (APCI's Proposed Project). APCI's Proposed Project involves an integrated carbon capture, transport, injection, sequestration, and monitoring program that will capture approximately one million tons per year of CO_2 from two Port Arthur, Texas plants (PA1 and PA2). The project is subdivided into four (4) major components:

1) CO_2 capture, concentration, and purification at PA1 and PA2 primarily at the Valero refinery;
2) transport of CO_2 within Jefferson County, Texas through a new 12.5-mile-long, 8-inch-diameter pipeline lateral that will interconnect with an existing CO_2 pipeline system for injection into a depleted oil field, the Hastings Field, in Brazoria County, Texas, for enhanced oil recovery;

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507
Fred.pozzuto@netl.doe.gov • Voice (304) 285-5219 • Fax (304) 285-4403 • www.netl.doe.gov

3) a new 7-mile-long, 10-inch-diameter hydrogen (H_2) pipeline lateral that will be collocated with the first 7 miles of the CO_2 pipeline lateral; and

4) implementation of a comprehensive monitoring, verification, and accounting (MVA) program to monitor the impacts of injection and sequestration of the injected CO_2 at the Hastings Field.

The pipeline laterals, which parallel existing utility corridors along the majority of their route, will be owned and operated by APCI. A map showing the proposed pipeline route is provided in Attachment 1. The CO_2 pipeline lateral will connect to a trunk pipeline, called the Green Pipeline, which is owned and operated by Denbury Onshore, LLC (Denbury). Denbury, which is partnering with APCI to implement APCI's Proposed Project, also owns and operates the Hastings Field and will conduct the Hastings Field MVA program.

According to the U.S. Fish and Wildlife Service (USFWS) online database (Attachment 2), Federally-listed threatened and endangered species within Jefferson County include bald eagle (*Haliaeetus leucocephalus*; delisted), piping plover (*Charadrius melodus*), and five sea turtle species. APCI's Proposed Project will not impact marine or shoreline habitats and no impacts to these species or their critical habitat are anticipated as a result of the Project. According to the Texas Parks and Wildlife Department (TPWD) online database (Attachment 3), other Federally-listed species with the potential to occur in Jefferson County include: smalltooth sawfish (*Pristis pectinata*), Louisiana black bear (*Ursus americanus luteolus*), and red wolf (*Canis rufus*). However, no impacts to these species or their critical habitats are anticipated as a result of the Project.

Biological surveys along the proposed pipeline route are scheduled to take place in February 2011. DOE requests that TPWD provide site-specific information within Jefferson County concerning natural resources, including threatened and endangered species, species of special concern, critical habitats, or any other significant biological resources (i.e., unique or sensitive habitats, nature preserves, migratory bird fallout areas, etc.) that might be located within the vicinity of the proposed pipeline corridor. DOE also requests guidance from TPWD concerning any potential seasonal threatened and endangered species surveying recommendations, or seasonal constraints on construction, which is currently expected to commence in the first or second quarter of 2012. Any information you provide will assist the DOE in the preparation of an environmental assessment (EA) and fulfillment of its responsibilities under the Endangered Species Act.

In the near future, DOE will submit a separate letter to TPWD requesting informal consultation on the APCI's Port Arthur, Texas CO_2 capture facilities (*at Valero's Refinery*) and the Hastings Field MVA aspects of the Project. DOE will also provide you a copy of the Draft EA, once completed (*est. June 2011*), where you may again respond to any specific concerns you may have. All correspondence(s) with your office will be included in an appendix to the EA.

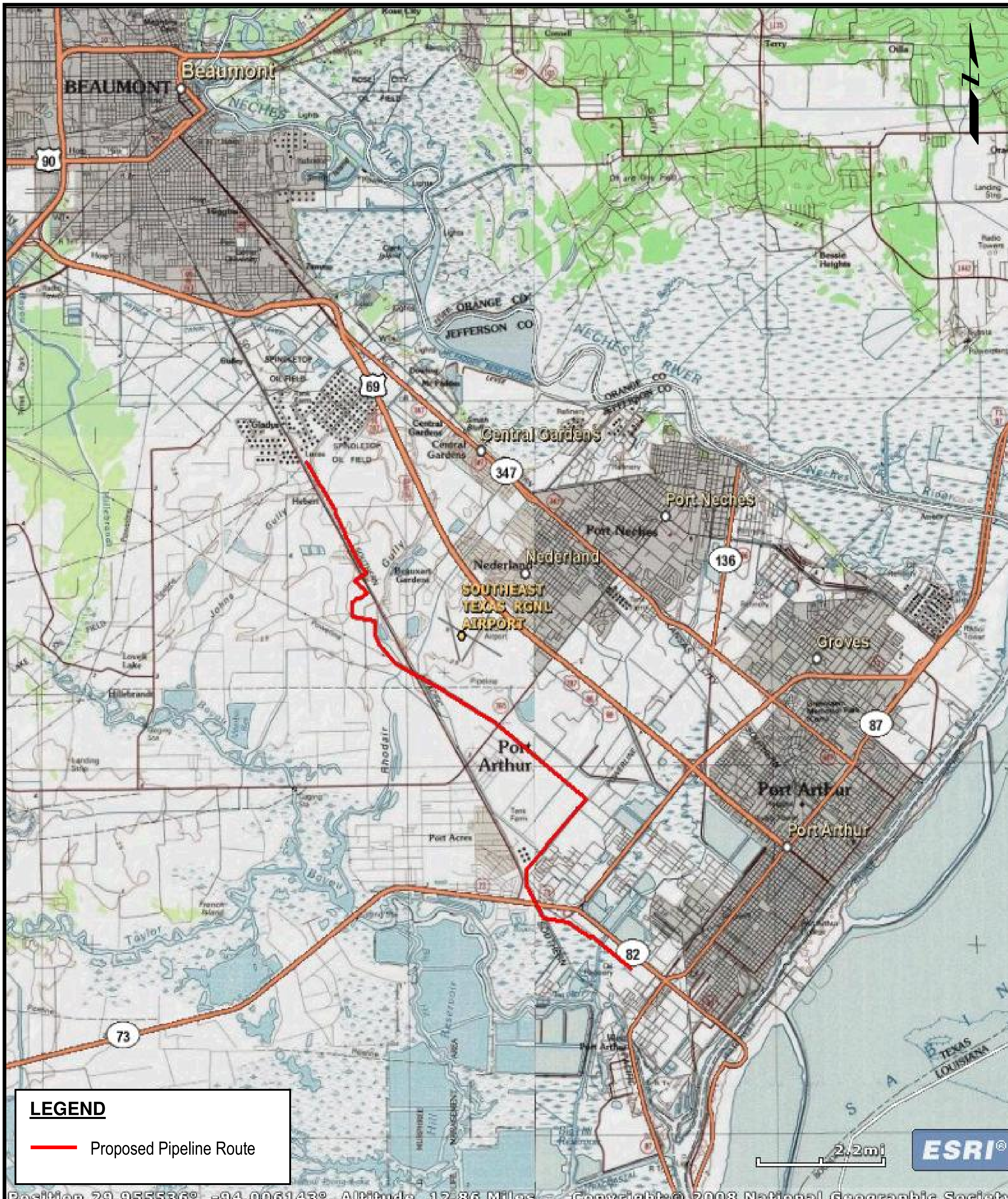
If you have any questions or require clarification, please telephone me at (304) 285-5219 or e-mail me at fred.pozzuto@netl.doe.gov. Thank you in advance for your consideration.

Sincerely,

Fred E. Pozzuto
Environmental Manager / NEPA Compliance Officer

Attachments: 1. Project Location
2. USFWS Endangered Species List
3. TPWD Rare Species List

Cc (w/o Attachments):
G.M. Frisby, URS
S. D. Fisher, URS
T. S. Houser, URS
K.S. Kisenbauer, APCI



CLIENT	Air Products and Chemicals, Inc. (APCI)			TITLE	**Project Location**
PROJECT	Port Arthur (TX) CO_2 and H_2 Pipelines				
REVISION NO		DES BY			URS Proj. 25014716
SCALE	As Shown	DR BY	AB	1/28/2011	ATTACHMENT 1
FILE		CHK BY	PC	2/2/2011	URS

U.S. Fish & Wildlife Service

Endangered Species List

Back to Start

List of species by county for Texas:

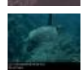
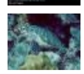
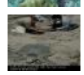
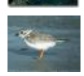
Counties Selected: Jefferson

Select one or more counties from the following list to view a county list:

Anderson
Andrews
Angelina
Aransas
Archer

View County List

Jefferson County

Common Name	Scientific Name	Species Group	Listing Status	Species Image	Species Distribution Map	Critical Habitat	More Info
bald eagle	*Haliaeetus leucocephalus*	Birds	DM				P
green sea turtle	*Chelonia mydas*	Reptiles	E, T				P
hawksbill sea turtle	*Eretmochelys imbricata*	Reptiles	E				P
Kemp's ridley sea turtle	*Lepidochelys kempii*	Reptiles	E				P
leatherback sea turtle	*Dermochelys coriacea*	Reptiles	E				P
loggerhead sea turtle	*Caretta caretta*	Reptiles	T				P
piping Plover	*Charadrius melodus*	Birds	E, T				P

JEFFERSON COUNTY

AMPHIBIANS

		Federal Status	State Status
Pig frog	*Lithobates grylio*		

prefers permanent bodies of open water with emergent vegetation; active mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

BIRDS

		Federal Status	State Status
American Peregrine Falcon	*Falco peregrinus anatum*	DL	T

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Arctic Peregrine Falcon *Falco peregrinus tundrius* DL

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Bald Eagle *Haliaeetus leucocephalus* DL T

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Black Rail *Laterallus jamaicensis*

salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mat of previous year's dead grasses; nest usually hidden in marsh grass or at base of Salicornia

Brown Pelican *Pelecanus occidentalis* DL E

largely coastal and near shore areas, where it roosts and nests on islands and spoil banks

Henslow's Sparrow *Ammodramus henslowii*

wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

Peregrine Falcon *Falco peregrinus* DL T

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

Piping Plover *Charadrius melodus* LT T

wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats

JEFFERSON COUNTY

BIRDS		Federal Status	State Status
Reddish Egret	*Egretta rufescens*		T

resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear

Snowy Plover *Charadrius alexandrinus*

formerly an uncommon breeder in the Panhandle; potential migrant; winter along coast

Southeastern Snowy Plover *Charadrius alexandrinus tenuirostris*

wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats

Swallow-tailed Kite *Elanoides forficatus* T

lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees

Western Snowy Plover *Charadrius alexandrinus nivosus*

uncommon breeder in the Panhandle; potential migrant; winter along coast

White-faced Ibis *Plegadis chihi* T

prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats

Wood Stork *Mycteria americana* T

forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960

FISHES		Federal Status	State Status
American eel	*Anguilla rostrata*		

coastal waterways below reservoirs to gulf; spawns January to February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; most aquatic habitats with access to ocean, muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries; diet varies widely, geographically, and seasonally

Smalltooth sawfish *Pristis pectinata* LE E

different life history stages have different patterns of habitat use; young found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft (10 m); in sheltered bays, on shallow banks, and in estuaries or river mouths; adult sawfish are encountered in various habitat types (mangrove, reef, seagrass, and coral), in varying salinity regimes and temperatures, and at various water depths, feed on a variety of fish species and crustaceans

JEFFERSON COUNTY

INSECTS		Federal Status	State Status
Bay skipper	*Euphyes bayensis*		

apparently tidal sawgrass marsh only, probably covers same range of salinity as saw grass, nectarivore (butterfly), herbivore (caterpillar), larval foodplant is so far unconfirmed but is probably sawgrass, diurnal; two well separated broods apparently peaking in late May and in September which suggests the larvae may well aestivate in summer and the next brood hibernate

MAMMALS		Federal Status	State Status
Black bear	*Ursus americanus*	T/SA;NL	T

bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened

Louisiana black bear	*Ursus americanus luteolus*	LT	T

possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas

Plains spotted skunk	*Spilogale putorius interrupta*		

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Rafinesque's big-eared bat	*Corynorhinus rafinesquii*		T

roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures

Red wolf	*Canis rufus*	LE	E

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

Southeastern myotis bat	*Myotis austroriparius*		

roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures

MOLLUSKS		Federal Status	State Status
Creeper (squawfoot)	*Strophitus undulatus*		

small to large streams, prefers gravel or gravel and mud in flowing water; Colorado, Guadalupe, San Antonio, Neches (historic), and Trinity (historic) River basins

Fawnsfoot	*Truncilla donaciformis*		

small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Little spectaclecase	*Villosa lienosa*		

creeks, rivers, and reservoirs, sandy substrates in slight to moderate current, usually along the banks in slower currents; east Texas, Cypress through San Jacinto River basins

Louisiana pigtoe	*Pleurobema riddellii*		T

JEFFERSON COUNTY

MOLLUSKS		Federal Status	State Status

streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins

Sandbank pocketbook	*Lampsilis satura*		T

small to large rivers with moderate flows and swift current on gravel, gravel-sand, and sand bottoms; east Texas, Sulfur south through San Jacinto River basins; Neches River

Southern hickorynut	*Obovaria jacksoniana*		T

medium sized gravel substrates with low to moderate current; Neches, Sabine, and Cypress river basins

Texas heelsplitter	*Potamilus amphichaenus*		T

quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins

Texas pigtoe	*Fusconaia askewi*		T

rivers with mixed mud, sand, and fine gravel in protected areas associated with fallen trees or other structures; east Texas River basins, Sabine through Trinity rivers as well as San Jacinto River

Wabash pigtoe	*Fusconaia flava*		

creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow

Wartyback	*Quadrula nodulata*		

gravel and sand-gravel bottoms in medium to large rivers and on mud; Red, Sabine, Neches River basins

REPTILES		Federal Status	State Status
Alligator snapping turtle	*Macrochelys temminckii*		T

perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October

Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	LE	E

Gulf and bay system, warm shallow waters especially in rocky marine environments, such as coral reefs and jetties, juveniles found in floating mats of sea plants; feed on sponges, jellyfish, sea urchins, molluscs, and crustaceans, nests April through November

Green sea turtle	*Chelonia mydas*	LT	T

Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches; adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds; nesting behavior extends from March to October, with peak activity in May and June

Gulf Saltmarsh snake	*Nerodia clarkii*		

saline flats, coastal bays, and brackish river mouthss

JEFFERSON COUNTY

REPTILES		Federal Status	State Status
Kemp's Ridley sea turtle	*Lepidochelys kempii*	LE	E

Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico; feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna; nests April through August

Leatherback sea turtle	*Dermochelys coriacea*	LE	E

Gulf and bay systems, and widest ranging open water reptile; omnivorous, shows a preference for jellyfish; in the US portion of their western Atlantic nesting territories, nesting season ranges from March to August

Loggerhead sea turtle	*Caretta caretta*	LT	T

Gulf and bay system primarily for juveniles, adults are most pelagic of the sea turtles; omnivorous, shows a preference for mollusks, crustaceans, and coral; nests from April through November

Northern scarlet snake	*Cemophora coccinea copei*		T

mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September

Sabine map turtle	*Graptemys ouachitensis sabinensis*		

Sabine River system; rivers and related tributaries, ponds and reservoirs with abundant aquatic vegetation; basks on fallen logs and exposed roots; eats insects, crustaceans, mollusks, and aquatic plants; breeding and egg-laying March-May, with hatchlings appearing in early fall

Texas diamondback terrapin	*Malaclemys terrapin littoralis*		

coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide

Texas horned lizard	*Phrynosoma cornutum*		T

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber/Canebrake rattlesnake	*Crotalus horridus*		T

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

PLANTS		Federal Status	State Status
Chapman's orchid	*Platanthera chapmanii*		

in Texas, appears restricted to wetland pine savannas and savanna swales in hillside seepage bogs, two very restricted and declining habitats in the State; flowering July-August

TEXAS PARKS & WILDLIFE

Life's better outside.®

Commissioners

Peter M. Holt
Chairman
San Antonio

T. Dan Friedkin
Vice-Chairman
Houston

Mark E. Bivins
Amarillo

Ralph H. Duggins
Fort Worth

Antonio Falcon, M.D.
Rio Grande City

Karen J. Hixon
San Antonio

Dan Allen Hughes, Jr.
Beeville

Margaret Martin
Boerne

S. Reed Morian
Houston

Lee M. Bass
Chairman-Emeritus
Fort Worth

Carter P. Smith
Executive Director

March 22, 2011

Fred Pozzuto
National Energy Technology Laboratory
P.O. Box 880
Morgantown, WV 26507

RE: Proposed pipeline portion of proposed project recovery act: Demonstration of CO_2 capture and sequestration for steam methane reforming process gas Jefferson, County, Texas.

Dear Mr. Pozzuto:

The Texas Parks and Wildlife Department (TPWD) has received your request for information regarding potential impacts to threatened and endangered species and for information on other issues of concern relating to the project referenced above. Under section 12.0011 of the Texas Parks and Wildlife Code, TPWD is charged with "providing recommendations that will protect fish and wildlife resources to local, state, and federal agencies that approve, permit, license, or construct developmental projects" and "providing information on fish and wildlife resources to any local, state, and federal agencies or private organizations that make decisions affecting those resources."

Please be aware that a written response to a TPWD recommendation or informational comment received by a state governmental agency on or after September 1, 2009 may be required by state law. For further guidance, see the Texas Parks and Wildlife Code, Section 12.0011 which can be found online at http://www.statutes.legis.state.tx.us/Docs/PW/htm/PW.12.htm#12.0011. For tracking purposes, please refer to TPWD project number 15899 in any return correspondence.

Project Description

The proposed project will involve the capture and sequestration of carbon dioxide (CO_2) from existing steam methane reformers in Port Arthur, Texas, and transport the captured CO_2 to oil fields in eastern Texas by pipeline where it will be used for enhanced oil recovery. The project will consist of four major components:

1. CO_2 capture, concentration, and purification;
2. transport of the CO_2 within Jefferson County, Texas through a new 12.5 mile long, 8-inch diameter pipeline lateral that will interconnect with an existing CO_2 pipeline system;
3. a new 7-mile long, 10-inch diameter hydrogen (H_2) pipeline lateral that will be collocated with the first 7 miles of the CO_2 pipeline lateral; and
4. implementation of a comprehensive monitoring, verification, and accounting program to monitor the impacts of injection and sequestration of the injected CO_2 at the Hastings Field.

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800

www.tpwd.state.tx.us

To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

Forested/Riparian Habitat

The project document does not include a summary of woody riparian vegetation to be impacted. However, after review of the aerial imagery, it appears that woody riparian vegetation would potentially be impacted by the proposed project.

> **Recommendations:** Woody riparian vegetation usually reflects high value wildlife habitat by providing sources of food, cover, nesting and roosting. Ecologically, it stabilizes stream banks, provides shaded microenvironments, and improves water quality by slowing flood waters, filtering pollutants and retaining sediment. The degree of adverse impacts to wildlife habitat resulting from direct loss of riparian vegetation relates directly to the quantity of vegetation lost, the quality of the vegetation assemblage in fulfilling the life requisites of the organisms using it, and the proposed mitigative measures to compensate for those impacts.

> **Recommendations:** TPWD recommends that clearing of mature, native trees be avoided. Loss of vegetation should be minimized by using site planning and construction techniques designed to avoid and preserve existing trees, shrubs, grasses, and forbs. *For impacts that are unavoidable, TPWD recommends transplanting the existing trees or replacing them at a ratio of 3 saplings for every tree lost.* Whether transplanted or replaced, a survival of 85% should be achieved. TPWD recommends that native plant and forage species that are beneficial to wildlife endemic to the area be used in mitigation and landscaped areas.

Federal regulation

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) provides for a year round closed season for non-game birds and prohibits the taking of migratory bird nests and eggs, except as permitted by the U.S. Fish and Wildlife Service.

> **Recommendations:** Construction activities such as, but not limited to, tree felling as well as vegetation clearing, trampling, or maintenance should occur outside the April 1- July 15 migratory bird nesting season of each year the project is authorized and lasting for the life of the project. To comply with the MTBA, the proposed site should be surveyed for migratory bird nest sites prior to construction or future maintenance activities. Since raptors nest in late winter and early spring, all construction activities as identified above should be excluded from a minimum zone of 100 meters around any raptor nest during the period of February 1- July 15.

Please contact the U.S. Fish and Wildlife Service Southwest Regional Office (Region 2) at (505) 248-6879 for further information.

Wetland Impacts

Recommendation. Wetland impacts should be monitored using the US Army Corps of Engineers-Galveston District Interagency Guidelines. Avoidance and minimization of impacts to wetlands should be proposed through:

1. reductions in the nominal construction ROW width in wetlands,
2. placement of the pipeline parallel to existing utility ROW,
3. selective routing,
4. the use of wetland and waterbody construction and mitigation procedures,
5. crossing wetlands using boring techniques, and
6. reducing maintenance of the permanent ROW in wetlands to a 10-ft. wide area centered over the pipeline.

Pipeline projects usually do not result in a net loss of wetlands, though there are reductions in overall functional value when forested wetlands are permanently and temporarily converted to emergent or scrub-shrub. Typically, an area 10-ft. wide centered over the pipeline is permanently maintained in an herbaceous state. Often times, trees beyond the 10-ft. wide area are selectively removed or prevented trimmed; therefore, forested wetlands beyond the 10-ft. wide area would not be given the chance to become a mature forested wetland.

Recommendation. The permanent impacts to forested wetlands should be calculated to include the total width of area where trees would be removed during long-term maintenance including any removal areas beyond the 10-ft. wide area. All forested wetland clearing is considered a permanent impact that would require compensatory mitigation.

Recommendation. The wetland mitigation plan should take into consideration the temporary and permanent impacts associated with conversion from forested to herbaceous or scrub/shrub wetlands.

Recommendation. The wetland mitigation plan should be developed in consultation with TPWD. TPWD requests that Air Products and Chemicals, Inc. address impacts to all wetland types in the wetland mitigation plan and mitigate for these impacts. Coordination of all impacts to the aquatic resources should be coordinated with Jamie Schubert with our Coastal Program; he can be reached at 281-534-0135.

State Regulations

Stream Crossings

The proposed pipelines would cross streams. In association with those waterways, the proposed line would cross herbaceous, scrub/shrub, forested wetlands, bottomland forests, and riparian habitats. Wetlands, riparian areas, and bottomland forests generally provide habitat for local wildlife and protect waterways from sediment loads in runoff water. Riparian habitat is a priority habitat type targeted for conservation by TPWD across the state.

> Recommendation. The EA should address wetland, riparian, and bottomland hardwood impacts at the proposed river and stream crossings to determine that the location chosen is most suitable and provides the least amount of unavoidable impacts compared to other possible crossing locations nearby. Mitigation for impacts to all wetlands, bottomland forests, and riparian areas should be provided.

> Recommendation. In these areas, only vegetation impeding construction should be removed, equipment should not be driven over vegetation when it is extremely wet, and heavy machinery should not be stored on vegetative cover for long periods of time. Protective mats should be placed within streambeds during construction to reduce the amount of soil and root disturbance and aid in the recovery of plants.

> Recommendation. High quality wetland, riparian, and bottomland hardwood communities should be crossed using directional drilling techniques when avoidance is not feasible. Staging areas for the drilling equipment should be located in previously disturbed areas or areas of low value habitat.

> Recommendation. Vehicles not needed specifically at creek crossings should utilize nearby roadways and bridges when crossing wetlands and streams to avoid soil disturbances.

> Recommendation. The applicant should minimize disturbance to inert microhabitats, i.e., snags, brush piles, fallen logs, creek banks, and pools as these provide habitat for a variety wildlife species and their food sources.

No TPWD permit is required for **boring underneath** navigable streams (as defined in Texas state law). A permit under Parks and Wildlife Code Chapter 86 may be required for open-cutting navigable streams. Information regarding such permits can be found at http://www.tpwd.state.tx.us/faq/landwater/sand_gravel/.

> Recommendation. Disturbance to state-owned streambeds crossed by any pipeline may require a permit issued by TPWD. Regarding permits for streambed disturbances, please coordinate with Tom Heger, TPWD – Inland Fisheries at

(512) 389-4583. Please keep the TPWD Wildlife Habitat Assessment Program up-to-date on the status of coordination with Inland Fisheries.

Parks and Wildlife Code

Texas has listed additional animal species not protected by the Endangered Species Act as "State-Threatened" (ST). Any take (incidental or otherwise) of ST animals is prohibited. However, state law only protects the species, and not its habitat. The ST species may only be handled/relocated by permitted individuals authorized by TPWD. There are penalties and restitution values associated with unauthorized take of state-listed species. ***Protection of State-Listed Species - Texas Parks and Wildlife Department Guidelines*** is attached.

Determining the actual presence of a species in a given area depends on many variables including daily and seasonal activity cycles, environmental activity cues, preferred habitat, transiency and population density (both wildlife and human). The absence of a species can be demonstrated only with great difficulty and then only with repeated negative observations, taking into account all the variable factors contributing to the lack of detectable presence.

The Texas Natural Diversity Database (TXNDD) is intended to assist users in avoiding harm to rare species or significant ecological features. Given the small proportion of public versus private land in Texas, the TXNDD does not include a representative inventory of rare resources in the state. Absence of information in the database does not imply that a species is absent from that area. Although it is based on the best data available to TPWD regarding rare species, the data from the TXNDD do not provide a definitive statement as to the presences, absence or condition of special species, natural communities, or other significant features within your project area. These data are not inclusive and **cannot be used as presence/absence data**. They represent species that could potentially be in your project area. This information cannot be substituted for on-the-ground surveys. The TXNDD is updated continuously based on new, updated and undigitized records; for questions regarding a record, please contact txndd@tpwd.state.tx.us.

Review of the TXNDD revealed the following occurrences of rare and protected species within 5 miles of the proposed project.

Species of Concern
Gulf Saltmarsh Snake (*Nerodia clarkii*)

TPWD County Lists

The TPWD county lists for rare species may be obtained from the following link: http://gis.tpwd.state.tx.us/TpwEndangeredSpecies/DesktopDefault.aspx. These lists provide information regarding rare species that have potential to occur within each county.

Rare species could potentially be impacted if suitable habitat is present at or near the project site.

Recommendation. Using the county lists of rare species, the portions of the proposed project with potential to support rare species should be field surveyed to determine the extent and quality of the suspect habitat and potential impacts.

Recommendation. If rare species or their habitat would be impacted by the proposed project, the applicant should coordinate with TPWD and the USFWS, as appropriate, to determine avoidance, minimization, and mitigation strategies.

Recommendation. Construction crews should be informed of the rare species that have potential to occur in the project county and should avoid disturbance to sensitive species if encountered during construction. Only personnel with a TPWD scientific collection permit are allowed to handle and move state listed species. For further information on the required permit please contact Chris Maldonado at (512) 389-4647.

Comment. Further consultation with TPWD would be warranted upon detection of a Texas listed rare, threatened, or endangered species within or near the proposed project at any time prior to or during construction.

Revegetation

Recommendations: TPWD recommends that Air Product and Chemicals, Inc. reseed disturbed soils with a mixture of grasses and forbs native Jefferson County. To enhance native grasses available to wildlife in the project area, TPWD recommends that Bermuda grass be avoided to the extent possible in reseeding efforts, though TPWD understands that slopes may require certain grasses to control erosion. As an introduced species that can be extremely invasive, its use in federally funded projects may be inconsistent with Executive Order 13112 on Invasive Species.

For assistance in determining the best native seed mix for the project area, please contact our staff. Runoff control measures should be maintained until native plants have been reestablished on disturbed areas.

TPWD advises review and implementation of these recommendations. If you have any questions, please contact me at (361) 576-0022.

Sincerely,

Amy Turner

Amy Turner
Wildlife Habitat Assessment Program
Wildlife Division

/ajt:15889

Attachments

Element Occurrence Record

Scientific Name: *Nerodia clarkii* **Occurrence #:** 3 **Eo Id:** 6471

Common Name: Gulf Saltmarsh Snake **TX Protection Status:**

Global Rank: G4Q **State Rank:** S4

Location Information:

Watershed Code:	Watershed Description:
12040201	Sabine Lake

County Code:	County Name:	Mapsheet Code:	Mapsheet Name:	State:
TXJFRS	Jefferson	29093-G8	Port Arthur South	TX
		29093-H8	Port Arthur North	TX

Directions:

PORT ARTHUR

Survey Information:

First Observation: **Survey Date:** **Last Observation:** 1959-08-20

Eo Type: **EO Rank:** **EO Rank Date:**

Observed Area (acres);

Comments:

General Description:

Comments: COLLECTED 20 AUGUST 1959

Protection Comments:

Management Comments:

Data:

EO Data:

Site:

Managed Area:

Managed Area Name: **Managed Area Type:**

Element Occurrence Record

Reference:

Full Citation:

Specimen:

University of New Mexico at Albuquerque, Museum of Southwestern Biology. 1959. Ted Brown and Howard Armstrong, Catalog # 13525 UNMMSB. 20 August 1959.

Code Key for Printouts from Texas Parks and Wildlife Department Texas Natural Diversity Database (TXNDD)

This information is for your assistance only; due to continuing data updates, vulnerability of private land to trespass and of species to disturbance or collection, **please refer all requesters to our office to obtain the most current information available.** Also, please note, identification of a species in a given area does not necessarily mean the species currently exists at the point or area indicated.

LEGAL STATUS AND CONSERVATION RANKS

FEDERAL STATUS (as determined by the US Fish and Wildlife Service)

LE	Listed Endangered
LT	Listed Threatened
PE	Proposed to be listed Endangered
PT	Proposed to be listed Threatened
PDL	Proposed to be Delisted (Note: Listing status retained while proposed)
SAE, SAT	Listed Endangered on basis of Similarity of Appearance, Listed Threatened on basis of Similarity of Appearance
DL	Delisted Endangered/Threatened
C	Candidate. USFWS has substantial information on biological vulnerability and threats to support proposing to list as threatened or endangered. Data are being gathered on habitat needs and/or critical habitat designations.
C*	C, but lacking known occurrences
C**	C, but lacking known occurrences, except in captivity/cultivation
XE	Essential Experimental Population
XN	Non-essential Experimental Population
Blank	Species is not federally listed

TX PROTECTION (as determined by the Texas Parks and Wildlife Department)

E	Listed Endangered
T	Listed Threatened
Blank	Species not state-listed

GLOBAL RANK (as determined by NatureServe)

G1	Critically imperiled globally, extremely rare, typically 5 or fewer viable occurrences
G2	Imperiled globally, very rare, typically 6 to 20 viable occurrences
G3	Very rare and local throughout range or found locally in restricted range, typically 21 to 100 viable occurrences
G4	Apparently secure globally
G5	Demonstrably secure globally
GH	Of historical occurrence through its range
GU	Possibly in peril range-wide, but status uncertain
G#G#	Ranked within a range as status uncertain
GX	Apparently extinct throughout range
Q	Rank qualifier denoting taxonomic assignment is questionable
#?	Rank qualifier denoting uncertain rank
C	In captivity or cultivation only
G#T#	"G" refers to species rank; "T" refers to variety or subspecies rank

STATE (SUBNATIONAL) RANK (as determined by the Texas Parks and Wildlife Department)

S1	Critically imperiled in state, extremely rare, vulnerable to extirpation, typically 5 or fewer viable occurrences
S2	Imperiled in state, very rare, vulnerable to extirpation, typically 6 to 20 viable occurrences
S3	Rare or uncommon in state, typically 21 to 100 viable occurrences
S4	Apparently secure in State
S5	Demonstrably secure in State
S#S#	Ranked within a range as status uncertain
SH	Of historical occurrence in state and may be rediscovered
SU	Unrankable – due to lack of information or substantially conflicting information
SX	Apparently extirpated from State
SNR	Unranked – State status not yet assessed
SNA	Not applicable – species id not a suitable target for conservation activities
?	Rank qualifier denoting uncertain rank in State

ELEMENT OCCURRENCE RECORD

Element Occurrence Record (EOR)	Spatial and tabular record of an area of land and/or water in which a species, natural community, or other significant feature of natural diversity is, or was, present and associated information; may be a single contiguous area or may be comprised of discrete patches or subpopulations
Occurrence #	Unique number assigned to each occurrence of each element when added to the NDD

LOCATION INFORMATION

Watershed Code	Eight digit numerical code determined by US Geological Survey (USGS)
Watershed	Name of watershed as determined by USGS
Quadrangle	Name of USGS topographical map
Directions	Directions to geographic location where occurrence was observed, as described by observer or in source

SURVEY INFORMATION

First/Last Observation	Date a particular occurrence was first/last observed; refers only to species occurrence as noted in source and does not imply the first/last date the species was present
Survey Date	If conducted, date of survey

EO Type State rank qualifiers:

M	Migrant – species occurring regularly on migration at staging areas, or concentration along particular corridors; status refers to the transient population in the State
B	Qualifier indicating basic rank refers to the breeding population in State
N	Qualifier indicating basic rank refers to the non-breeding population in State

EO Rank

A	Excellent	**AI**	Excellent, Introduced
B	Good	**BI**	Good, Introduced
C	Marginal	**CI**	Marginal, Introduced
D	Poor	**DI**	Poor, Introduced
E	Extant/Present	**EI**	Extant, Introduced
H	Historical/No Field Information	**HI**	Historical, Introduced
X	Destroyed/Extirpated	**XI**	Destroyed, Introduced
O	Obscure	**OI**	Obscure, Introduced

EO Rank Date	Latest date EO rank was determined or revised
Observed Area	Acres, unless indicated otherwise

COMMENTS

Description	General physical description of area and habitat where occurrence is located, including associated species, soils, geology, and surrounding land use
Comments	Comments concerning the quality or condition of the element occurrence at time of survey
Protection Comments	Observer comments concerning legal protection of the occurrence
Management Comments	Observer comments concerning management recommendations appropriate for occurrence conservation

DATA

EO Data	Biological data; may include number of individuals, vigor, flowering/fruiting data, nest success, behaviors observed, or unusual characteristic, etc.

SITE

Site Name	Title given to site by surveyor

MANAGED AREA INFORMATION

Managed Area Name	Place name or (on EOR printout) name of area when the EO is located within or partially within an area identified for conservation, such as State or Federal lands, nature preserves, parks, etc.
Alias	Additional names the property is known by
Acres	Total acreage of property, including non-contiguous tracts
Manager	Contact name, address, and telephone number for area or nearest area land steward

Please use one of the following citations to credit the source for the printout information:

Texas Natural Diversity Database. [year of printouts]. Wildlife Diversity Program of Texas Parks & Wildlife Department. [day month year of printouts].

Texas Natural Diversity Database. [year of printouts]. Element occurrence printouts for [scientific name] *records # [occurrence number(s)]. Wildlife Diversity Program of Texas Parks & Wildlife Department. [day month year of printouts]. *Use of record #'s is optional.

Revised 1 Apr 2008

Protection of State-Listed Species
Texas Parks and Wildlife Department Guidelines

Protection of State-Listed Species

State law prohibits any take (incidental or otherwise) of state-listed species. State-listed species may only be handled by persons possessing a **Scientific Collecting Permit** or a **Letter of Authorization** issued to relocate a species.

- **Section 68.002 of the Texas Parks and Wildlife (TPW) Code** states that species of fish or wildlife indigenous to Texas are endangered if listed on the United States List of Endangered Native Fish and Wildlife or the list of fish or wildlife threatened with statewide extinction as filed by the director of Texas Park and Wildlife Department. Species listed as Endangered or Threatened by the Endangered Species Act are protected by both Federal and State Law. The State of Texas also lists and protects additional species considered to be threatened with extinction within Texas.

- **Animals -** Laws and regulations pertaining to state-listed endangered or threatened animal species are contained in **Chapters 67 and 68 of the Texas Parks and Wildlife (TPW) Code** and **Sections 65.171 - 65.176 of Title 31 of the Texas Administrative Code (TAC).** State-listed animals may be found at **31 TAC §65.175 & 176.**

- **Plants -** Laws and regulations pertaining to endangered or threatened plant species are contained in **Chapter 88 of the TPW Code and Sections 69.01 - 69.9 of the TAC**. State-listed plants may be found at **31 TAC §69.8(a) & (b).**

Prohibitions on Take of State Listed Species

Section 68.015 of the TPW Code states that no person may capture, trap, take, or kill, or attempt to capture, trap, take, or kill, endangered fish or wildlife.

Section 65.171 of the Texas Administrative Code states that except as otherwise provided in this subchapter or **Parks and Wildlife Code, Chapters 67 or 68**, no person may take, possess, propagate, transport, export, sell or offer for sale, or ship any species of fish or wildlife listed by the department as endangered or threatened.

"Take" is defined in **Section 1.101(5) of the Texas Parks and Wildlife Code** as:

> *"Take," except as otherwise provided by this code, means collect, hook, hunt, net, shoot, or snare, by any means or device, and includes an attempt to take or to pursue in order to take.*

Penalties

The penalties for take of state-listed species (**TPW Code, Chapter 67 or 68**) are:

- 1ST Offense = Class C Misdemeanor:
  $25-$500 fine

- One or more prior convictions = Class B Misdemeanor
  $200-$2,000 fine and/or up to 180 days in jail.

- Two or more prior convictions = Class A Misdemeanor
  $500-$4,000 fine and/or up to 1 year in jail.

Restitution values apply and vary by species. Specific values and a list of species may be obtained from the TPWD Wildlife Habitat Assessment Program.

URS

January 17, 2011

Mr. Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
108 West 16th Street
Austin, Texas 78701

Re: Request for Section 106 Review. Scope of Work - Cultural Resources Inventory of the Proposed Air Products and Chemicals, Inc., Port Arthur (TX) CO_2 Pipeline Project in Jefferson County.

Dear Mr. Wolfe:

Please find enclosed a copy of the above referenced Scope of Work for your office's review. It presents the proposed Phase I cultural resources inventory methodology to be used for a 12.5 mile long carbon dioxide pipeline and 7 mile long hydrogen pipeline proposed by Air Products and Chemicals, Inc. (APCI). Although the permanent right-of-way will generally be 50 feet or less, this Scope of Work anticipates the use of a 200 foot wide corridor to ensure adequate survey coverage or accommodate minor alignment changes. Nearly the entire length of the proposed APCI pipeline will be collocated with already built energy pipelines.

This project is receiving funds from the Department of Energy (DOE), making this a Section 106 undertaking under the National Historic Preservation Act. DOE will also be the lead federal agency and will review the project through an Environmental Assessment that will have other agency and public input. APCI has contracted with URS Corporation to provide environmental and cultural resources services in support of the proposed project.

A small portion (approximately 0.7 mile) of the CO_2 line crosses state lands administered by the Texas Department of Corrections. APCI is in the process of obtaining written land permission for the required Texas Antiquities Permit, the application for which shall be submitted separately in the near future. No survey will occur on state lands prior to THC issuing the Antiquities permit, however APCI would appreciate comment on the Scope so that survey can proceed on privately owned parcels.

APCI and URS appreciate your efforts to review this request and thank you for any assistance you are able to provide. Should you have any questions, please do not hesitate to give me a call at (225) 935-2974 or you can reach me at rob_lackowicz@urscorp.com.

Sincerely,

Rob Lackowicz, M.A.
Principal Investigator
URS Corporation

Cc: Greg Frisby and Steve Fisher, Project Managers, APCI

URS Corporation
7389 Florida Blvd.,
Suite 300
Baton Rouge, LA 70806
Tel: 225.922.5700
Fax: 225.922.5701
www.urscorp.com

URS

Proposed Scope of Work: Phase I Cultural Resources Inventory of Air Products and Chemicals, Inc., Proposed Port Arthur (TX) CO_2 Pipeline Project in Jefferson County, Texas.

Project Introduction

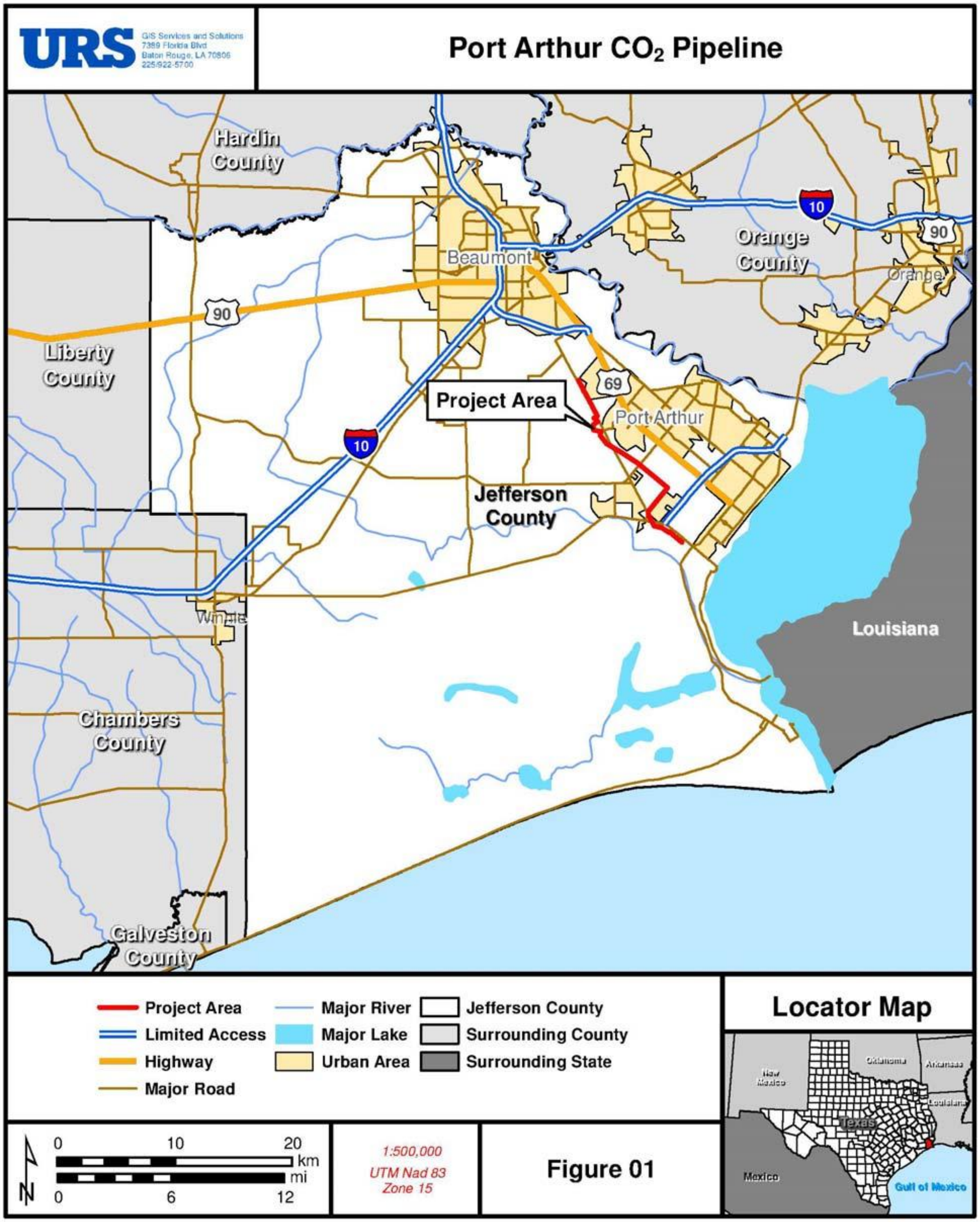
Under the American Recovery and Reinvestment Act of 2009, the U.S. Department of Energy (DOE) has made funding available for large-scale carbon dioxide (CO_2) projects that capture more than 1 million tons of CO_2 per year if they are operational by 2015. In June 2010 the DOE National Energy Technology Laboratory announced it had selected an Air Products and Chemicals, Inc. (APCI) project under this program to move to Phase 2, the project execution phase. It includes an approximately 12.5 mile (20 km) long, 8-inch outside diameter CO_2 pipeline lateral near Port Arthur in Jefferson County, Texas that will ultimately transport captured, concentrated, and/or purified CO_2 to the mature Hastings Oil Field in Brazoria County, Texas (Figure 1). The APCI pipeline will extend from an existing Valero refining facility at its southern end to the Denbury Resources Inc. Green Pipeline. Although new, as proposed this APCI pipeline will be collocated with multiple existing energy pipelines (up to six, owned mainly by Enterprise and TEPPCO) and drainage canals for almost the entirety of its length. Due to engineering or staging uncertainties, several possible small reroutes identified along its length may also be surveyed.

The project, as currently envisioned, will also include an upgrade of APCI's hydrogen (H_2) pipeline supply system to the host Valero refinery. The H_2 pipeline lateral, currently also of 10-inch diameter, will be co-installed with the CO_2 pipeline inside the selected right-of-way. The route of this new H_2 pipeline lateral will follow the first seven miles of the route that is proposed for the 12.5 mile (20 km) CO_2 pipeline. Because the H_2 pipeline will be co-installed with the CO_2 pipeline, statements referring to the CO_2 pipeline within this Scope of Work should be understood to also refer to the H_2 pipeline, as applicable.

The project will undergo National Environmental Policy Act review and it will require an Environmental Assessment (EA) and a Finding of No Significant Impact (FONSI) for Department of Energy funding. The anticipated environmental and cultural survey corridor is 200 feet (61 m) wide and lies solely within privately owned (non-federal or state) lands, excluding 0.7 miles (1.1 km) at its northern end that runs through two land parcels administered by a Texas Correctional Facility, which are identified as parcels TX-JF-055 and -058 in Topographic Map Sheet 1 (Appendix 1) and Aerial Photo Sheets 1 and 2 (Appendix 2). This scope of work includes the methodology that will be used for that segment. The Texas Department of Corrections is currently being contacted for survey permission and signing of an Antiquities Permit application form, which will be submitted shortly to the Texas Historical Commission (THC). No survey will occur on state lands until an Antiquities Permit has been issued by THC.

APCI has contracted with URS Corporation to provide environmental and cultural resources services in support of their regulatory compliance. This Scope of Work presents the proposed Phase I cultural resources survey inventory methodology that will be implemented for this project for review by THC (State Historic Preservation Office) and interested federal agencies. The direct archaeological Area of Potential Effect (APE) is roughly defined as the 200 foot (61 m) wide by 12.5 mile (20.2 km) long corridor that will be centered on the proposed pipeline(s), which represents approximately 303 acres (123 hectares) of area to assess. Pedestrian survey and shovel testing efforts will be restricted to the above APE, except where altered to take into account additional temporary workspace (ATWS), horizontal directional drill (HDD) pads, or land owner survey restrictions. New compression or other major ancillary facilities are not anticipated at this time. APCI is currently assessing the need to upgrade or improve private access roads; however, some road upgrades or improvements are expected during the construction phase of the project. These areas will also be surveyed for cultural resource concerns during the project.

Figure 1: Location of the proposed APCI CO_2 Pipeline in Jefferson County, Texas.



Federal Involvement

Principal federal oversight of the project's compliance with Section 106 of the National Historic Preservation Act will come from the DOE as the principal funding agency. The U.S. Army Corps of Engineers, Galveston District, is also expected to be involved in the federal review for relevant nationwide environmental permit compliance. Unless the agency decides otherwise, DOE will initiate consultation with federally-recognized Native American tribal organizations that may have interest in the project area.

Proposed Work Guidelines

URS will conduct a Phase I cultural resources inventory of the proposed APCI CO_2 pipeline and access roads. The purpose of this investigation will be to identify and assess significant cultural resources, such as historic and prehistoric archeological sites, historic buildings, or cemeteries that are located within the boundaries of the proposed undertaking. This investigation will follow the guidelines and procedures outlined in the following documents: (1) The THC's *Preserving Our Heritage: a Statewide Plan for Texas*; (2) Council of Texas Archeologists standards for cultural resources survey; (3) Antiquities Code of Texas (and the THC's *Rules of Practice and Procedure for the Antiquities Code of Texas*); (4) National Historic Preservation Act of 1966 (as amended); (5) Archaeological and Historic Preservation Act of 1974; (6) Archaeological Resources Protection Act of 1979, as amended (if required); (7) Title 36 of the Code of Federal Regulations (Parts 60-66 and 800); and (8) *Archeology and Historic Preservation: The Secretary of the Interior's Guidelines.*

Previous Cultural Resource Investigations

The project area lies within the Southeast Texas Archeological Region, which is associated with the larger Eastern Planning Region (Kenmotsu and Perttula 1993). The Southeast Texas Archeological Region is comprised of the following 18 counties in addition to Jefferson: Brazoria, Brazos, Chambers, Fort Bend, Galveston, Grimes, Hardin, Harris, Jasper, Liberty, Montgomery, Newton, Orange, Polk, San Jacinto, Tyler, Walker and Waller (Perttula 1993).

Prior to initiating the fieldwork component of this project, a review was conducted by URS of data currently on file at the THC via the online Texas Archeological Sites Atlas. This research was undertaken to identify previously completed cultural resources surveys and cultural resources recorded within 1 mile (1.6 km) to either side of the proposed pipeline centerline. The proposed APCI CO_2 pipeline crosses, or lies near, a number of cultural resources surveys that were conducted between 1979 and 2008 (see attached Topographic Map Sheets 1 to 5 in Appendix 1). Although none of the studies shown encompass significant portions of the currently proposed right-of-way, additional recent projects available to THC staff but not posted to the Site Atlas may also be present. A vehicular inspection was conducted by APCI and URS staff at points along the proposed pipeline route on December 16, 2010. This inspection found the pipeline is often collocated with several recent energy pipelines, including an Enterprise crude oil line with its southern terminus at the Valero facility that had been constructed several months ago.

According to the Texas Archeological Site Atlas, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, historic buildings or historic structures have been identified previously within 1 mile (1.6 km) of the proposed pipeline centerline. The closest appears to be Site 41JF81, about 1.4 miles southeast of the pipeline's initiation point at the Valero facility, on the banks of Taylor Bayou. The northern terminus of the line is located just over one mile from the outer boundary defined for the Spindletop historic oil field district and National Historic Landmark.

Two state historic markers and a single contemporary cemetery were identified within 1 mile (1.6 km) of the proposed survey corridor. The first marker is Atlas No. 5245012672, erected in 1966 to commemorate the historic impacts of the early oil pipelines to the state and nation (Topographic Map Sheet 3 in Appendix 1). The other marker is Atlas No. 5245013118, erected in 2003 to commemorate the historic effects of the Spindletop oil field and early pipelines to Port Arthur (Topographic Map Sheet 4 in Appendix 1). Neither of these features is located within 750 feet (250 m) of the proposed survey corridor. The single known cemetery within the vicinity of the proposed undertaking is Live Oak Memorial (JF-C025), which is located on the opposite bank of Rhodair Gully at Viterbo, west of the county's regional airport (Topographic Map Sheet 2 in Appendix 1). It also will not be impacted by the project. Based on a review of the online National Park Service database, no historic properties listed on the National Register of Historic Places properties lie within 1 mile (1.6 km) of the proposed survey corridor.

Project Ecoregions

The regional landscape strongly influences the preservation and subsequent identification of any archeological materials that may have been deposited within the proposed project corridor. The project area falls within the Gulf Coastal Prairie and Marshes ecoregion (Griffith et al. 2004; http://www.fs.fed.us/land/pubs/ecoregions/ch21.html). It includes extensive freshwater and saltwater tidal marshes and plains that have primarily developed on top of Holocene clays, silts, and peat.

Project Soils and Landforms

According to USDA datasets, the proposed 12.5 mile (20 km) long CO_2 pipeline (and its possible reroutes) cross 12 soil series as show in Soil Map Sheets 1 through 10 (Appendix 3) and Table 1. All but a small percentage of the proposed route is located on level landforms with poor drainage. The Neel-Urban series is limited to the perimeter of the existing Valero Industrial facility.

Table 1: Soil Characteristics within Pipeline Survey Corridor and Possible Reroute (Crenwelge 2006; USDA Natural Resource Conservation Service GIS dataset (see Soil Map Sheets 1 through 10 in Appendix 3)

Proposed Route Soils				
Symbol	**Soil Name**	**Acres**	**Drainage**	**Percentage**
AsA	Anahuac-Aris complex, 0 to 1 percent slopes	15.29	Moderately-well at ridges otherwise poor	4.95%
BmA	Beaumont clay, 0 to 1 percent slopes	57.11	Poor	18.51%
CeA	Caplen mucky peat, 0 to 1 percent slopes, frequently flooded	8.06	Very poor	2.61%
FrA	Franeau clay, 0 to 1 percent slopes, occasionally flooded	18.90	Poor	6.13%
HaA	Harris clay, 0 to 1 percent slopes, frequently flooded	23.75	Very poor	7.70%
LcA	Labelle-Aris complex, 0 to 1 percent slopes	14.38	Poor	4.66%
LdA	Labelle-Levac complex, 0 to 1 percent slopes	19.49	Poor	6.32%
LtA	League clay, 0 to 1 percent slopes	61.44	Poor	19.91%
LwA	Leton loam, ponded, 0 to 1 percent slopes	2.81	Poor	0.91%
NuC	Neel-Urban land complex, 2 to 5 percent slopes, rarely flooded	1.82	Moderately-well	0.59%
VtA	Viterbo silty clay loam, 0 to 1 percent slopes	10.38	Poor	3.36%
W	Water	12.72	n/a	4.12%
ZuA	Zummo muck, 0 to 1 percent slopes, frequently flooded,	62.40	Very poor	20.22%
	Total =	308.54		100.00%

Possible Reroute Soils				
Symbol	**Soil Name**	**Acres**	**Drainage**	**Percentage**
BmA	Beaumont clay, 0 to 1 percent slopes	9.25	Poor	34.75%
LtA	League clay, 0 to 1 percent slopes	4.65	Poor	17.47%
NuC	Neel-Urban land complex, 2 to 5 percent slopes, rarely flooded	3.00	Moderately-well	11.28%
FrA	Franeau clay, 0 to 1 percent slopes, occasionally flooded	9.08	Poor	34.13%
HaA	Harris clay, 0 to 1 percent slopes, frequently flooded	0.63	Very poor	2.37%
	Total =	26.61		100.00%

<u>Definition of Archaeological Site Potential and Survey Methods</u>

The poor drainage and lack of archaeological sites recorded during previous surveys within the area indicate that overall archaeological potential along the proposed APCI route is minimal. The potential for intact undisturbed historic properties is further diminished, as the proposed APCI pipeline will be collocated with existing built pipelines or canals for its length (see Aerial Photo Sheets 1 through 10 in Appendix 2). The anticipated general width of new permanent right-of-way is expected to be 50 feet (15 m) or less, and spoil will generally be deposited on the existing cleared right-of-way during construction. The proposed route is mainly situated within industrial, commercial, or pastoral lands or alongside transportation corridors or built drainage canals. A section near State Highways 73 and 93 runs within visual sight of residences and commercial properties; these properties will be assessed for the presence of historic built structures in the manner described below. The December 16, 2010 field visit indicates that the residential areas generally date to the 1960s to 1970s, along with more recent construction.

Prehistoric archaeological potential is generally limited given the level of previous ground disturbance and soil drainage conditions. This includes the likelihood of encountering buried sites along the route. Site potential is believed highest within proximity of drainages (defined for this field effort as within 1300 feet (400 m) of water crossings) and along any slightly raised scar ridges associated with the Anahuac-Aris complex soil series. Historic archaeological site potential is also considered limited due to a lack of recorded buildings on topographic maps, the open and level terrain without physiographic relief, its collocation with existing pipeline corridors, and the soil drainage conditions.

This Phase I cultural resources survey effort will be comprised of linear transect survey involving systematic pedestrian survey augmented by shovel testing within the entire project corridor. In general, two pedestrian survey transects will be spaced approximately 75 feet (23 m) apart within the 200 foot (61 m) wide survey corridor (single transects generally located to either side of the existing pipeline rights-of-way). Transect survey methods will allow for these portions of the proposed survey corridor to be assessed in a systematic and uniform manner and assist with the identification and delineation of any cultural resources encountered as a result of the survey effort. Standardized survey segment forms will record whether each segment was evaluated using Low, Moderate or High Potential survey methods.

Shovel tests will display an average excavated diameter of 12 inches (30 cm) and they will be excavated to at least 20 inches (50 cm) below surface, unless impenetrable subsoils or ground water are encountered. If the soil types encountered indicate the potential for more deeply buried sites, the depth of the shovel test will be increased accordingly, up to 39 inches (100 cm) below surface. All shovel tests will be excavated in natural soil layers at 4-inch or 8-inch (10 or 20 cm) intervals and all excavated soils will be screened through ¼-inch mesh unless water-saturated, in which case they will be hand sorted by trowel. If cultural materials are encountered, then the base of the shovel test excavation will extend to at least 16 inches (40 cm) beneath the last occurrence of cultural materials. Based on the types of landforms crossed and level of previous disturbance, the use of mechanical excavation techniques is not anticipated.

Typical Munsell soil charts will be used to describe soil color. Standard soils nomenclature will also be used in the description of the excavated sediments associated with each shovel test. Prior to closing up the shovel test, each shovel test will have survey ribbon placed into it indicating the Date, Crew Initials, Transect Number, and Shovel Test Number. All of the excavated shovel tests will be backfilled immediately upon the completion of the excavation process. Shovel testing will not be conducted in areas where the landform slope is greater than 20%; where safety hazards, such as buried utilities, exist and the shovel test cannot be offset; or where standing water, impenetrable clays, environmental hazards, or impervious substrates (e.g. asphalt roads) are encountered. The above information concerning each shovel test location will be recorded on standardized shovel test forms; any shovel test that cannot be excavated due to one or more of the above reasons will be defined in the Phase I cultural resource survey report sent to THC.

All recovered cultural materials will be recorded in the field using electronic standardized field collection techniques using an electronic field data collection device (e.g., Toughbook, Yuma, or similar). GPS data collectors with sub-meter accuracy will be used to record the beginning and endpoint of survey transects, pipeline inflexion (PI) points, survey areas, access roads, locus datum locations, and the corners of any standing structures encountered during the course of this investigation. Digital photographs will be taken of all survey areas to document current conditions. Detailed pace-and-compass maps for all encountered cultural resources will also be produced.

Survey Methods in Low Archaeological Potential Areas

Portions of the project corridor cross short sections of wetlands fully inundated by water; in these areas pedestrian survey of accessible lands with photo-documentation of inundated survey areas will be considered sufficient for the purposes of cultural resources assessment. Where extensive pastoral or agricultural cultivation is present, ground surface exposures exceed 50 percent and the likelihood of buried archaeological sites is low based on soil types and topography, systematic pedestrian survey will be used as an adequate survey methodology, augmented with judgmental shovel tests to confirm soil conditions. Each judgmental shovel test will be excavated at an interval of 1640 ft (500 m) or less.

Survey Methods in Moderate Archaeological Potential Areas

In areas with poorly draining soils, located away from defined drainages poor but where buried sites are considered possible, shovel tests will be excavated at 328 feet (100 m) intervals along one of the survey transects located within the 200 foot (61 m) wide survey corridor (Table 2).

Survey Methods in High Archaeological Potential Areas

High archaeological site potential for this project includes all elevated landforms such as hills or knolls present within a project area, and all landforms within 1300 feet (400 m) of natural water drainages. In these areas, shovel tests will be excavated along both survey transects at 164 feet (50 m) intervals (Table 2). Judgmentally placed shovel tests on top of the landform may be used if the landform is less than 165 feet (50 m) in width.

If cultural materials are encountered within areas defined as having Low or Moderate Archaeological Potential, the survey crew will immediately change to the High Potential shovel testing intervals and the site delineation methods presented further below will also be implemented. If deeply buried cultural deposits are encountered as a result of the shovel testing program, heavy machinery may be required to more fully assess these deposits. These activities will be performed only after consultation with THC and APCI.

Table 2: Proposed Shovel Test Intervals

Shovel Test Width	Shovel Test Depth	Moderate Probability	High Probability	Site Delineation
30 cm (12 in)	50 cm (20 in) (unless artifacts or possibility of deeply buried sites)	Every 100 m (328 ft) along one transect	Every 50 m (164 ft) along two transects	10 to 25 m (33 to 82 ft) intervals within site area

<u>Horizontal Directional Drilling / Boring Segments and Additional Temporary Work Spaces</u>

Due to the number of poorly draining landforms, drainage canals and roadways crossed by the proposed pipeline and its location adjacent to existing pipelines, deep HDDs and bores are expected to be commonly used along the length of the proposed APCI CO_2 pipeline. Setup locations for the HDD and bore locations (pads) may exceed the standard 200 foot (61 m) survey corridor. Additional temporary work spaces (ATWS) may also be required in some areas. Any location that exceeds the standard survey corridor will be assessed for cultural resource concerns using the methods discussed above, as determined by the site potential. Standardized URS forms will also be used to document all of the cultural resource survey information associated with these additional facilities.

<u>Texas Department of Corrections Land</u>

Two short sections of the pipeline cross state lands administered by the Texas Department of Criminal Justice (Stiles Unit). The combined length of these segments is approximately 0.7 miles (1.1 km) and crosses level, previously harvested land that is again mainly forested with young trees on its southern parcel (TX-JF-055) and clear open land on its northern parcel (TX-JF-058), as shown in the highlighted parcels on Topographic Map Sheet 1 (Appendix 1) and Aerial Photo Sheets 1 and 2 (Appendix 2). The proposed APCI pipeline remains collocated with several other existing oil pipelines along these two segments.

The survey of these lands falls under the Antiquities Code of Texas and the THC's *Rules of Practice and Procedure for the Antiquities Code of Texas*. An Antiquities Permit application for these state lands has been submitted to the THC with survey permission and a Texas Department of Criminal Justice representative's signature. Given the lack of topographic and water features and the level of ground disturbance from previous timber harvesting and the existing pipelines, archaeological potential within this segment is considered relatively low and the Phase I archaeological survey is expected to employ the Moderate Archaeological Potential methods listed above, unless landforms meeting the High Potential category are encountered while in the field. If an archaeological site or historic building is identified, the delineation, recording and analysis methods described further below will be used.

<u>Access Roads</u>

Access roads to the pipeline right-of-way are expected to be used by APCI during the construction phase of the project. If the access road is an existing public roadway, or is constructed of asphalt or concrete, no examination for cultural resources is proposed. For any existing dirt or gravel access road that will require no improvements (e.g., widening, straightening or grading for addition of gravel or sand), it is proposed that only a visual examination of both road sidewalls up to 50 ft (15 m) from the road centerline will be required. For any access road that will require new construction, or where improvements (e.g., widening, straightening or grading for addition of gravel or sand) will be required during the course of the project to make the roadway suitable for heavy machinery, a visual examination of both road sidewalls up to 50 ft (15 m) from the road centerline will be made for cultural resources and shovel tests will be excavated along its extent, with the tests alternating to either side of the roadway, away from existing land disturbance. If the access road is positioned within an area considered to display high potential for buried cultural resources, these tests will be excavated at 165 foot (50 m) intervals, otherwise the tests will be excavated at 328 foot (100 m) intervals. Information associated with the cultural resources survey of these access roads will be noted on standardized URS forms.

Ancillary Facilities

Major ancillary facilities, such as compression stations or warehouse yards, are not currently anticipated for the project. In the event that they are added, the survey methods presented above will be implemented. Standardized URS survey area forms will be used to document all of the cultural resource survey information associated with these additional facilities. One or more excess flow valve (EFV) stations will likely be installed along the route. However, these EFV stations are small structures that are expected to be situated entirely within the 200 foot (61 m) survey corridor.

Archaeological Site Delineation

All identified archaeological sites will be recorded on Texas Archeological Site Data Forms and submitted for a site number. All of the above information, in association with the analysis of the recovered cultural material, will be used in support of determining whether the sites should be considered eligible, not eligible, or cannot be assessed using the National Register of Historic Places criteria for evaluation (36 CFR 60.4 [a-d]).

Any cultural resource identified by the Phase I cultural resource inventory study will be reported to THC, although if cultural resources are identified, route modifications may be first considered by APCI. If a decision is made to proceed at the site the cultural resources identified will be systematically assessed to determine the integrity, association, and research potential of the cultural deposits. Delineation of the cultural resources will involve the excavation of shovel tests at approximately 82 foot (25 m) intervals from an established locus datum for large sites and at approximately 33 foot (10 m) intervals for sites less than 165 ft (50 m) in diameter. Shovel tests will be oriented in a cruciform (cross) pattern and will continue to be excavated until two negative shovel tests are encountered within the established project corridor or workspace.

Where possible, landowner permission will be requested to extend the evaluation beyond the survey corridor if the site exceeds it, to fully delimit the horizontal boundaries of the site. When cultural materials are encountered, the base of the shovel test excavation will be extended to at least 16 inches (40 cm) beneath the last occurrence of cultural materials; this will function to define the vertical boundaries of the site. A bucket auger may also be used to excavate to a maximum depth of 39 inches (100 cm) to determine if more deeply buried deposits are represented within the boundaries of the identified archaeological site. If the site location is characterized by a deflated, erosional context (i.e., recently plowed agricultural or pastoral field with sufficient ground visibility), a systematic surface collection will be conducted at approximately 50 foot (15 m) intervals from the established site datum; cultural materials from a 16.4 foot (5 m) wide radius around each point will then be collected.

Historic Building and Structure Evaluation

Cultural resources staff will assess all buildings, structures, cemeteries, Texas Historic Landmarks and State Archeological Landmarks that are visually located within 328 feet (100 m) of the project survey corridor, access road or ATWS / HDD pad location. The recording procedures for architectural resources follows the guidelines established by the National Park Service in their 1995 "*National Register Bulletin 24: Guidelines for Local Survey – A Basis for Preservation Planning*". Both straight-on and corner photographs of all historic structures and/or engineering elements over approximately 45 years in age will be taken, where possible from public rights-of-way or from within the landowner permitted survey area. Specific information related to building materials, foundation type, structural form, architectural style, associated outbuildings, and observed alterations, will be collected to assist in assessing if the structure should be eligible, not eligible, or not assessed for the purposes of the National Register of Historic Places criteria for evaluation (36 CFR 60.4 [a-d]). Locally or state-available archival information and land title data will also be used when making this determination.

Laboratory Analysis

Upon return to the URS laboratory, all recovered cultural materials will be cleaned and separated into their basic material categories (i.e., prehistoric [lithic, shell or ceramic], historic [ceramic, glass, metal, etc.] or faunal). Relevant provenience and material culture observations will be recorded for each artifact and will be entered into a relational database. This information will then be used to support any determinations of eligibility for the purposes of the National Register of Historic Places criteria for evaluation (36 CFR 60.4 [a-d]). All recovered prehistoric cultural materials and identified cultural features will be interpreted based upon cultural historical frameworks developed for the prehistory of Southeast Texas, including discussions in Aten (1983), Perttula (1993), and Story (1990), among others.

Historic Material Analysis

Historic cultural materials will be categorized by material type (e.g., ceramic, glass, metal or synthetic). Following this, a functional classification will be implemented, following those attributes as generally defined by South (1977); individual diagnostic attributes, specifically those describing a temporal or cultural relationship, will also be identified. The following standard historic material culture reference works will be utilized for this project: Jones and Sullivan (1989), Lockhart (2004, 2006), Lyman (1977), Miller (1991), Miller and McNichol (2002), Miller et al. (2000), Toulouse (1969, 1971), and White (1978).

Prehistoric Lithic Analysis

The lithic analysis protocol will be technological in nature and designed to document lithic reduction strategies and tool function. The first attribute analyzed will be lithic raw material type, which will be identified through comparisons to known geological descriptions, based on texture, color, and translucence. Artifact types will be described according to their general morpho-functional class (i.e., biface, core, debitage, drill, graver, groundstone, manuport, projectile point/knife, scraper, etc.) and degree of intentional shaping (formed vs. unformed). Typological classifications for temporally and/or regionally diagnostic tools will use standard references to established regional lithic typologies.

Prehistoric Ceramic Analysis

Encountered prehistoric ceramics will be categorized using established type and variety systems, including surface decoration, aplastic inclusions, and vessel portion. Regional named ceramic types and varieties will be identified through reference to published sources for the study area noted in Aten (1983) and Story (1990), among others. Surface decorations represented will be described, including surface treatment, slips, paint type, and style. As well, vessel form, portion (i.e., base, body, collar, neck, rim, etc.), principal paste and temper will be documented.

Faunal Material Analysis

Faunal material recovered as a result of the project will be analyzed with standard zooarcheological identification protocols. The identification of faunal specimens will be based on comparing the recovered material to a skeletal reference collection. The analysis will be augmented by consulting standard reference works such as Gilbert (1980), Hillson (1986), and Olsen (1964, 1968). The selected samples will be identified as to class, order, family, genus, or species. Taxonomic classes may include Aves (birds), Mammalia (mammals), Osteichthyes (fish), Reptilia (reptiles), Invertebra (invertebrates), and Indeterminate specimens. If specimens cannot be identified below class, fragments will be placed into size categories; large, large-medium, medium, medium-small, and small. Size classes will be determined subjectively based on cortical thickness, amount of cancellous bone present, and fragment curvature. Within each taxon, efforts will be made to determine element, portion, and side of each specimen.

Curation

Following review and acceptance of the final cultural resources report, all archeological records, photographs, and field notes will be curated with the Texas Archeological Research Laboratory (TARL) at The University of Texas at Austin, 1 University Station R7500, in Austin, Texas (78712-0714). It is anticipated that private landowners will retain ownership of any artifacts identified during the field effort. In the event that they decide not to keep the artifacts then they will be curated at the above facility.

References Cited

Aten, L. E.
1983 *Indians of the Upper Texas Coast*. Academic Press, New York.

Crenwelge, J.
2006 *Soil Survey of Jefferson and Orange Counties, Texas*. USDA Soil Conservation Service.

Gilbert, B. M.
1980 *Mammalian Osteology*. Missouri Archaeological Society, Columbia, Missouri.

Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A. Comstock, A. C. Rogers, B. Harrison, S. L. Hatch, and D. Bezanson
2004 *Ecoregions of Texas*. US Environmental Protection Agency, Corvallis, Oregon.

Hillson, S.
1986 *Teeth.* Cambridge Manuals in Archaeology, Cambridge University Press, Cambridge.

Jones, O. and C. Sullivan
1989 *Parks Canada Glass Glossary.* Canada Parks Service.

Kenmotsu, N. A. and T. K. Perttula
1993 *Archeology in the Eastern Planning Region, Texas: A Planning Document*, Department of Antiquities Protection, Cultural Resources Management Report 3, Texas Historical Commission.

Lockhart, B.
2004 The Dating Game: Owens-Illinois Glass Company. *Bottles and Extras* 15(3):24-27.

2006 The Color Purple: Dating Solarized Amethyst Container Glass. *Historical Archaeology* 40(2):45-56.

Lyman, R. L.
1977 Analysis of Historical Faunal Remains. *Historical Archaeologist* 11:67-73.

Miller, G. L.
1991 Revised Set of CC Index Values for Classification and Economic Scaling of Ceramics from 1787 to 1880. *Historical Archaeology* 25(1):1-25.

Miller, G. L., and T. McNichol
2002 *Dates for Suction Scarred Bottoms: Chronological Changes in Owens Machine-Made Bottles*. URS Corporation, Florence, New Jersey. Paper given at the 2002 SHA meetings, Mobile, Alabama.

Miller, G. L., P. Samford, E. Shlasko, and A. Madsen
2000 Telling Time for Archaeologists. *Northeast Historical Archaeology* 29:1-21.

Olsen, S. J.
1964 *Mammal Remains from Archaeological Sites: Part I, Southeastern and Southwestern United States.* Papers of the Peabody Museum of Archaeology and Ethnology, Vol. LVI, No. 1. Harvard University, Cambridge.

1968 *Fish, Amphibian and Reptile Remains from Archaeological Sites: Part One, Southeastern and Southwestern United States.* Papers of the Peabody Museum of Archaeology and Ethnology Vol. 56, No. 2. Harvard University, Cambridge.

Perttula, T. K.
1993 Section IV: Regional Preservation Plan for Archeological Resources, Southeast Texas Archeological Region. In *Archeology in the Eastern Planning Region, Texas: A Planning Document,* N. A. Kenmotsu and T. K. Perttula, pg. 205-213, Department of Antiquities Protection, Cultural Resources Management Report 3, Texas Historical Commission.

South, S.
1977 *Method and Theory in Historical Archaeology*. Academic Press, New York.

Story, D. A.
1990 Cultural History of the Native Americans. In *The Archaeology and Bioarchaeology of the Gulf Coastal Plain*, by D. A. Story, J. A. Guy, B. A. Burnett, M. D. Freeman, J. C. Rose, D. G. Steele, B. W. Olive, and K. J. Reinhard, pg. 163-366. Research Series No. 38, Arkansas Archeological Survey, Fayetteville, Arkansas.

Toulouse, J. H.
1969 A Primer on Mold Seams, Part II. *Western Collector* 7(12):578-587.

1971 *Bottle Makers and Their Marks*. Thomas Nelson Inc., Camden, New Jersey.

White, J. R.
1978 Bottle Nomenclature: A Glossary of Landmark Terminology for the Archaeologist. *Historical Archaeology* 12: 58-67.

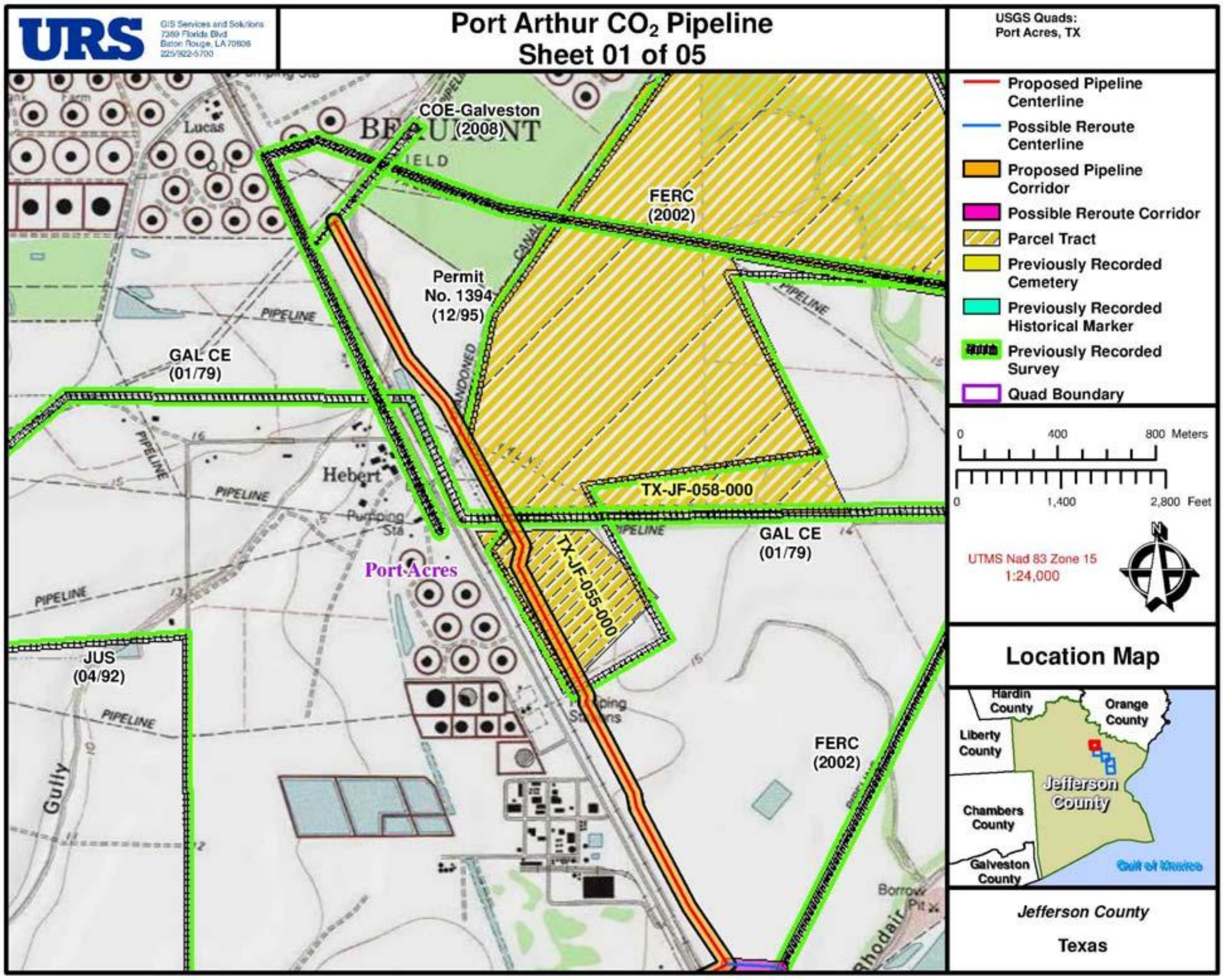
Websites Accessed

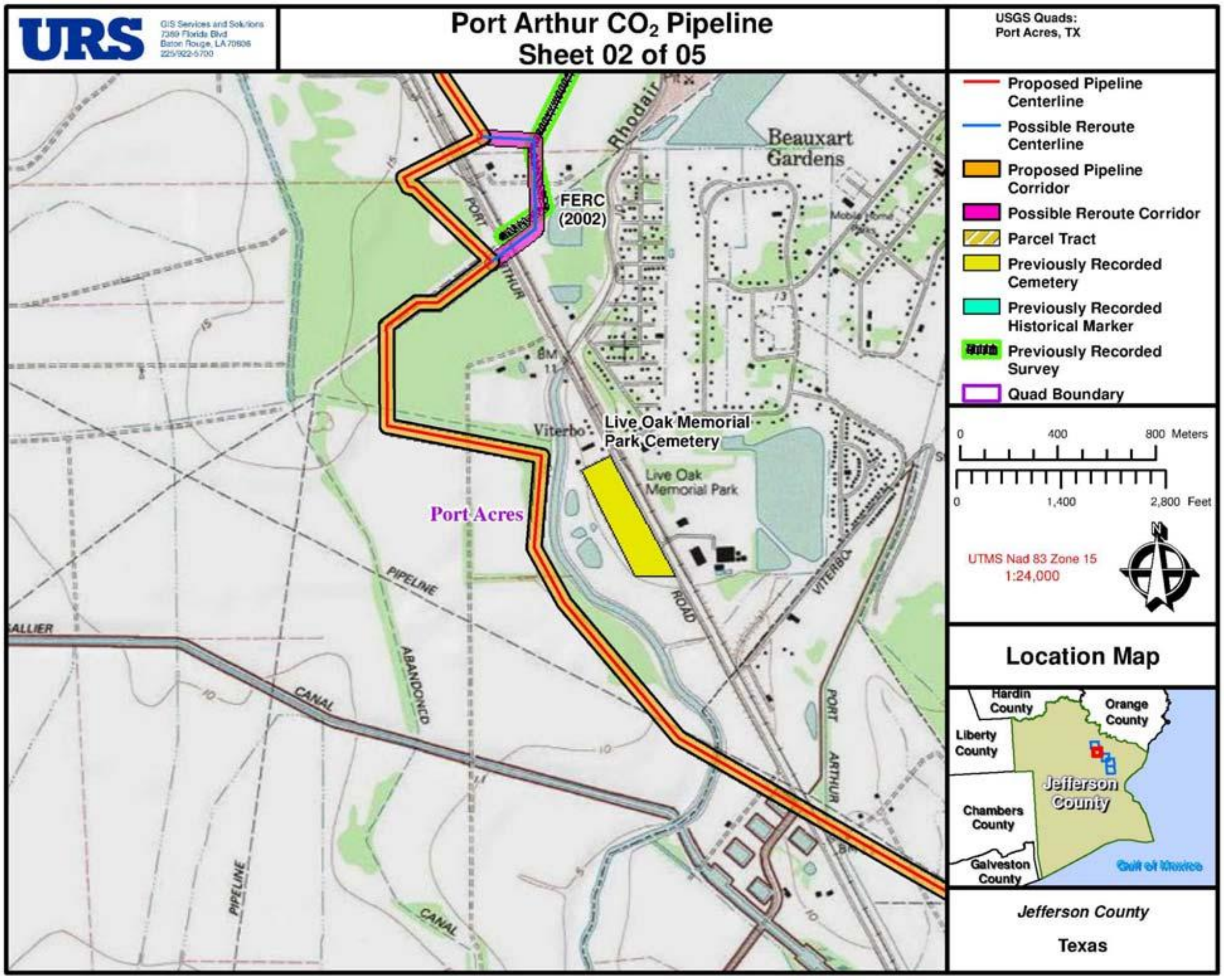
http://nueces.thc.state.tx.us/, Accessed December 15, 2010

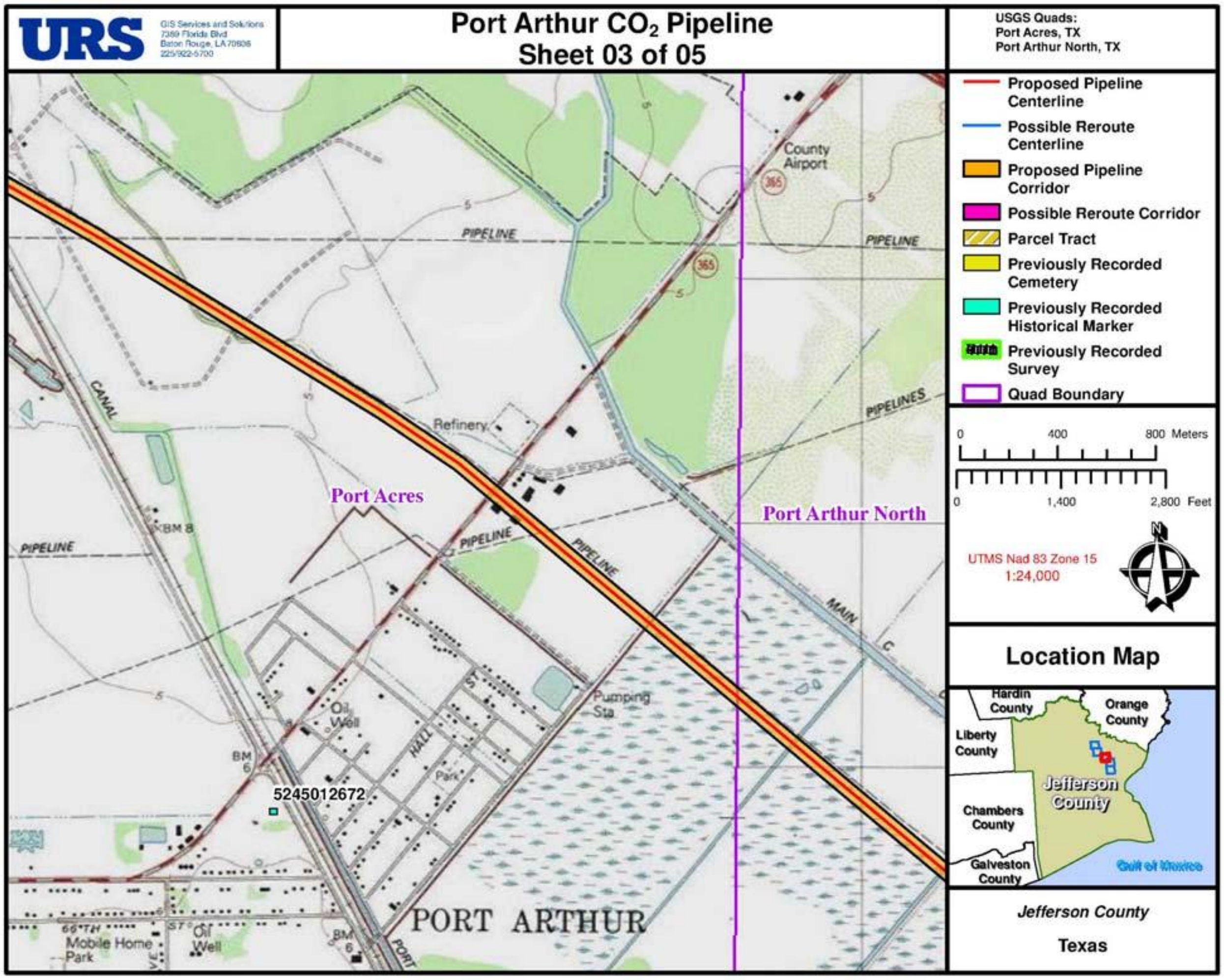
ftp://ftp.epa.gov/wed/ecoregions/us/useco.pdf, Accessed December 20, 2010

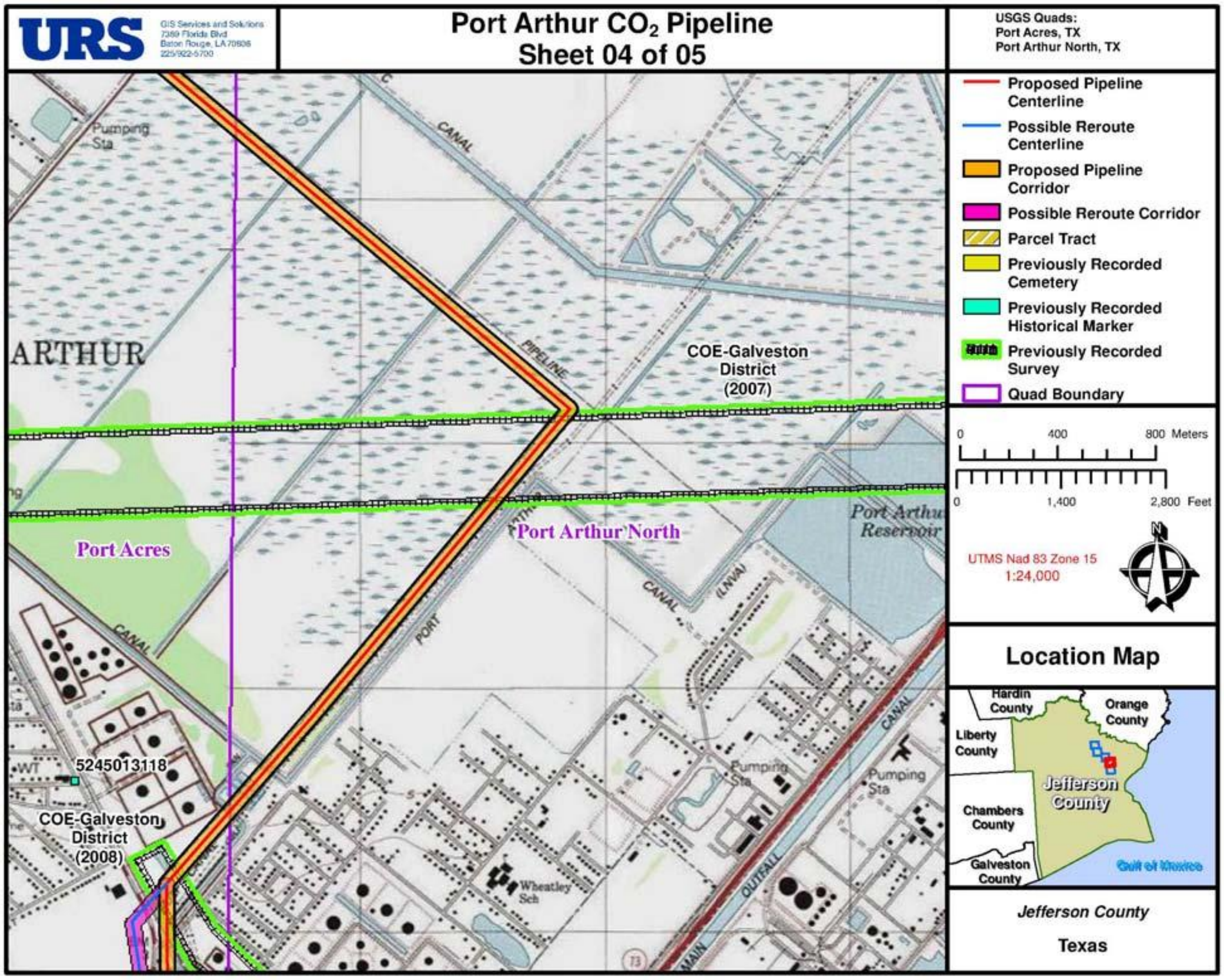
http://www.fs.fed.us/land/pubs/ecoregions/, Accessed December 20, 2010

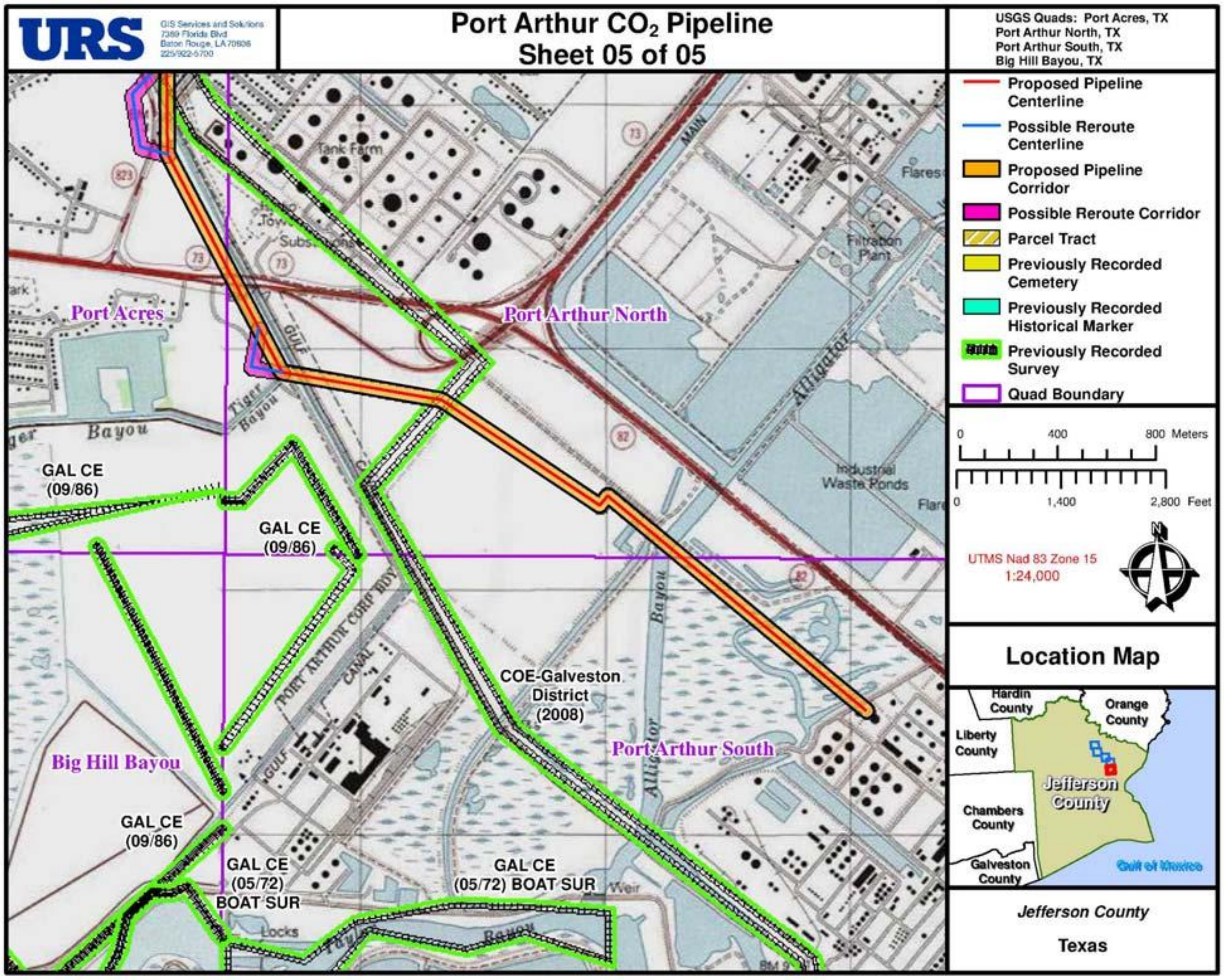
http://websoilsurvey.nrcs.usda.gov/, Accessed December 21, 2010

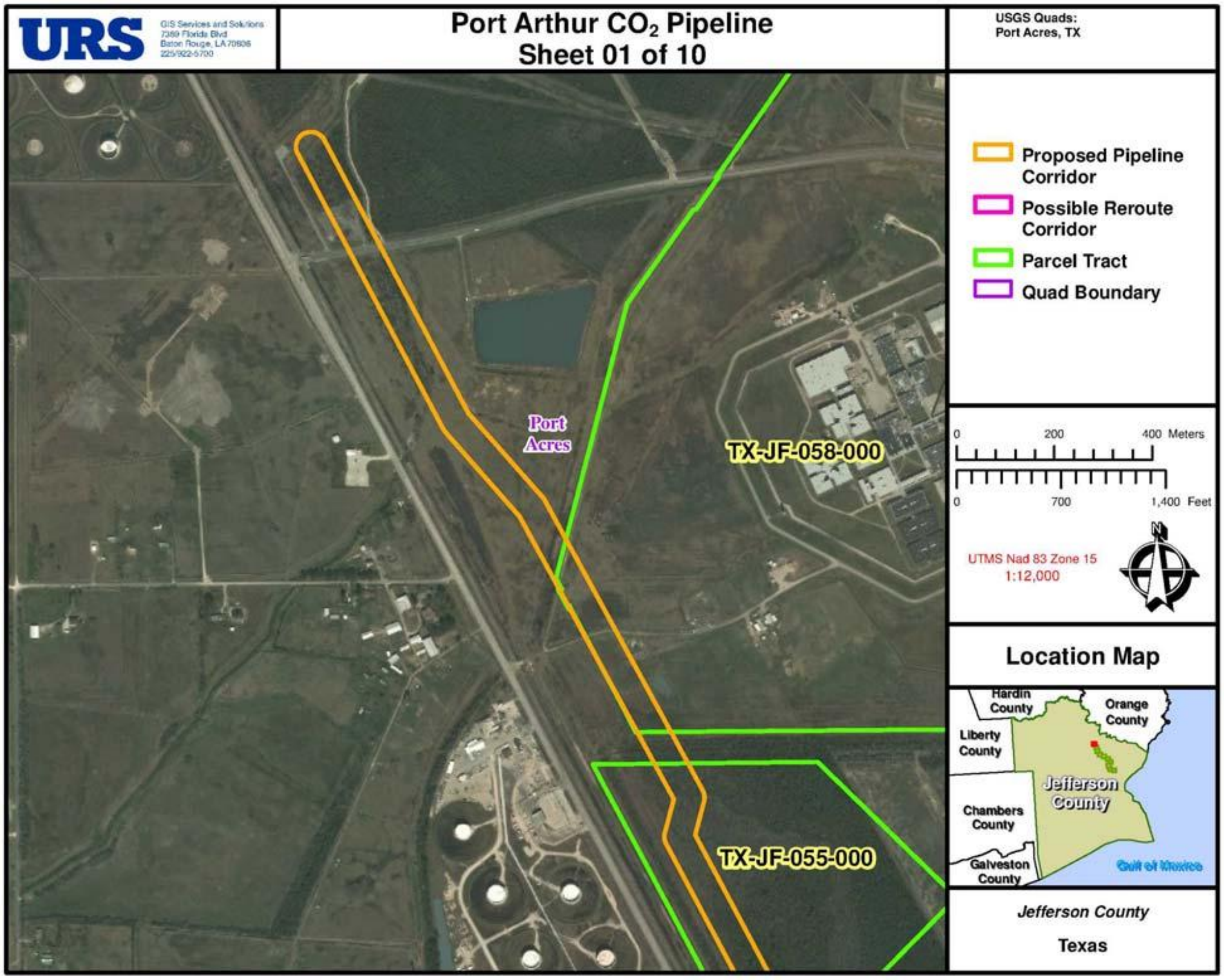

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 01 of 05
USGS Quads:
Port Acres, TX
Proposed Pipeline Centerline
Possible Reroute Centerline
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Previously Recorded Cemetery
Previously Recorded Historical Marker
Previously Recorded Survey
Quad Boundary
0 400 800 Meters
0 1,400 2,800 Feet
UTMS Nad 83 Zone 15
1:24,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas
COE-Galveston
(2008)
FERC
(2002)
Permit
No. 1394
(12/95)
GAL CE
(01/79)
TX-JF-058-000
TX-JF-055-000
GAL CE
(01/79)
JUS
(04/92)
FERC
(2002)
Hebert
Port Acres
Lucas
PIPELINE
Gully
Borrow
Pit

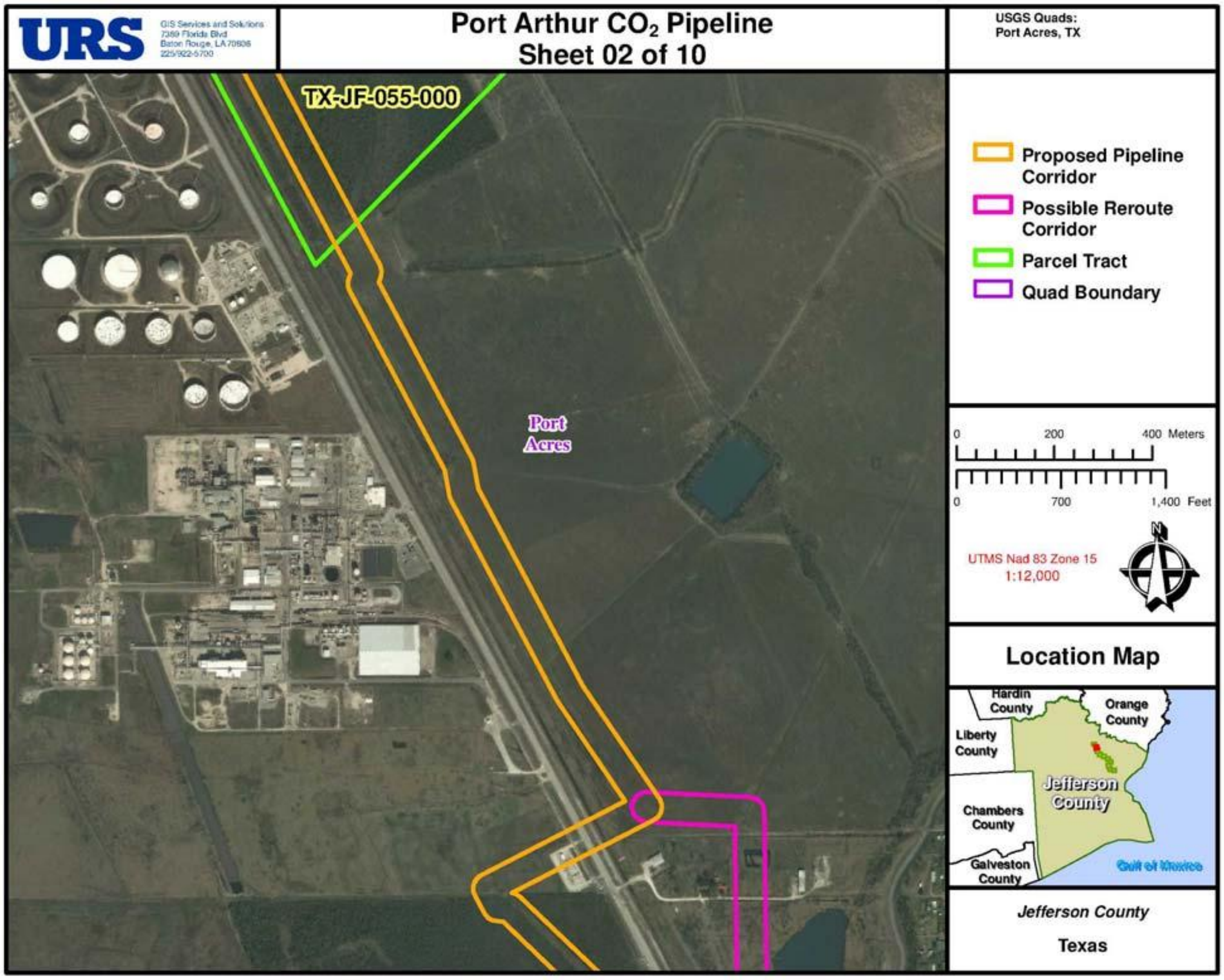

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 02 of 05
USGS Quads:
Port Acres, TX
Proposed Pipeline Centerline
Possible Reroute Centerline
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Previously Recorded Cemetery
Previously Recorded Historical Marker
Previously Recorded Survey
Quad Boundary
0 400 800 Meters
0 1,400 2,800 Feet
UTMS Nad 83 Zone 15
1:24,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas
Beauxart Gardens
FERC (2002)
Live Oak Memorial Park Cemetery
Live Oak Memorial Park
Port Acres
Viterbo
PIPELINE
CANAL
ABANDONED
PORT ARTHUR
ROAD
Rhodair

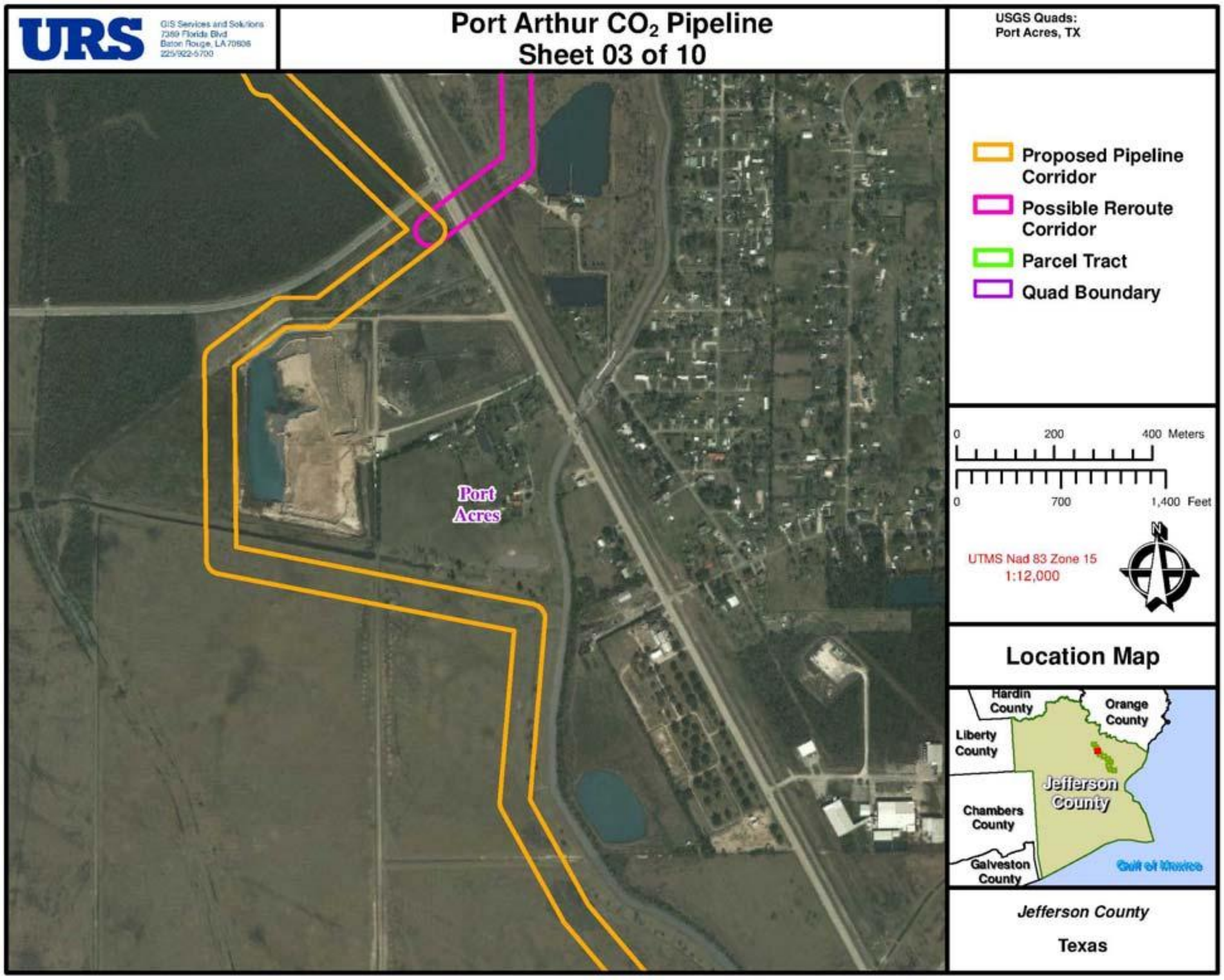

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 03 of 05
USGS Quads:
Port Acres, TX
Port Arthur North, TX
Proposed Pipeline Centerline
Possible Reroute Centerline
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Previously Recorded Cemetery
Previously Recorded Historical Marker
Previously Recorded Survey
Quad Boundary
0 400 800 Meters
0 1,400 2,800 Feet
UTMS Nad 83 Zone 15
1:24,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas
Port Acres
Port Arthur North
PORT ARTHUR
County Airport
Refinery
Pumping Sta
Oil Well
Mobile Home Park
PIPELINE
PIPELINES
CANAL
MAIN
HALL
BM 8
BM 6
5245012672

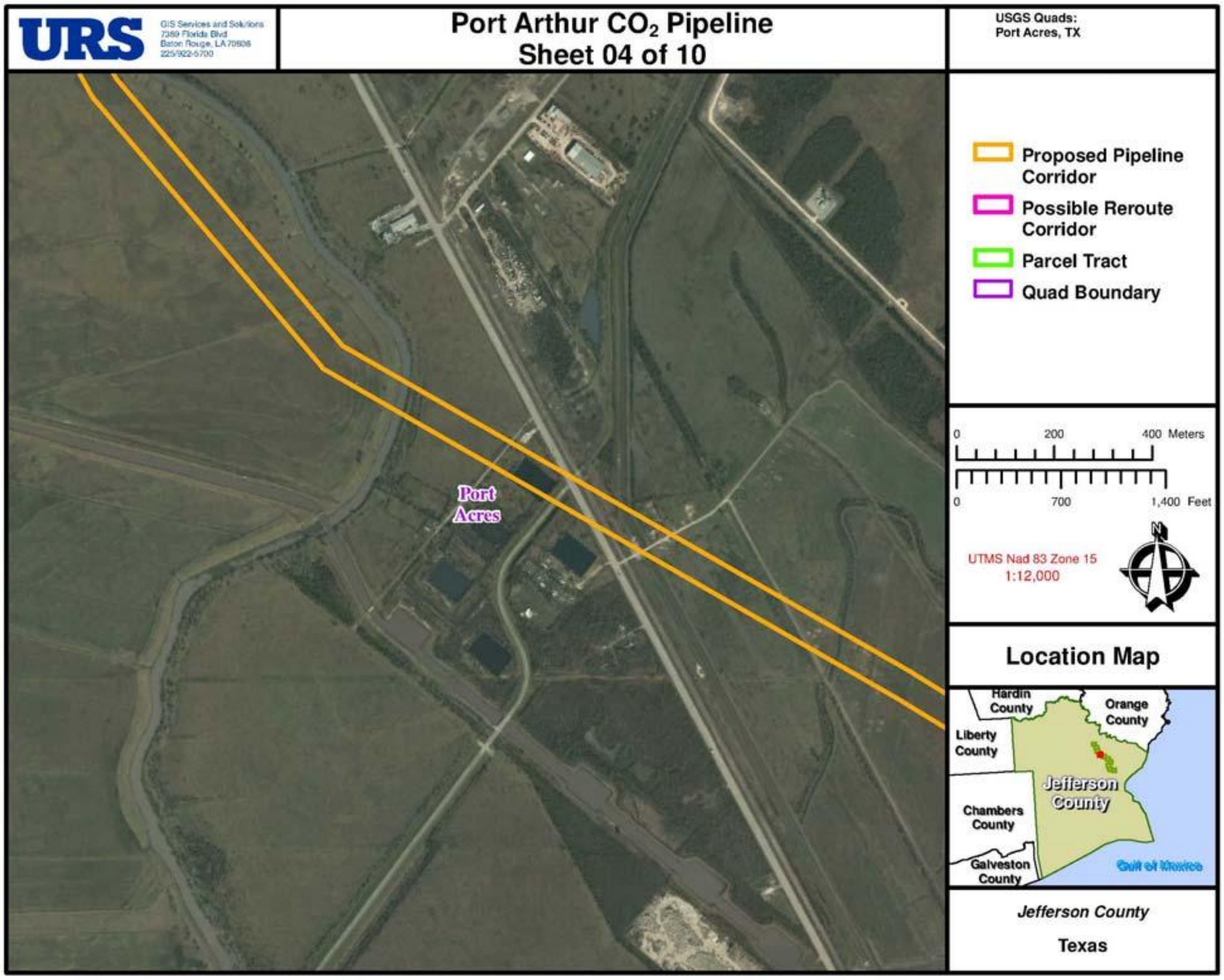

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 04 of 05
USGS Quads:
Port Acres, TX
Port Arthur North, TX
Proposed Pipeline Centerline
Possible Reroute Centerline
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Previously Recorded Cemetery
Previously Recorded Historical Marker
Previously Recorded Survey
Quad Boundary
0 400 800 Meters
0 1,400 2,800 Feet
UTMS Nad 83 Zone 15
1:24,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas
ARTHUR
Pumping Sta
CANAL
PIPELINE
COE-Galveston District (2007)
Port Acres
Port Arthur North
Port Arthur Reservoir
PORT
5245013118
COE-Galveston District (2008)
Wheatley Sch
MAIN
OUTFALL

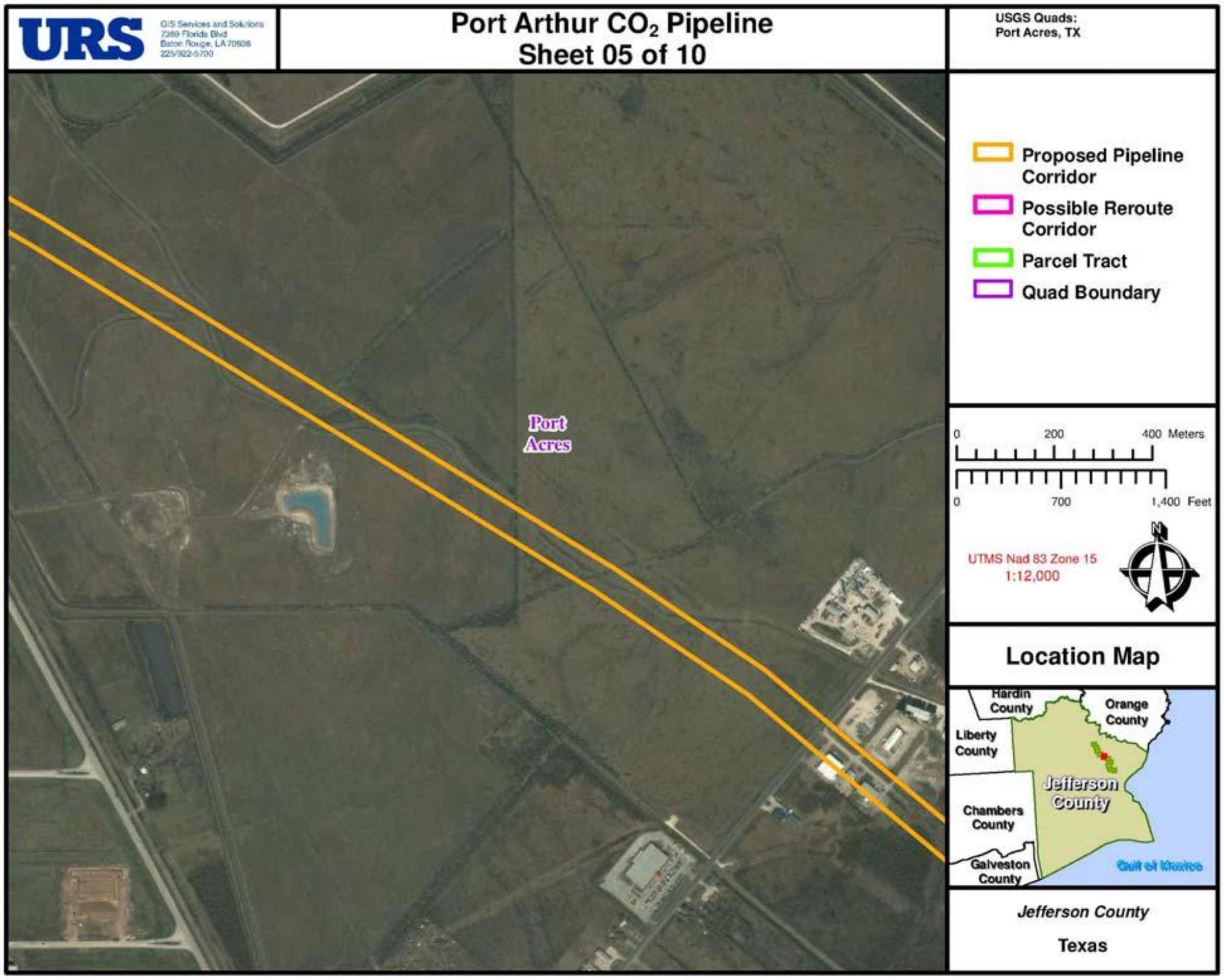

URS
Port Arthur CO2 Pipeline
Sheet 05 of 05
USGS Quads: Port Acres, TX
Port Arthur North, TX
Port Arthur South, TX
Big Hill Bayou, TX
Proposed Pipeline Centerline
Possible Reroute Centerline
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Previously Recorded Cemetery
Previously Recorded Historical Marker
Previously Recorded Survey
Quad Boundary
0 400 800 Meters
0 1,400 2,800 Feet
UTMS Nad 83 Zone 15
1:24,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas
Port Acres
Port Arthur North
Port Arthur South
Big Hill Bayou
GAL CE
(09/86)
GAL CE
(09/86)
GAL CE
(09/86)
GAL CE
(05/72)
BOAT SUR
GAL CE
(05/72) BOAT SUR
COE-Galveston
District
(2008)
Tank Farm
Industrial
Waste Ponds
Filtration
Plant

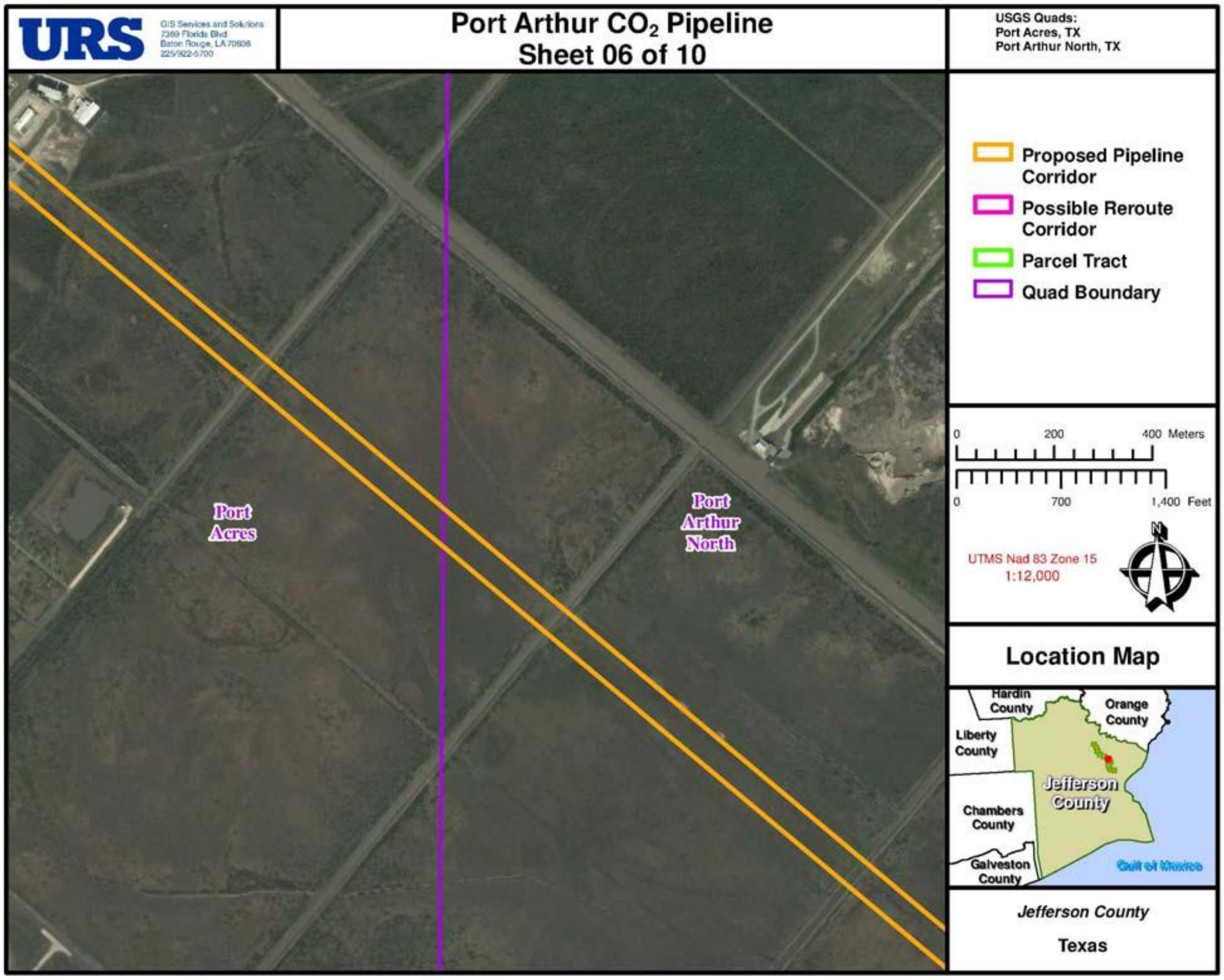

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 01 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
0
200
400 Meters
0
700
1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas
Port Acres
TX-JF-058-000
TX-JF-055-000

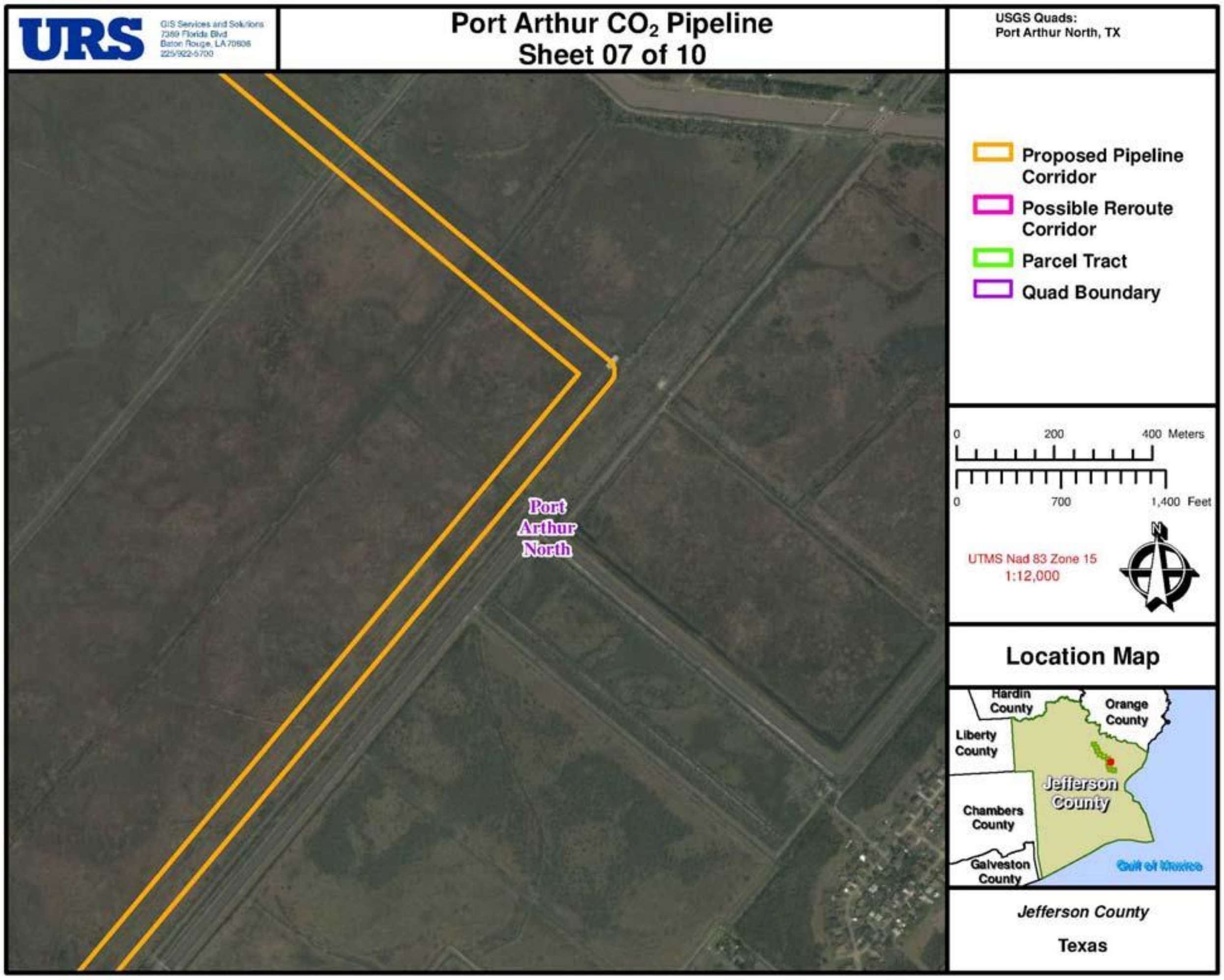

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 02 of 10
USGS Quads:
Port Acres, TX
TX-JF-055-000
Port Acres
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
0
200
400 Meters
0
700
1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas

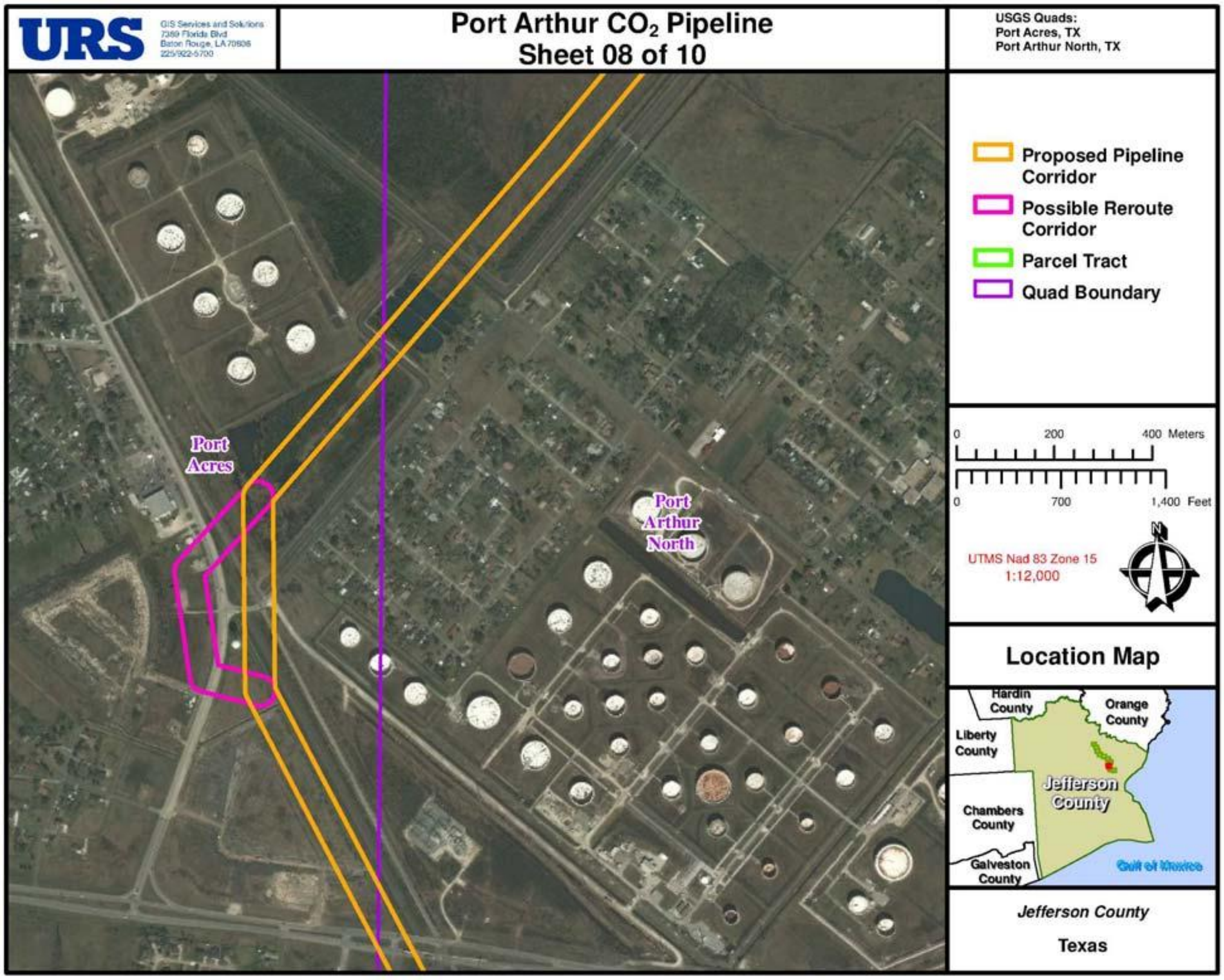

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 03 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
Port Acres
0
200
400 Meters
0
700
1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas

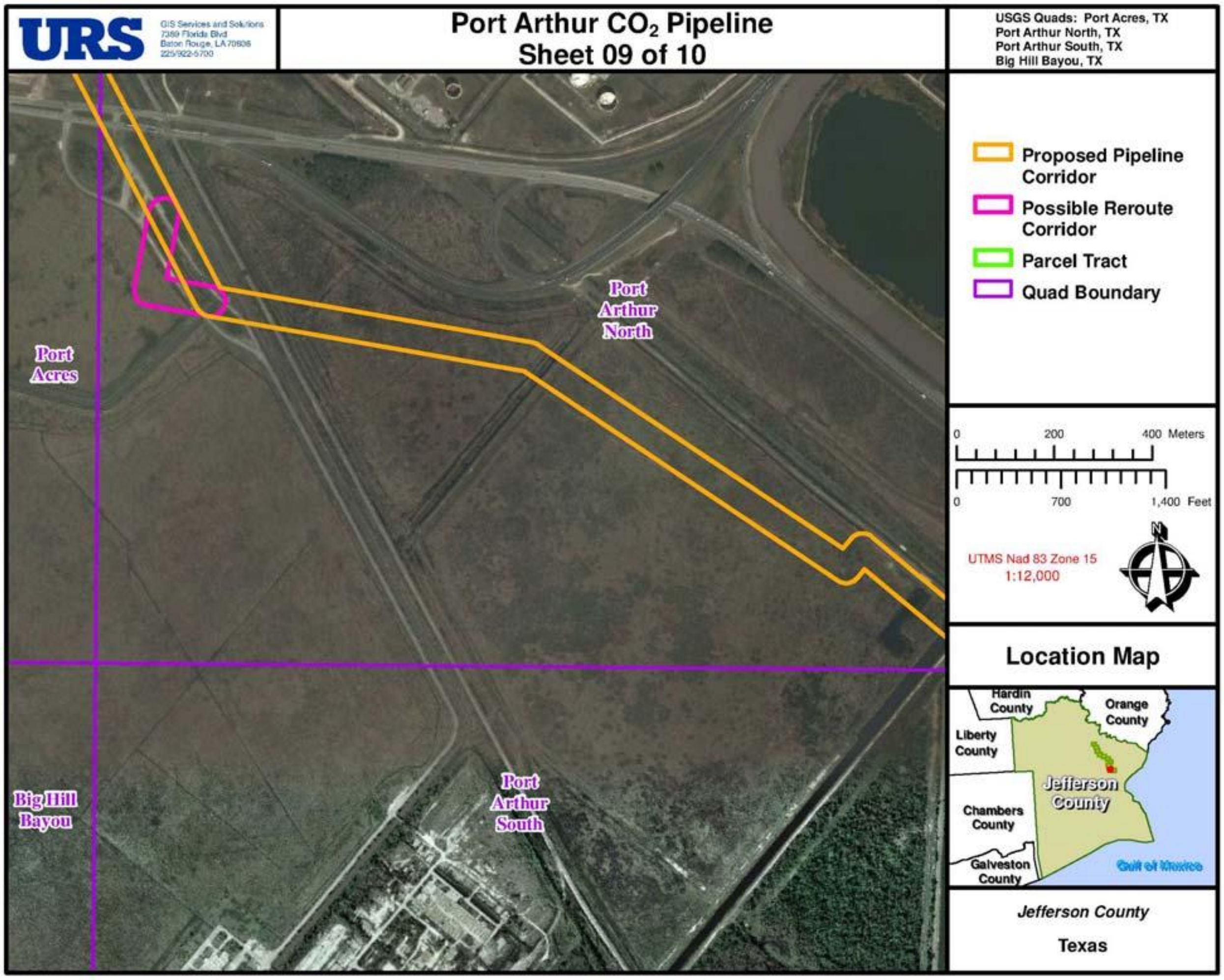

URS
Port Arthur CO2 Pipeline
Sheet 04 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Port Acres
Jefferson County
Texas

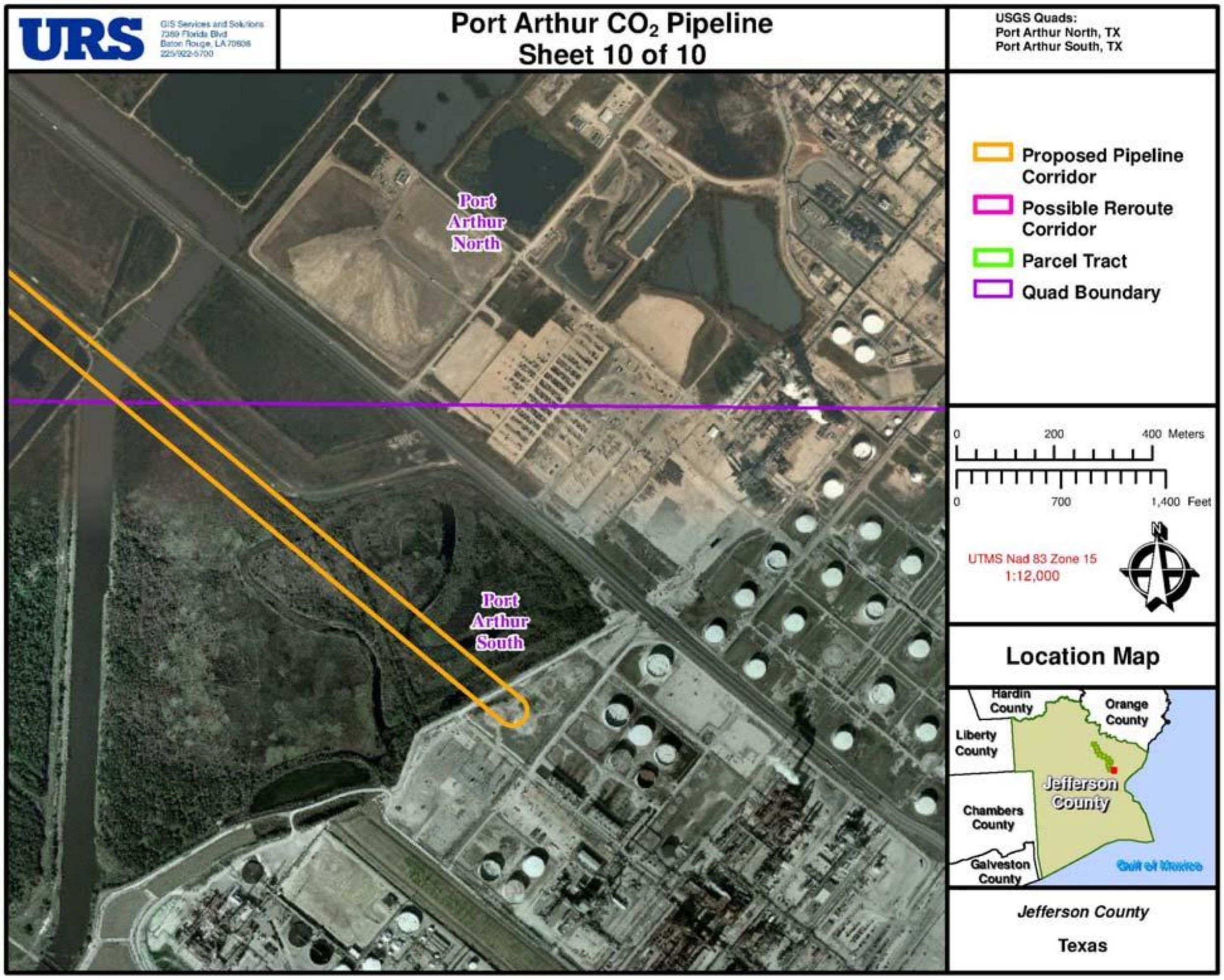

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 05 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
Port Acres
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas

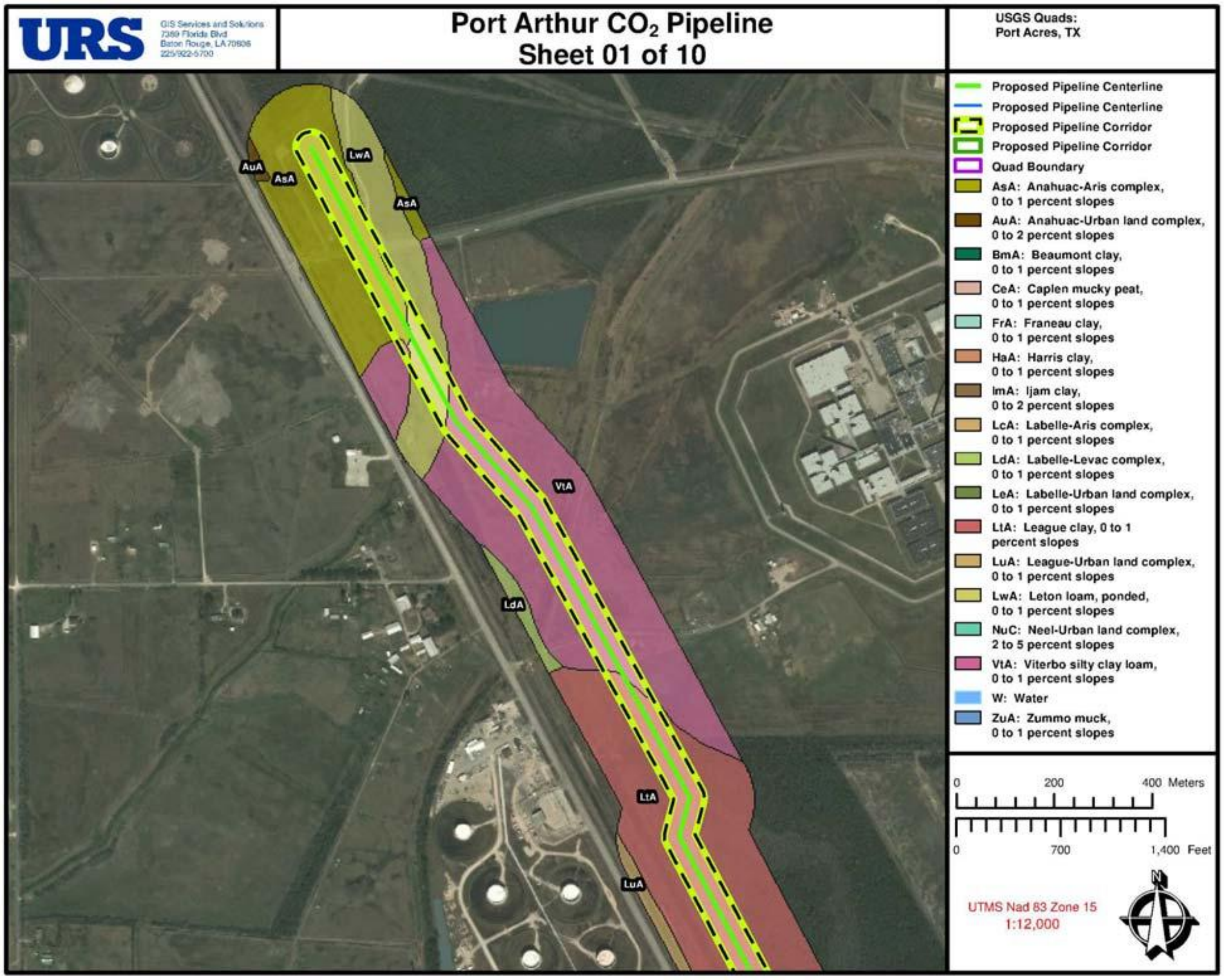

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 06 of 10
USGS Quads:
Port Acres, TX
Port Arthur North, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N
Port Acres
Port Arthur North
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas


URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 07 of 10
USGS Quads:
Port Arthur North, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N
Port Arthur North
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas

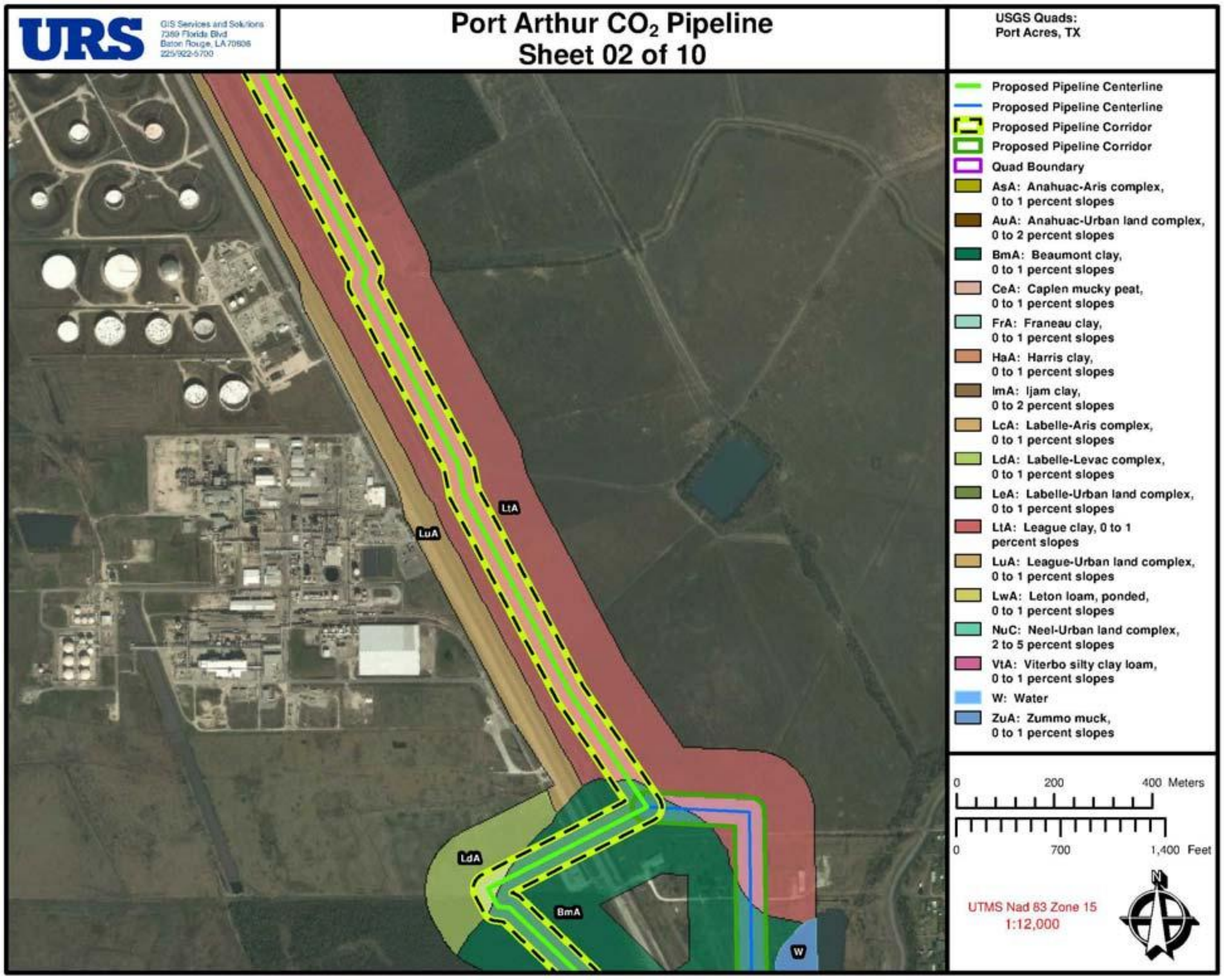

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 08 of 10
USGS Quads:
Port Acres, TX
Port Arthur North, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
Port Acres
Port Arthur North
0
200
400 Meters
0
700
1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas

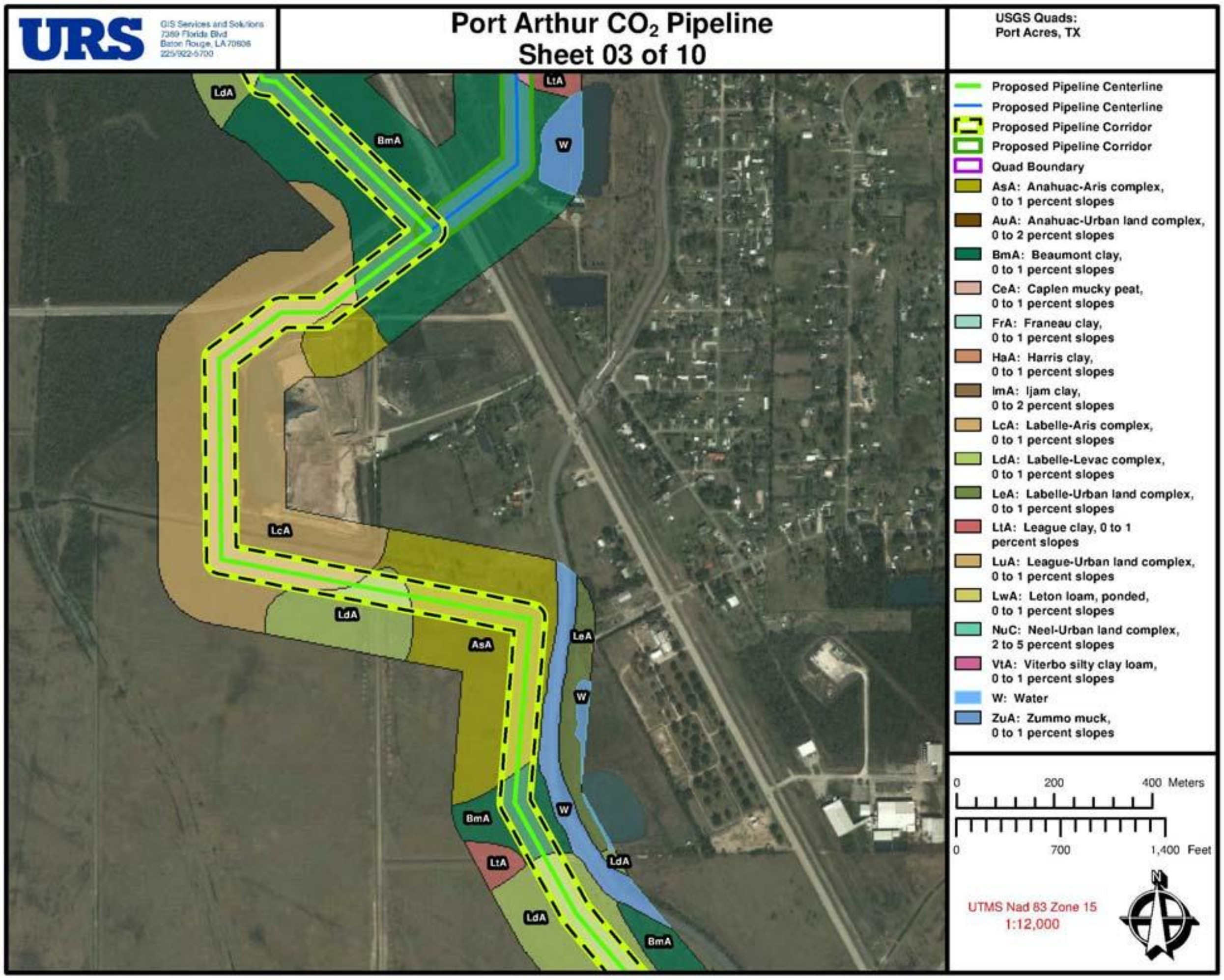

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 09 of 10
USGS Quads: Port Acres, TX
Port Arthur North, TX
Port Arthur South, TX
Big Hill Bayou, TX
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
0
200
400 Meters
0
700
1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas
Port Arthur North
Port Acres
Big Hill Bayou
Port Arthur South

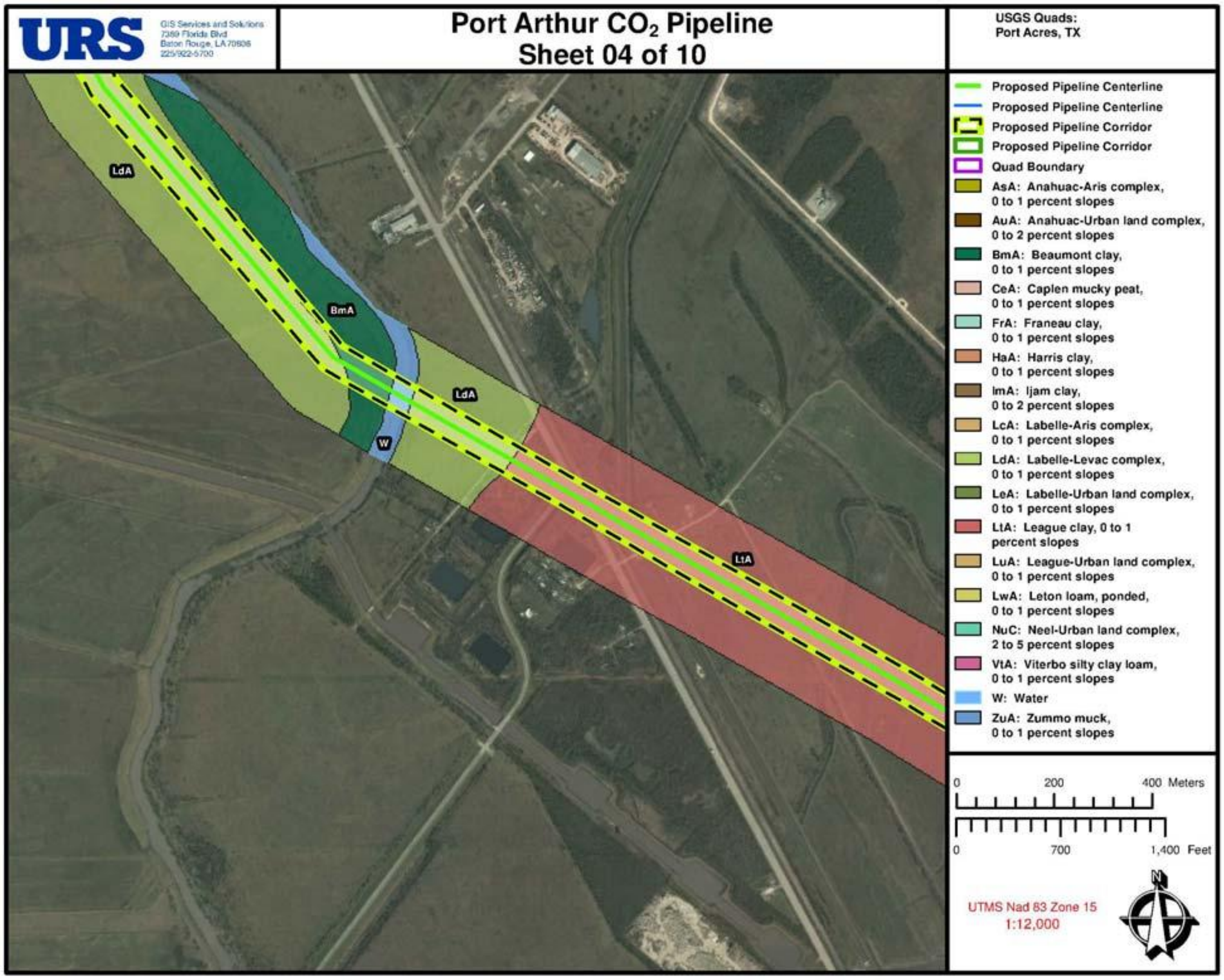

URS
GIS Services and Solutions
Port Arthur CO_2 Pipeline
Sheet 10 of 10
USGS Quads:
Port Arthur North, TX
Port Arthur South, TX
Port Arthur North
Port Arthur South
Proposed Pipeline Corridor
Possible Reroute Corridor
Parcel Tract
Quad Boundary
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
Location Map
Hardin County
Orange County
Liberty County
Jefferson County
Chambers County
Galveston County
Gulf of Mexico
Jefferson County
Texas

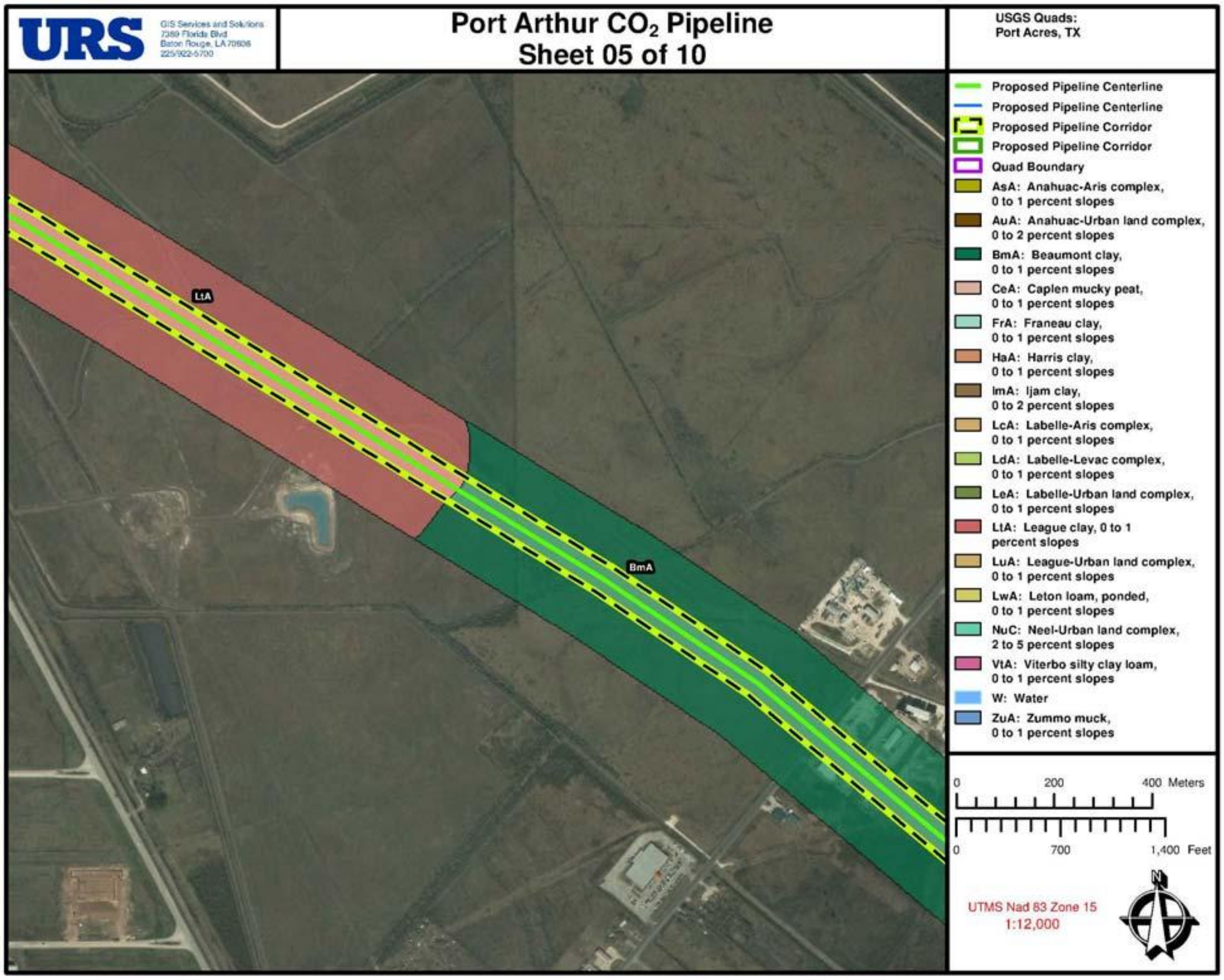


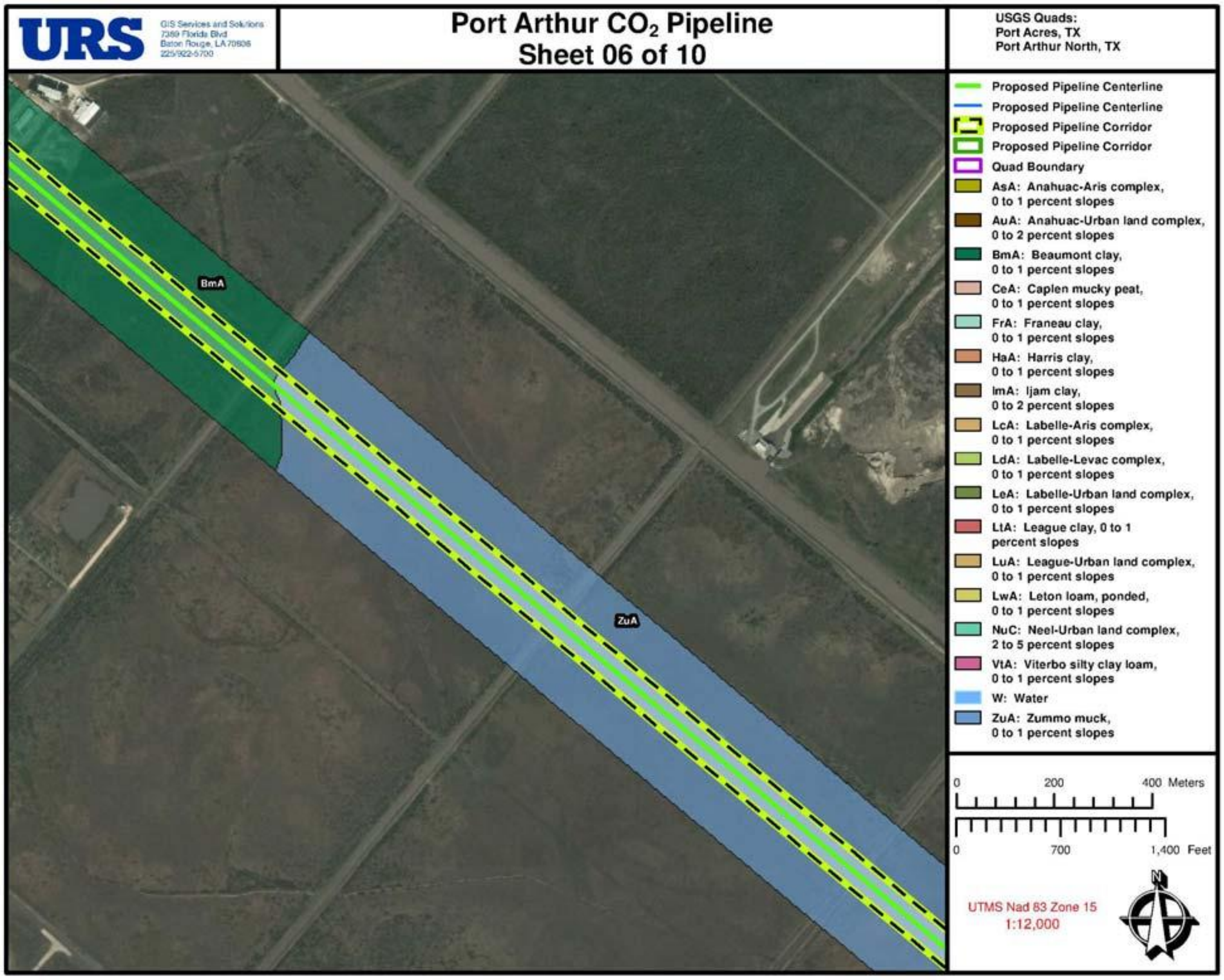
URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 01 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
AuA
AsA
LwA
AsA
VtA
LdA
LtA
LuA

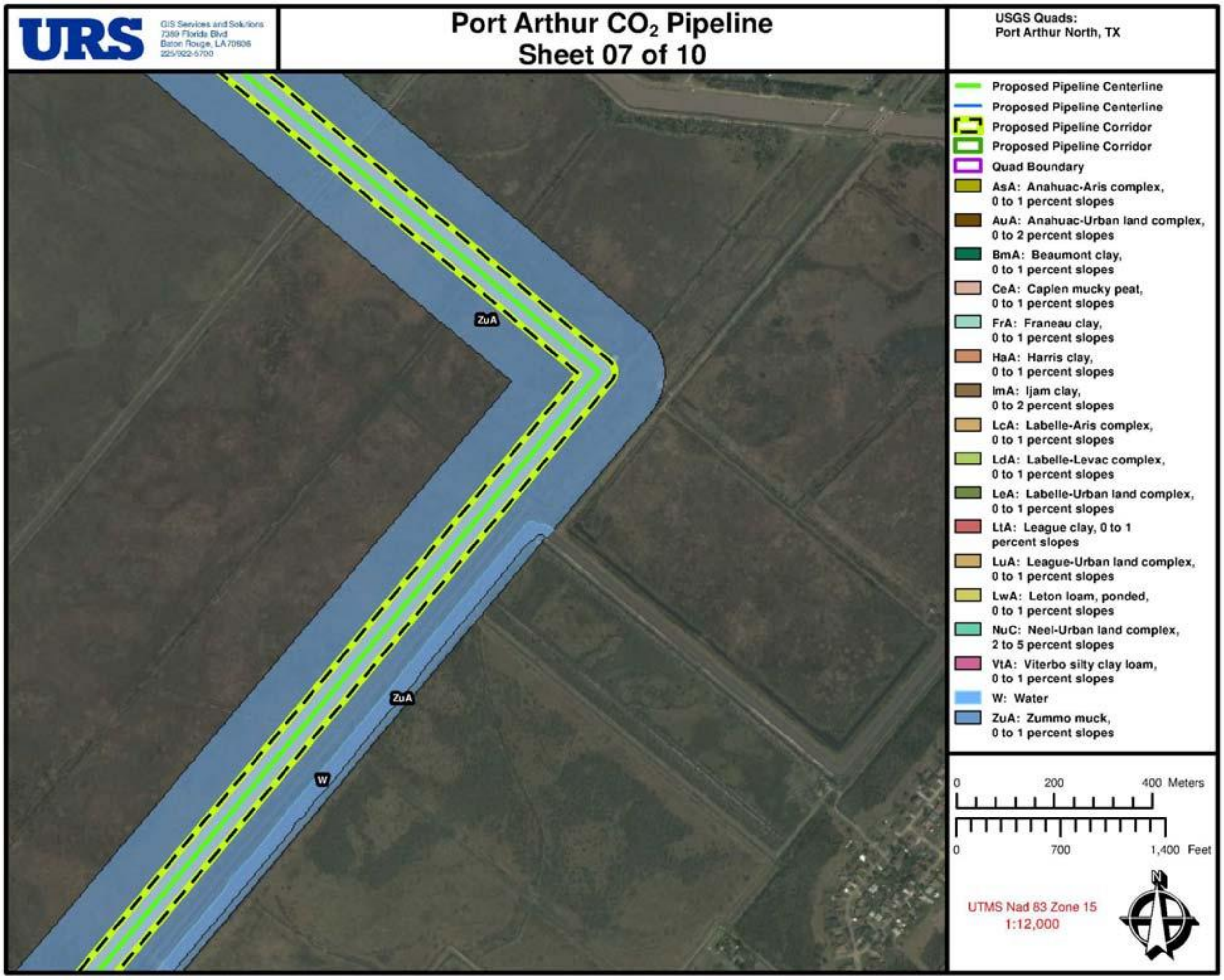

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 02 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N
LtA
LuA
LdA
BmA
W

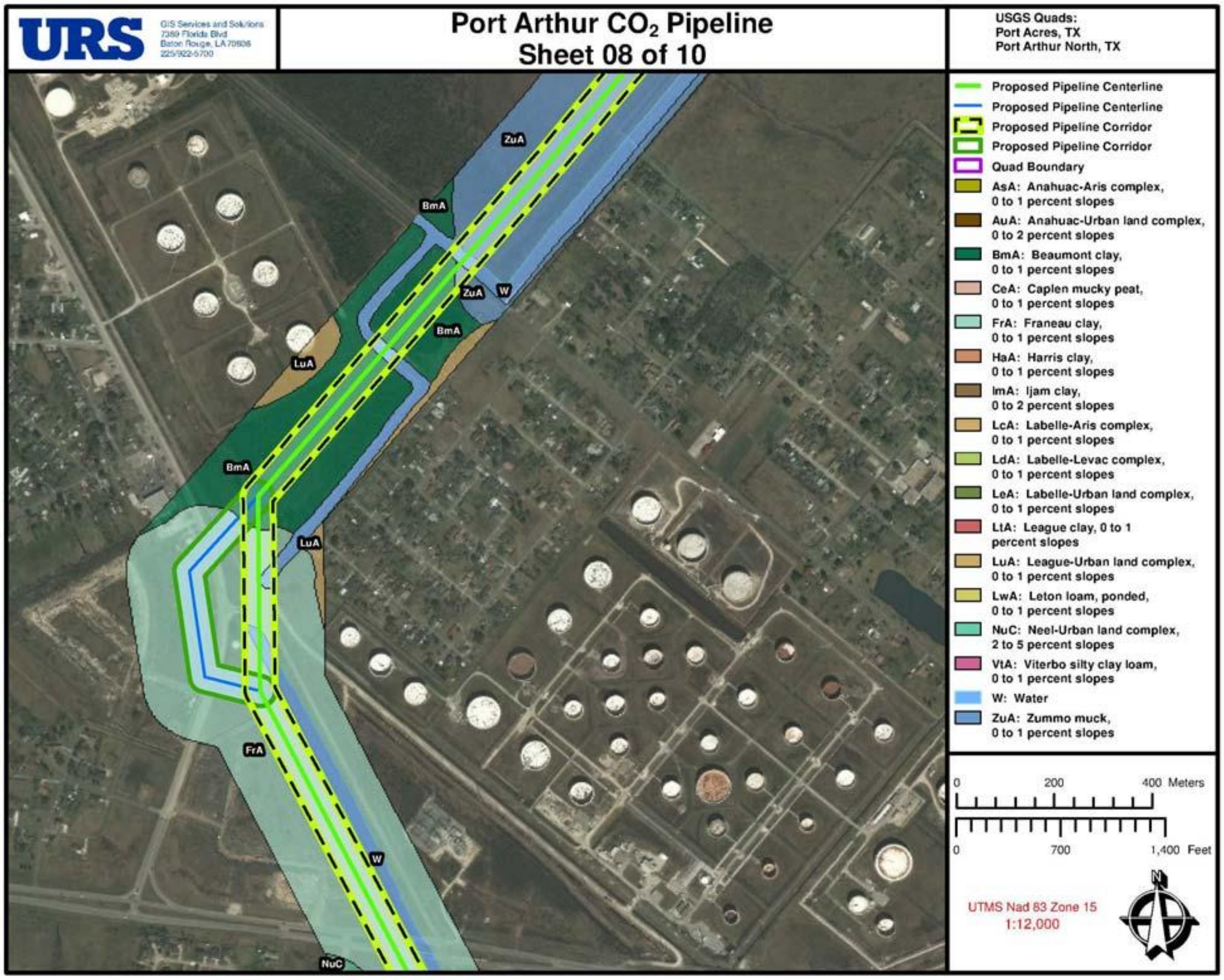

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 03 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
LdA
BmA
LtA
W
LcA
LdA
AsA
LeA
W
W
BmA
LtA
LdA
LdA
BmA

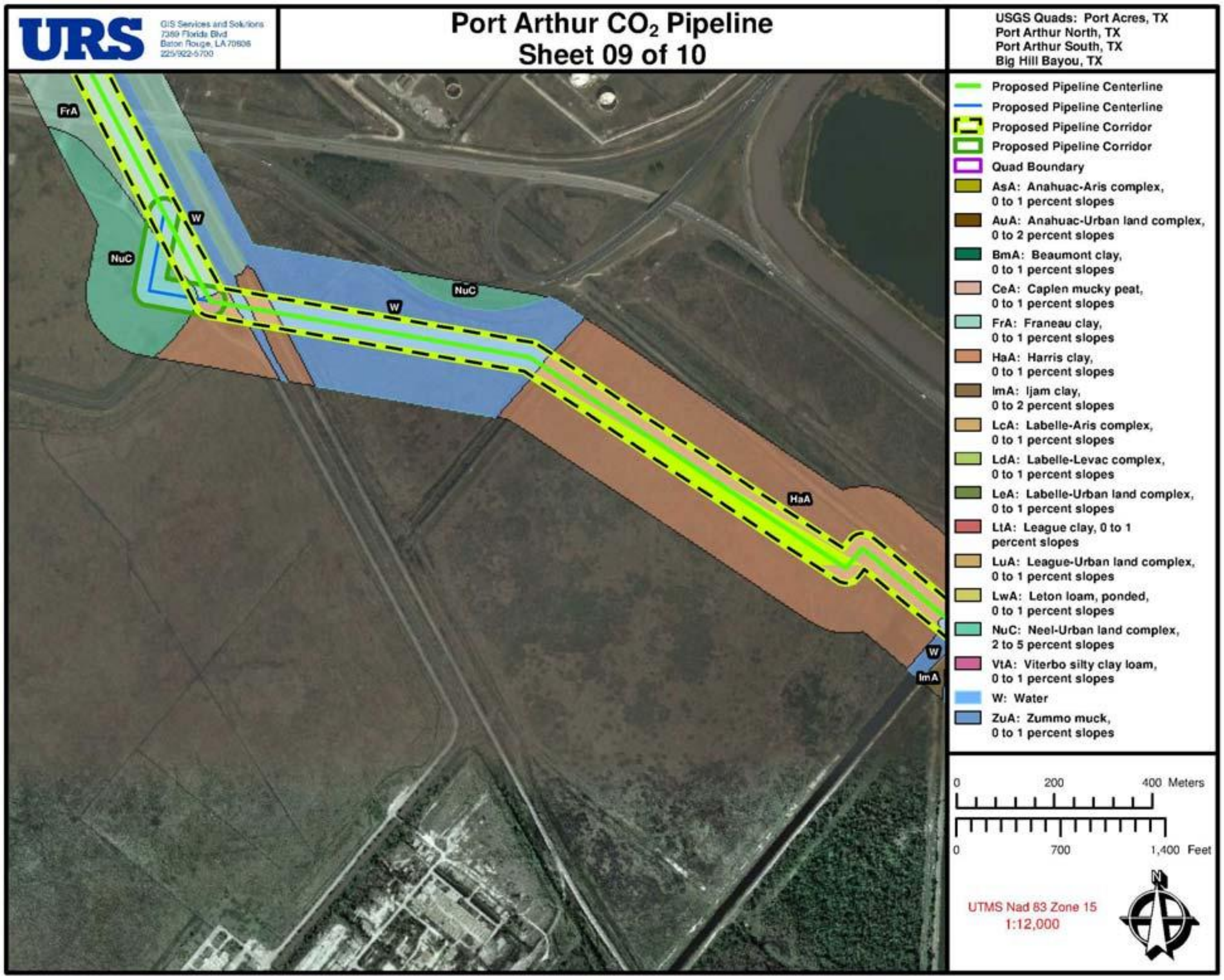

URS
Port Arthur CO2 Pipeline
Sheet 04 of 10
USGS Quads:
Port Acres, TX
LdA
BmA
LdA
W
LtA
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000

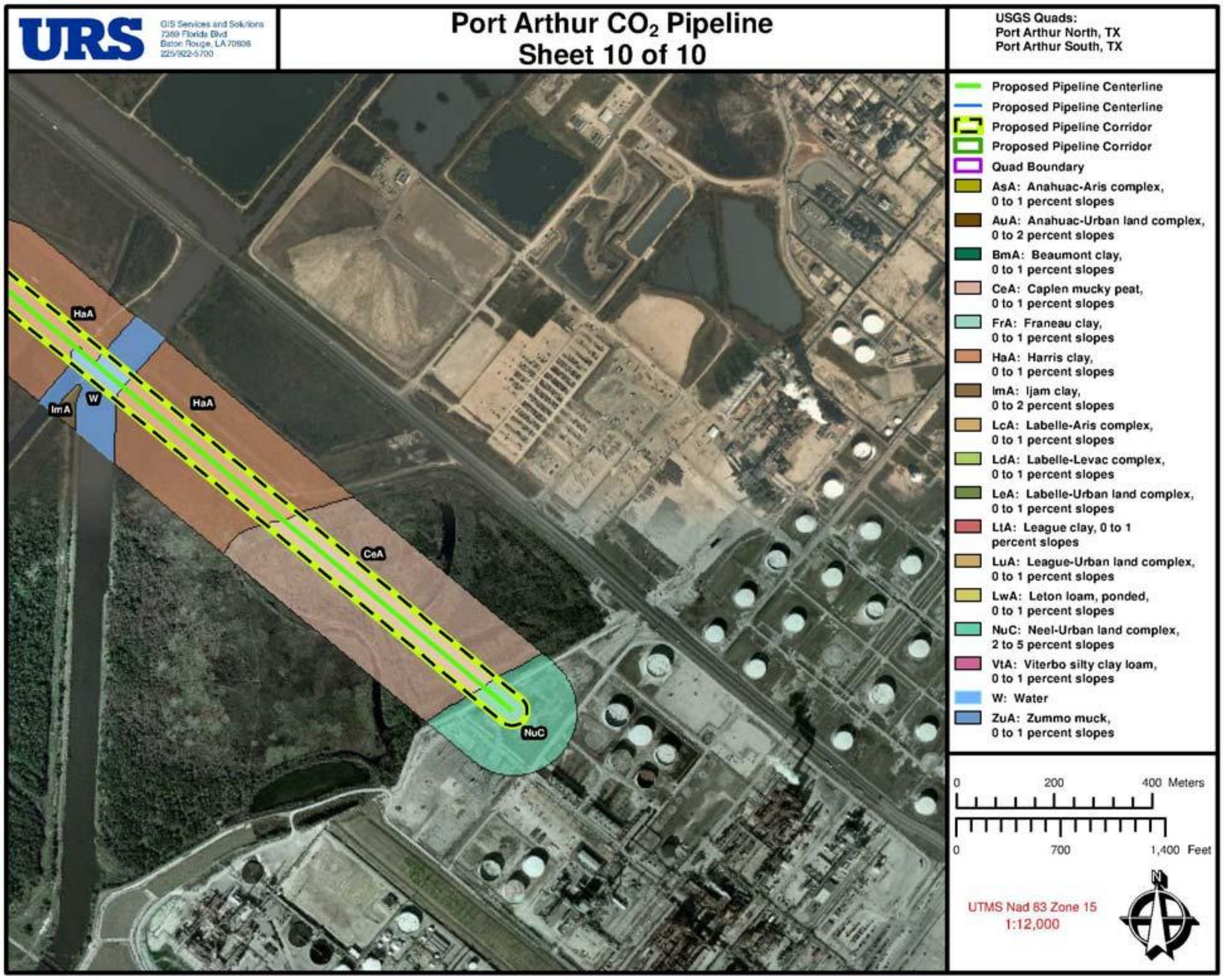

URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 05 of 10
USGS Quads:
Port Acres, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
LtA
BmA
0
200
400 Meters
0
700
1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N


URS
Port Arthur CO_2 Pipeline
Sheet 06 of 10
USGS Quads:
Port Acres, TX
Port Arthur North, TX
BmA
ZuA
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N


URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 07 of 10
USGS Quads:
Port Arthur North, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
ZuA
ZuA
W
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000


URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 08 of 10
USGS Quads:
Port Acres, TX
Port Arthur North, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
ZuA
BmA
ZuA
W
BmA
LuA
BmA
LuA
FrA
W
NuC


URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO2 Pipeline
Sheet 09 of 10
USGS Quads: Port Acres, TX
Port Arthur North, TX
Port Arthur South, TX
Big Hill Bayou, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
FrA
NuC
W
NuC
W
HaA
W
ImA


URS
GIS Services and Solutions
7389 Florida Blvd
Baton Rouge, LA 70806
225/922-5700
Port Arthur CO_2 Pipeline
Sheet 10 of 10
USGS Quads:
Port Arthur North, TX
Port Arthur South, TX
Proposed Pipeline Centerline
Proposed Pipeline Centerline
Proposed Pipeline Corridor
Proposed Pipeline Corridor
Quad Boundary
AsA: Anahuac-Aris complex, 0 to 1 percent slopes
AuA: Anahuac-Urban land complex, 0 to 2 percent slopes
BmA: Beaumont clay, 0 to 1 percent slopes
CeA: Caplen mucky peat, 0 to 1 percent slopes
FrA: Franeau clay, 0 to 1 percent slopes
HaA: Harris clay, 0 to 1 percent slopes
ImA: Ijam clay, 0 to 2 percent slopes
LcA: Labelle-Aris complex, 0 to 1 percent slopes
LdA: Labelle-Levac complex, 0 to 1 percent slopes
LeA: Labelle-Urban land complex, 0 to 1 percent slopes
LtA: League clay, 0 to 1 percent slopes
LuA: League-Urban land complex, 0 to 1 percent slopes
LwA: Leton loam, ponded, 0 to 1 percent slopes
NuC: Neel-Urban land complex, 2 to 5 percent slopes
VtA: Viterbo silty clay loam, 0 to 1 percent slopes
W: Water
ZuA: Zummo muck, 0 to 1 percent slopes
HaA
ImA
W
HaA
CeA
NuC
0 200 400 Meters
0 700 1,400 Feet
UTMS Nad 83 Zone 15
1:12,000
N

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

U.S. DEPARTMENT OF ENERGY

January 31, 2011

Mr. Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
1511 Colorado St.
Austin, Texas 78701

Re: Antiquities Permit Application for Scope of Work submitted January 17, 2011 Texas Department of Corrections Properties. Cultural Resources Inventory of the Proposed Air Products and Chemicals, Inc. (APCI), Port Arthur (TX) CO_2 Pipeline Project in Jefferson County

Dear Mr. Wolfe:

The U. S. Department of Energy (DOE) has determined that an environmental assessment (EA) constitutes the appropriate level of National Environmental Policy Act (NEPA) review for the proposed project, which would demonstrate the capture and sequestration of carbon dioxide (CO_2) from a steam methane reformer used for large-scale hydrogen production. Our office is preparing a draft EA for this project. In order for DOE to comply with NEPA, Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the Texas Historical Commission (THC) a reasonable opportunity to comment.

Please find enclosed the signed Antiquities Permit application for the above referenced properties. This accompanies the Scope of Work that was previously submitted for your office's review on January 17, 2011 by Mr. Rob Lackowicz of URS Corporation (*DOE's consultant for this project's environmental assessment*). The requested permit is for the Phase I cultural resources inventory of APCI's proposed CO_2 pipeline, approximately 0.7 mile of which crosses state lands administered by the Texas Department of Corrections. No survey will occur on state lands prior to THC issuing the Antiquities Permit.

DOE and APCI appreciate your efforts to review this request and thank you for any assistance you are able to provide. Should you have any technical questions, please contact Mr. Rob Lackowicz at 225-935-2974 or by email at rob_lackowicz@urscorp.com.

Sincerely,

Fred E. Pozzuto
Environmental Mgr./NEPA Compliance Officer

Enclosure

Cc(w/Encl.): Gregory M. Frisby and Stephen D. Fisher, APCI
Robert J. Lackowicz M.A., R.P.A., URS

TEXAS HISTORICAL COMMISSION

ANTIQUITIES PERMIT APPLICATION FORM ARCHEOLOGY

GENERAL INFORMATION

I. PROPERTY TYPE AND LOCATION

Project Name (and/or Site Trinomial) APCI Port Arthur (TX) CO2 Pipeline
County (ies) Jefferson
USGS Quadrangle Name and Number Port Acres, TX USGS 29094-H1
UTM Coordinates (NAD 83) Zone 15N E 397321 N 3318376
Location Within Dept. of Corrections lands 7.1 miles southeast of junction of Interstate 10 and Highway 124 at west edge of Beaumont, Texas
Federal Involvement X Yes ❑ No
Name of Federal Agency U.S. Department of Energy
Agency Representative Anthony Zinn (Federal Project Manager)

II. OWNER (OR CONTROLLING AGENCY)

Owner Texas Department of Corrections
Representative DIANNE FULLER
Address 2405 Avenue I, Suite E
City/State/Zip Huntsville, Texas 77340
Telephone (include area code) 936-437-5428 Email Address dianne.fuller@tdcj.state.tx.us

III. PROJECT SPONSOR (IF DIFFERENT FROM OWNER)

Sponsor Air Products and Chemicals, Inc.
Representative Stephen Fisher, Project Manager
Address 7201Hamilton Blvd.
City/State/Zip Allentown, PA 18195
Telephone (include area code) 610-481-5263 Email Address fishers2@apci.com

PROJECT INFORMATION

I. PRINCIPAL INVESTIGATOR (ARCHEOLOGIST)

Name Robert Lackowicz
Affiliation URS Group, Inc.
Address 7389 Florida Blvd., Suite 300
City/State/Zip Baton Rouge, LA, 70806
Telephone (include area code) 225-935-2974 Email Address rob_lackowicz@urscorp.com

(OVER)

ANTIQUITIES PERMIT APPLICATION FORM (CONTINUED)

II. PROJECT DESCRIPTION

Proposed Starting Date of Fieldwork January 31, 2011
Requested Permit Duration 1 Years 0 Months (1 year minimum)
Scope of Work (Provided an Outline of Proposed Work) Proposed oil pipeline collocated with multiple existing lines; pedestrian survey augmented by shovel tests at 100 m intervals unless cultural materials found (see attached scope)

III. CURATION & REPORT

Temporary Curatorial or Laboratory Facility URS Group, 7389 Florida Blvd., Suite 300, Baton Rouge, LA 70806
Permanent Curatorial Facility Texas Archeological Research Laboratory at University of Texas, Austin

IV. LAND OWNER'S CERTIFICATION

I, DIANNE FULLER, as legal representative of the Land Owner, Texas Department of Corrections, do certify that I have reviewed the plans and research design, and that no investigations will be performed prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that ~~the~~ Owner, Sponsor, and Principal Investigator are responsible for completing the terms of the permit.
Signature D Fuller Date 1-21-11

V. SPONSOR'S CERTIFICATION

I, Stephen Fisher, as legal representative of the Sponsor, Air Products and Chemicals, Inc., do certify that I have reviewed the plans and research design, and that no investigations will be performed prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Sponsor, Owner, and Principal Investigator are responsible for completing the terms of this permit.
Signature Stephen P. Fisher Date 1-27-11

VI. INVESTIGATOR'S CERTIFICATION

I, Rob Lackowicz, as Principal Investigator employed by URS Group, Inc (Investigative Firm), do certify that I will execute this project according to the submitted plans and research design, and will not conduct any work prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Principal Investigator (and the Investigative Firm), as ~~well as the~~ Owner and Sponsor, are responsible for completing the terms of this permit.
Signature [signature] Date January 18, 2011

Principal Investigator must attach a research design, a copy of the USGS quadrangle showing project boundaries, and any additional pertinent information. Curriculum vita must be on file with the Archeology Division.

FOR OFFICIAL USE ONLY

Reviewer ______ Date Permit Issues ______
Permit Number ______ Permit Expiration Date ______
Type of Permit ______ Date Received for Data Entry ______

Texas Historical Commission
Archeology Division
P.O. Box 12276, Austin, TX 78711-2276
Phone 512/463-6096
www.thc.state.tx.us
3/3/09

TEXAS HISTORICAL COMMISSION
The State Agency for Historic Preservation

TEXAS HISTORICAL COMMISSION

real places telling real stories

February 28, 2011

Mr. Robert Lackowiez
URS Corporation
7389 Florida Blvd., Suite 300
Baton Rouge, LA

Re: Project review under the Antiquities Code of Texas
Air Products and Chemical, Inc., Port Arthur C02 Pipeline
Texas Antiquities Permit #5884

Dear Colleague:

Thank you for your Antiquities Permit Application for the above referenced project. This letter presents the final copy of the permit application from the Executive Director of the Texas Historical Commission, the state agency responsible for administering the Antiquities Code of Texas.

Please keep this copy for your records. Additionally, please note that due to a new rule change the THC no longer requires 20 copies of the final report be mailed to the THC, instead the Antiquities Permit investigations now require production of one printed copy of the final report, a completed abstract form, two copies of the final report on a tagged PDF CD (one with site location information & one without), and verification that any artifacts recovered and records produced during the investigations are curated at the repository listed in the permit.

If you have any questions concerning this permit or if we can be of further assistance, please contact Lillie Thompson at 512/463-1858. The reviewer for this project is Debra Beene, 512/463-6096.

Sincerely,

William A. Martin

for
Mark Wolfe
Executive Director

MW/lft

Enclosure

Cc: Dianne Fuller, TDCJ
Stephen Fisher, APCI

State of Texas

TEXAS ANTIQUITIES COMMITTEE

ARCHEOLOGY PERMIT # 5884

This permit is issued by the Texas Historical Commission, hereafter referred to as the Commission, represented herein by and through its duly authorized and empowered representatives. The Commission, under authority of the Texas Natural Resources Code, Title 9, Chapter 191, and subject to the conditions hereinafter set forth, grants this permit for:

Intensive Survey

To be performed on a potential or designated landmark or other public land known as:

Title: ***Air Products and Chemicals, Inc. Port Arthur CO2 Pipeline***

County: ***Jefferson***

Location: ***Within Department of Corrections lands 7.1 miles Southeast of Junction of Interstate 10 and Highway 124 at west edge of Beaumont, Texas***

Owned or Controlled by: (hereafter known as the Permittee):

Texas Department of Criminal Justice
2405 Avenue I, Suite E
Huntsville, TX 77340

Sponsored by (hereafter known as the Sponsor

Air Products and Chemicals, Inc.
7201 Hamilton Blvd.
Allentown, PA 18195

The Principal Investigator/Investigation Firm representing the Owner or Sponsor is:

Robert Lackowiez
URS Corporation
7389 Florida Blvd., Suite 300
Baton Rouge, LA 70806

This permit is to be in effect for a period of:

1 Years and 0 Months

and Will Expire on:

02/23/2012

During the preservation, analysis, and preparation of a final report or until further notice by the Commission, artifacts, field notes, and other data gathered during the investigation will be kept temporarily at:

URS Group, Baton Rouge, LA

Upon completion of the final permit report, the same artifacts, field notes, and other data will be placed in a permanent curatorial repository at:

Texas Archeological Research Lab.

Scope of Work under this permit shall consist of:

Proposed oil pipeline collacated with with multiple existing lines; pedestrian survey augmented by shovel tests at 100 m intervals unless cultural materials found. For details, see scope of work submitted with permit application.

ARCHEOLOGY PERMIT # 5884

This permit is granted on the following terms and conditions:

1) This project must be carried out in such a manner that the maximum amount of historic, scientific, archeological, and educational information will be recovered and preserved and must include the scientific, techniques for recovery, recording, preservation and analysis commonly used in archeological investigations. All survey level investigations must follow the state survey standards and the THC survey requirements established with the projects sponsor(s).
2) The Principal Investigator/Investigation Firm, serving for the Owner/Permittee and/or the Project Sponsor, is responsible for insuring that specimens, samples, artifacts, materials and records that are collected as a result of this permit are appropriately cleaned, and cataloged for curation. These tasks will be accomplished at no charge to the Commission, and all specimens, artifacts, materials, samples, and original field notes, maps, drawings, and photographs resulting from the investigations remain the property of the State of Texas, or its political subdivision, and must be curated at a certified repository. Verification of curation by the repository is also required, and duplicate copies of any requested records shall be furnished to the Commission before any permit will be considered complete.
3) The Principal Investigator/Investigation Firm serving for the Owner/Permittee, and/or the Project Sponsor is responsible for the publication of results of the investigations in a thorough technical report containing relevant descriptions, maps, documents, drawings, and photographs. A draft copy of the report must be submitted to the Commission for review and approval. Any changes to the draft report requested by the Commission must be made or addressed in the report, or under separate written response to the Commission. Once a draft has been approved by the Commission, one (1) printed, unbound copy of the final report containing at least one map with the plotted location of any and all sites recorded and two copies of the report in tagged PDF format on an archival quality CD or DVD shall be furnished to the commission. One copy must include the plotted location of any and all sites recorded and the other should not include the site location data. A paper copy and an electronic copy of the completed Abstracts in Texas Contract Archeology Summary Form must also be submitted with the final report to the Commission. (Printed copies of forms are available from the Commission or also online at www.thc.state.tx.us.)
4) If the Owner/Permittee, Project Sponsor or Principal Investigator/Investigation Firm fails to comply with any of the Commission's Rules of Practice and Procedure or with any of the specific terms of this permit, or fails to properly conduct or complete this project within the allotted time, the permit will fall into default status. A notification of Default status shall be sent to the Principal Investigator/Investigation Firm, and the Principal Investigator will not be eligible to be issued any new permits until such time that the conditions of this permit are complete or, if applicable, extended.
5) The Owner/Permittee, Project Sponsor, and Principal Investigator/Investigation Firm, in the conduct of the activities hereby authorizes, must comply with all laws, ordinances and regulations of the State of Texas and of its political subdivisions including, but not limited to, the Antiquities Code of Texas; they must conduct the investigation in such a manner as to afford protection to the rights of any and all lessees or easement holders or other persons having an interest in the property and they must return the property to its original condition insofar as possible, to leave it in a state which will not create hazard to life nor contribute to the deterioration of the site or adjacent lands by natural forces.
6) Any duly authorized and empowered representative of the Commission may, at any time, visit the site to inspect the fieldwork as well as the field records, materials, and specimens being recovered.
7) For reasons of site security associated with historical resources, the Project Sponsor (if not the Owner/Permittee), Principal Investigator, Owner, and Investigation Firm shall not issue any press releases, or divulge to the news media, either directly or indirectly, information regarding the specific location of, or other information that might endanger those resources, or their associated artifacts without first consulting with the Commission, and the State agency or political subdivision of the State that owns or controls the land where the resource has been discovered.
8) This permit may not be assigned by the Principal Investigator/Investigation Firm, Owner/Permittee, or Project Sponsor in whole, or in part to any other individual, organization, or corporation not specifically mentioned in this permit without the written consent of the Commission.
9) Hold Harmless: The Owner/Permittee hereby expressly releases the State and agrees that Owner/Permittee will hold harmless, indemnify, and defend (including reasonable attorney's fees and cost of litigation) the State, its officers, agents, and employees in their official and/or individual capacities from every liability, loss, or claim for damages to persons or property, direct or indirect of whatsoever nature arising out of, or in any way connected with, any of the activities covered under this permit.The provisions of this paragraph are solely for the benefit of the State and the Texas Historical Commission and are not intended to create or grant any rights, contractual or otherwise, to any other person or entity.
10) Addendum: The Owner/Permittee, Project Sponsor and Principal Investigator/Investigation Firm must abide by any addenda hereto attached.

Upon a finding that it is in the best interest of the State, this permit is issued on 02/23/2011.

James E. Bruseth, for the Texas Historical Commission

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

U.S. DEPARTMENT OF ENERGY

April 5, 2011

Ms. Debra Beene
Texas Historical Commission
1511 Colorado Street
Austin, Texas 78701

Re: Section 106 Determination for Project Activities within Previously Developed Lands in Valero Refinery and West Hastings Oil Field; Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)
(Connected Action: Texas Antiquities Permit #5884)

Dear Ms. Beene:

This letter supplements my earlier communication to Mr. Mark Wolfe dated January 31, 2011, regarding the above-referenced Air Products and Chemicals, Inc. (APCI), carbon dioxide (CO_2) capture and sequestration project. As noted in my earlier letter, U. S. Department of Energy (DOE) National Energy Technology Laboratory is currently preparing a draft environmental assessment (EA) to comply with National Environmental Policy Act and Section 106 of the National Historic Preservation Act of 1966.

APCI's proposed project includes the following three primary components:

1) CO_2 capture, concentration, and purification at APCI's two Port Arthur, Texas hydrogen plants (PA1 and PA2), which are located within the Valero Port Arthur Refinery;
2) Transport of CO_2 within Jefferson County, Texas through a new 12.8-mile-long, 8-inch-diameter pipeline lateral that will interconnect with an existing CO_2 pipeline system for injection into a depleted oil field, the West Hastings Field in Brazoria County, Texas, for enhanced oil recovery; and
3) Implementation of a comprehensive monitoring, verification, and accounting program to monitor the impacts of injection and sequestration of the injected CO_2 at the West Hastings Field.

Please note that the 7-mile-long hydrogen pipeline lateral discussed in previous submittals to the Texas Historical Commission (THC) is no longer included in the project scope. The proposed pipeline route listed above as component (2) is being assessed through a Phase I cultural resource field investigation, partly under Texas Antiquities Permit #5884, which was issued by your office on February 23, 2011. DOE expects the results of that survey to be reported to you in the near future for separate comment.

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507
fred.pozzuto@netl.doe.gov • Voice (304) 285-5219 • Fax (304) 285-4216 • www.netl.doe.gov

APCI project components (1) and (3), as listed above, are described further in the enclosed document to afford the THC a reasonable opportunity to comment before the EA is issued. Given the level of existing land disturbance and the types of activities to be conducted as part of APCI project components (1) and (3), as described in the enclosed document, it is the opinion of DOE that the activities proposed in these two project areas will not impact historic properties meeting the criteria of significance for listing on the National Register of Historic Places. Please reply whether your office concurs with this determination of No Historic Properties Present or Affected. Again, please refer to the attached enclosure.

For any overall environmental project questions please call me at 304-285-5219. Should you have any technical questions please contact our NEPA contractor, Mr. Rob Lackowicz at 225-935-2974 or by email at rob_lackowicz@urscorp.com.

Sincerely,

Fred E. Pozzuto
Environmental Manager/NEPA Compliance
Officer

Enclosures

Cc: THC (Mr. Mark Wolfe)
APCI (Messrs. Greg Frisby, Tom Houser, Steve Fisher and Kent Kisenbauer)
URS (Messrs. Pete Conwell and Rob Lackowicz)

URS

Date: April 1, 2011

Air Products and Chemicals, Inc. (APCI) Port Arthur CO_2 Project:
Valero Refinery, Jefferson County and West Hastings Field, Brazoria County, Texas
Assessment of Project Activities Impacting Historic Properties

(Connected Action: Texas Antiquities Permit #5884)

Study Purpose

The purpose of this letter is to evaluate the above two project areas in Jefferson and Brazoria Counties, Texas (Figure 1) for their potential to contain and impact significant cultural resources, defined as historic properties under Section 106 of the National Historic Preservation Act (NHPA) and the National Register of Historic Places (NRHP) criteria for evaluation (36 CFR Part 800 and 36 CFR 60.4). Section 106 of the NHPA, as amended, requires the lead federal agency with jurisdiction over an undertaking to consider impacts to historic properties before the undertaking occurs. Undertakings in this sense include activities, projects, or programs that are directly or indirectly funded by a federal agency. The U.S. Department of Energy - National Energy Technology Laboratory (DOE-NETL) proposes to provide financial assistance to APCI for this project under the American Recovery and Reinvestment Act of 2009 (ARRA).

The NHPA defines a historic property as any archeological site, district, building, structure, or object that is included in, or eligible for inclusion in, the NRHP. Under this definition, other cultural resources may be present within a project's Area of Potential Effect but are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. To be eligible for the NRHP, a property generally must be greater than 50 years of age, although there are provisions for listing recent cultural resources if they are of exceptional federal, state or local importance.

Project Introduction

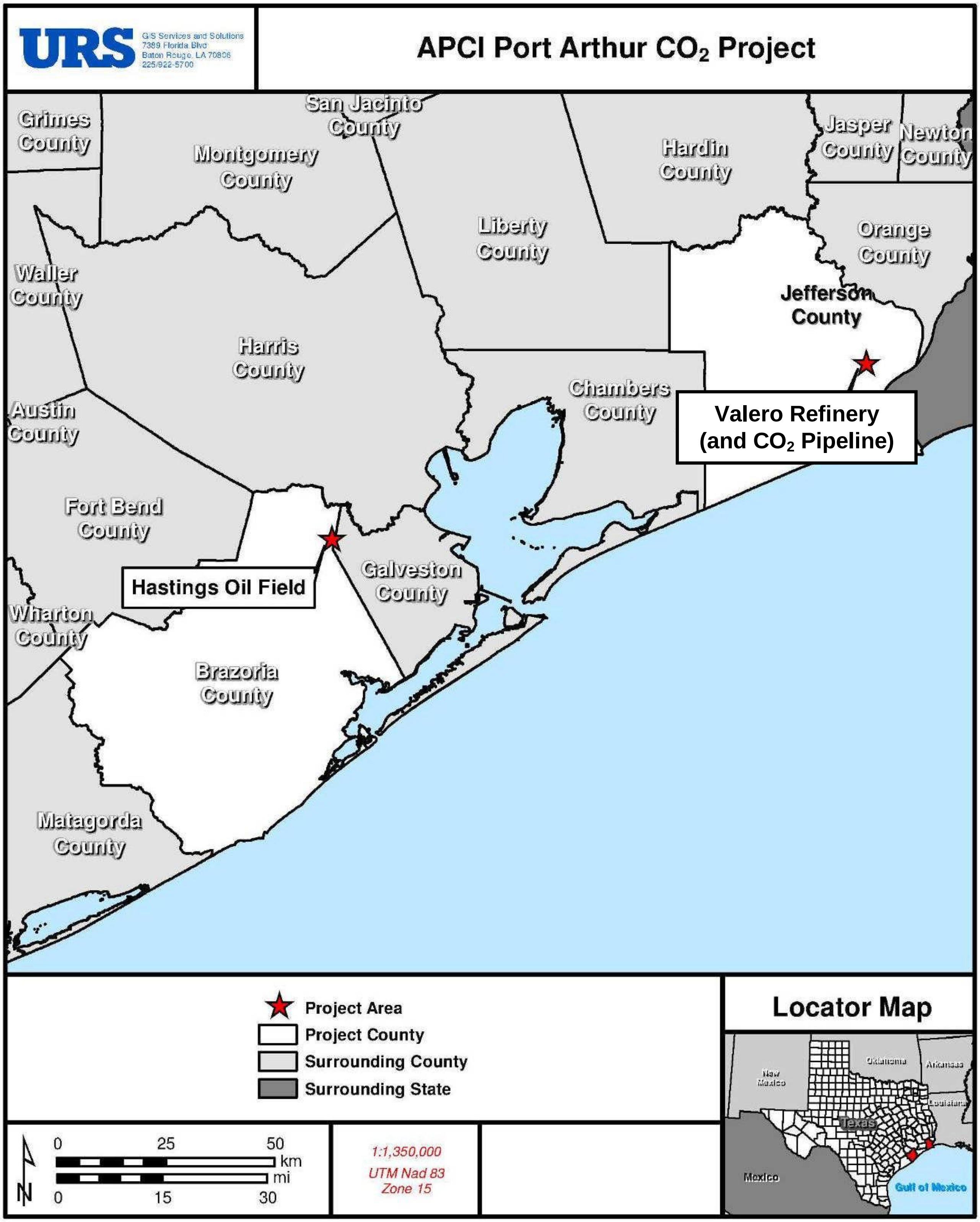
Under the ARRA, the DOE has made funding available for large-scale carbon dioxide (CO_2) projects that capture more than one million tons of CO_2 per year if they are operational by 2015. In June 2010 the DOE-NETL announced it had selected the APCI project discussed here to move to the project execution phase.

APCI's proposed project will involve the capture and sequestration of CO_2 from APCI's existing steam methane reformer (SMR) plants in Port Arthur, Texas, starting in November 2012, and transport of the captured CO_2 to oil fields in eastern Texas by pipeline where it will be used for enhanced oil recovery (EOR). APCI's project involves an integrated carbon capture, transport, injection, sequestration, and monitoring program that will capture approximately one million tons per year of CO_2, based on current engineering estimates. APCI's two Port Arthur, Texas plants (PA1 and PA2) in the existing Valero Refinery produce hydrogen, electric power, and steam. APCI's proposed project is subdivided into three major components:

1) CO_2 capture, concentration, and purification to be integrated with the existing SMR plants PA1 and PA2 within the existing Valero Refinery in Jefferson County;
2) Transport of CO_2 through a new, approximately 12.8 mile long, 8-inch diameter CO_2 pipeline, which, will interconnect with an existing CO_2 pipeline system for injection into the depleted Hastings Field in Brazoria County, Texas, for EOR; and

URS Group
7389 Florida Blvd., Suite 300
Baton Rouge, LA 70806
Tel: 225.922.5700
Fax: 225.922.5701
www.urscorp.com

Figure 1: General Overview of APCI Project Items, Valero Refinery and Hastings Field



3) Implementation of a comprehensive monitoring, verification, and accounting (MVA) program to monitor the impacts of injection and sequestration of the injected CO_2 at the West Hastings Field.

The proposed CO_2 pipeline, which parallels existing utility corridors along over 95% of its route, will be owned by APCI and will connect to the existing Denbury Onshore, LLC (Denbury) Green Pipeline. Denbury also owns and operates the Hastings Field and is partnering with APCI to conduct the Hastings Field MVA program.

The DOE-NETL has determined that an environmental assessment (EA) constitutes the appropriate level of National Environmental Policy Act review for the proposed project. APCI has contracted with URS Group, Inc. (URS) to provide environmental and cultural resources services in support of the project's permitting needs. The pipeline portion of this project, listed above as Project Component 2, was referred to the Texas Historical Commission (THC) for evaluation on January 17, 2011. It was assessed separately by URS through a Phase I cultural resource field investigation, partly under Texas Antiquities Permit #5884. The results of that survey will be reported to the THC upon the report's completion. The sections below examine Project Components (1) and (3), the project activities anticipated within the Valero Refinery and within the Hastings Field.

Location of APCI Project Areas, Planned Activities and Current Environment

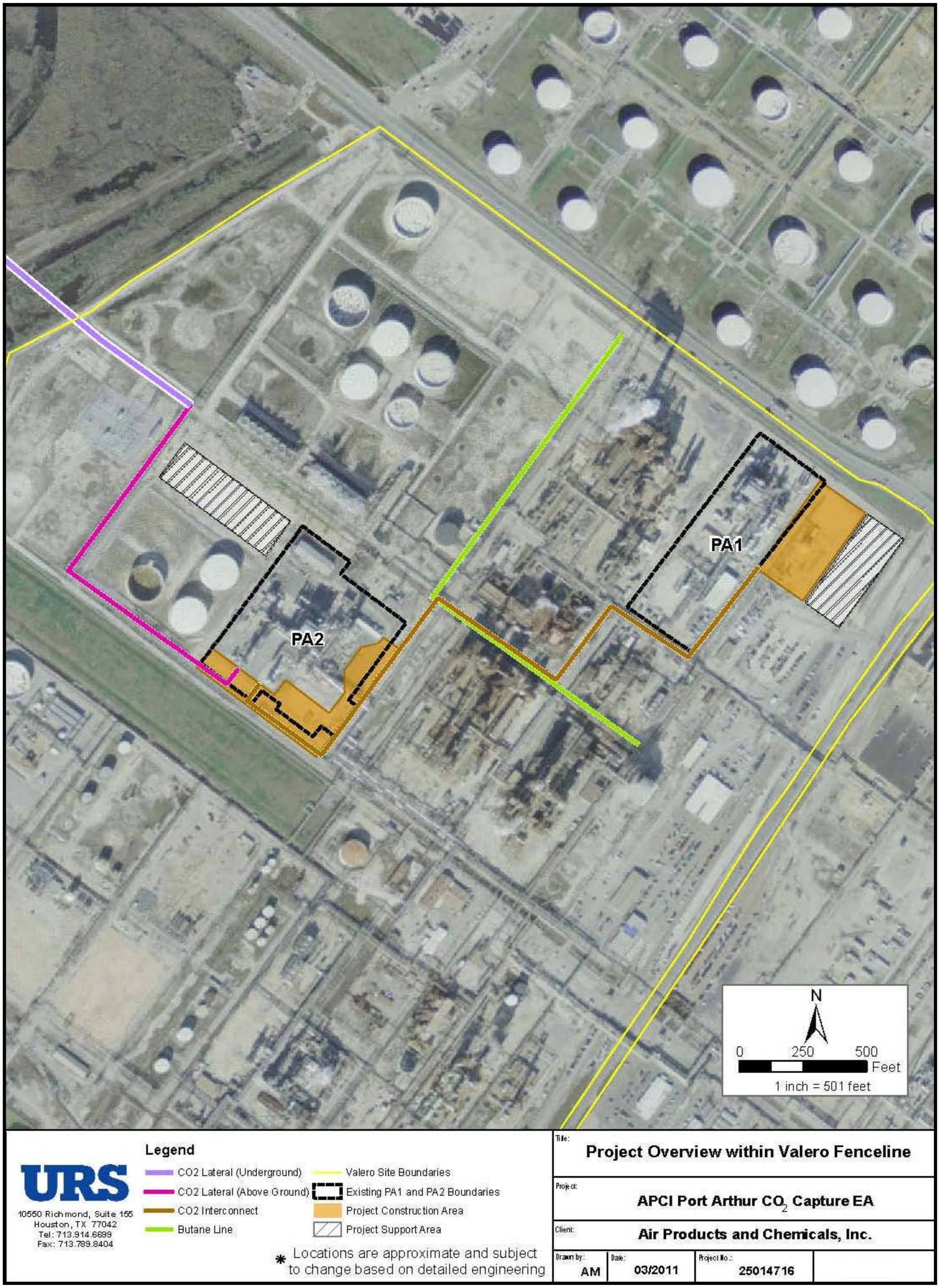
(1) CO_2 Capture, Valero Refinery, Jefferson County

APCI's two Port Arthur, Texas plants (PA1 and PA2) are located within the fence line of the Valero Refinery, which is located at the southwest edge of the city of Port Arthur. The CO_2 capture component of the project will use vacuum swing adsorption (VSA) technology to capture CO_2 from the syngas generated by the SMR at each of the PA1 and PA2 locations shown in Figure 2. After compression and final drying, the CO_2 will exit the refinery limits and enter the new 12.8-mile-long CO_2 pipeline that was surveyed by URS as part of Texas Antiquities Permit #5884.

The specific components of APCI's proposed project that lie within the Valero Refinery are presented in Figure 2. They include the southern terminus of the 12.8-mile-long CO_2 pipeline, approximately 192 meters (630 feet) in length in this area and underground except at its tie-in; roughly 501 meters (1,643 feet) of aboveground pipe that will extend from the CO_2 tie-in to PA2; a 2.5-acre (1.1 hectare) expansion of the footprint of PA2; approximately 897 meters (2,942 feet) of aboveground CO_2 pipeline that will connect PA1 to PA2; and a 2.1-acre (0.9 hectare) expansion of the PA1 footprint. There will also be two laydown yards and workspaces, one northwest of PA2 that is approximately 1.8 acre (0.7 hectare) in area and one directly southwest of PA1 that is 1.6 acre (0.6 hectare) in area. Roughly 690 meters (2,262 feet) of an existing 5-inch-diameter liquid butane line will also be relocated during the course of the planned activities. All of the above listed project activities are situated within lands that have been extremely disturbed by ongoing refinery operations, including land fill and leveling, and road, building, and equipment construction.

A review was conducted by URS on March 11, 2011 of data on file at the THC via the online Texas Archeological Sites Atlas, along with the online records of the NRHP. This research was undertaken to identify previously completed cultural resources surveys and cultural resources recorded within one mile (1.6 km) of the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within one mile (1.6 km) of the proposed pipeline centerline. The closest is Site 41JF81, which is located approximately 1.1 mile southeast of the Valero facility on the banks of Taylor Bayou.

Figure 2: Proposed APCI Project Activities within Valero Refinery, Jefferson County



(2) West Hastings Field, MVA Program, Brazoria County

The Hastings Fields is located roughly 18 miles (30 km) south of Houston on the border of Brazoria and Galveston Counties (Figure 1). The first successful oil wells in the Hastings Field were drilled in the 1930s and it was a substantial producer of oil until the last few decades. The Hastings Fields is now considered a depleted field that can only produce oil with pumps and other artificial means. The CO_2 captured by APCI's proposed project will be used by Denbury within the West Hastings Field to recover oil through EOR. As this is a DOE-funded CO_2 capture and storage project, the project will involve an MVA program at the West Hastings Field. The MVA program will be carried out by Denbury or their representatives with some oversight by APCI since the MVA program is a component of APCI's proposed project.

Denbury plans to implement CO_2 injection into the West Hastings Field in a series of four phases. Phases 1 and 2, including pre-fieldwork preparatory activities, are planned to occur in the north end of the field in 2010–2012, in the central section during 2013-2014, and in the southern end during 2015-2016. A preliminary design has been made and estimates of the CO_2 storage capacity for the reservoir have been determined. Based on this schedule, the CO_2 supplied from the APCI Port Arthur project will be primarily used in the central and southern portions of the field.

There are currently 72 active wells, 113 inactive but accessible wells, 9 temporarily abandoned wells, and 110 plugged and abandoned wells in the central and south portions of the West Hastings Field. Prior to beginning CO_2 injection, Denbury will review well data and every active, inactive, and plugged and abandoned well will have its mechanical status defined. Existing wells that are unable to accommodate the pressure increase from the CO_2 injection will be remediated by Denbury prior to initiating CO_2 injection.

The plan currently prepared for Denbury for the MVA program proposes to use/convert existing oil field wells into use for CO_2 injection where possible. Some new wells will likely need to be installed and selected existing wells in the West Hastings Field will be re-entered and converted as needed to use for CO_2 injection. Based on existing available information, it is estimated that eight new well sites may be needed and six existing wells would be converted/utilized for injection. The current plan includes a series of inverted "9-spot" patterns, each comprised of a central injection well surrounded by nine oil production wells. The approximate locations of these proposed MVA well sites are shown in Figures 3 and 4. The final number of required new wells and existing wells to be adapted and re-used for injection may change somewhat during the final stages of the injection/production well system design. Initial plans are for Denbury to develop seven such 9-spot patterns in 2013 and seven more in 2014, resulting in a total of 14 CO_2 injection wells and 61 associated producing/observation wells. At this time, all of the MVA project activities are expected to be limited to the West Hastings Field.

A review of the online Texas Archeological Sites Atlas and National Register of Historic Places was performed by URS on March 11, 2011. This research was undertaken to identify previously completed surveys and cultural resources in proximity to the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within three miles (5 km) of this portion of the Hastings Field.

Figure 3: General Location of APCI / Denbury Project Activities within West Hastings Field, Brazoria County (USGS Algoa, TX Quad)

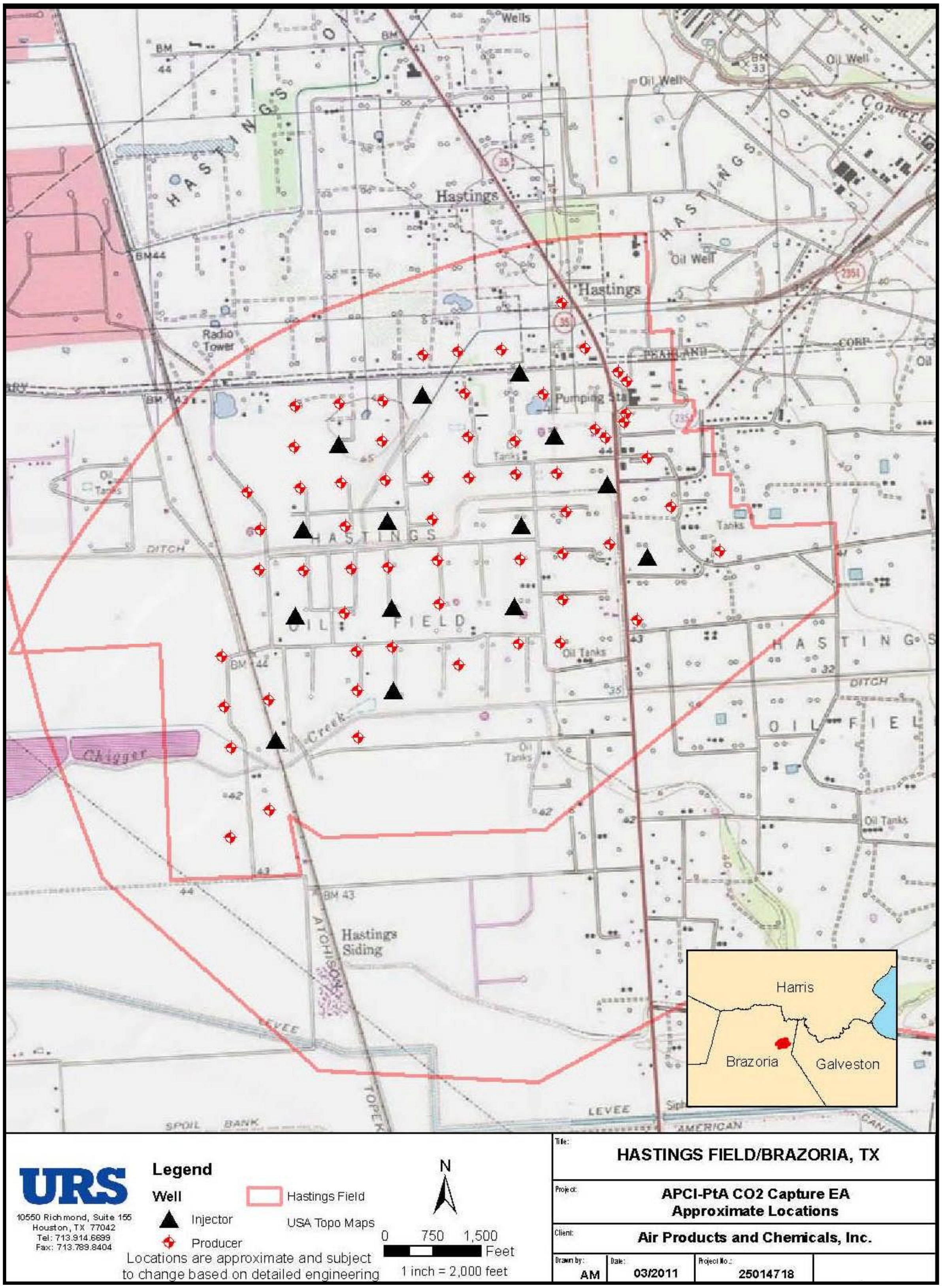
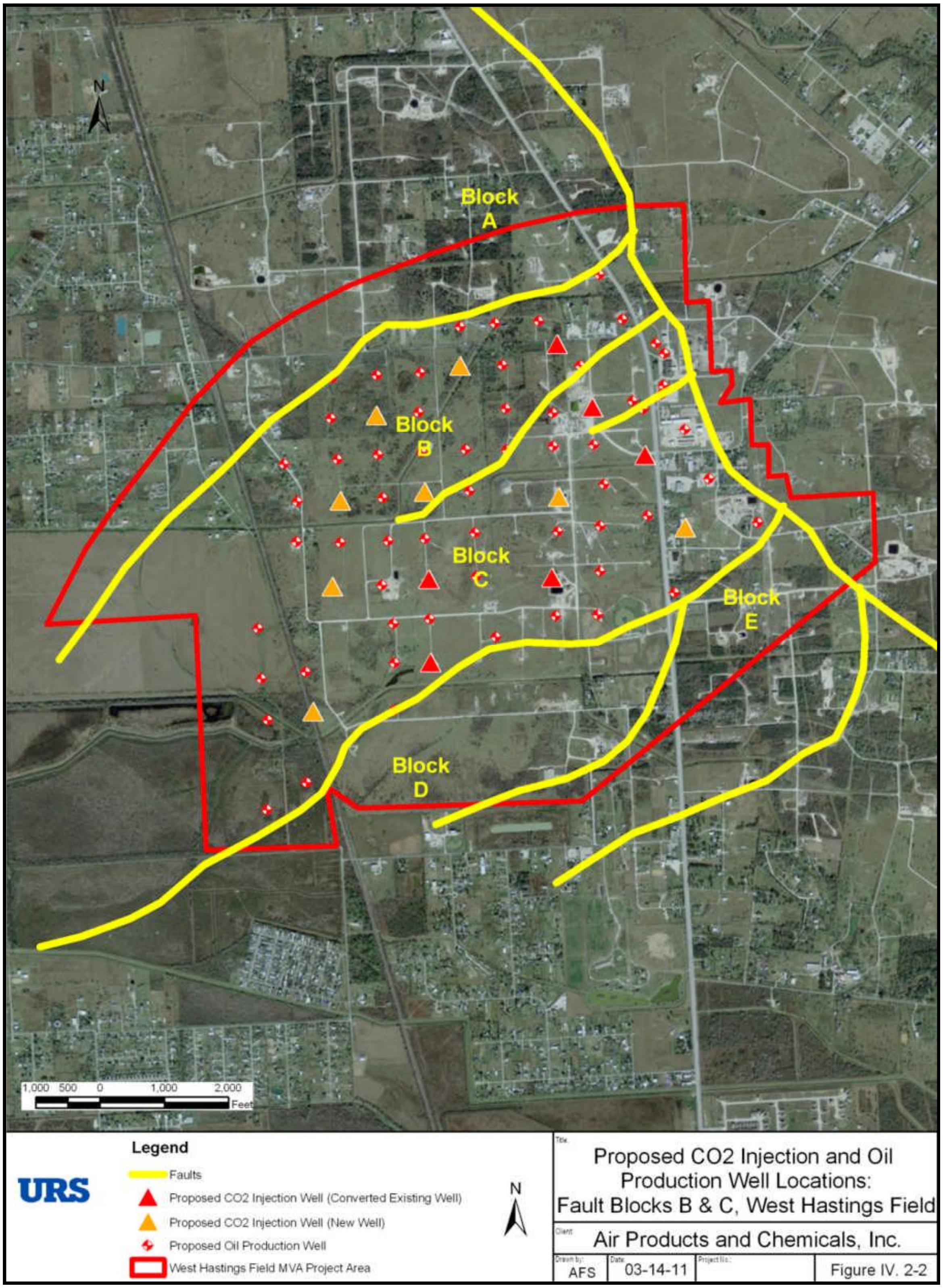


Figure 4: General Location of APCI / Denbury Project Activities within West Hastings Field, Brazoria County (Aerial)



Findings and Recommendation

URS has conducted an office review of the potential for proposed APCI Port Arthur CO_2 Project activities within the Valero Refinery in Jefferson County, Texas and the Hastings Field in Brazoria County, Texas to contain and impact historic properties as defined under Section 106 of the National Historic Preservation Act (NHPA). A records review has found that no historic properties are currently plotted within the project areas.

Based on our review of the proposed project activities and their location, it is our opinion that a very low likelihood exists of unrecorded historic properties being situated within the Area of Potential Effect associated with these two proposed project areas. This opinion for the Valero Refinery is based on the level of existing ground disturbance within this operating facility, which includes extensive grading as well as construction of roads, buildings, and equipment. For the Hastings Field, our opinion is based on project plans that anticipate re-using six existing well sites for the proposed monitoring program, and eight new wells will be located within the defined limits of ongoing Hastings Field operations. We therefore recommend that no further archaeological or architectural studies are warranted for these project activities, as currently defined.

If you have any questions or concerns regarding this study, please do not hesitate to contact me at 225-935-2974 or by email at rob_lackowicz@urscorp.com.

Sincerely,

Rob Lackowicz, M.A.
Principal Investigator
URS Group, Inc.

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

U.S. DEPARTMENT OF ENERGY

April 5, 2011

APR 8 2011

Ms. Debra Beene
Texas Historical Commission
1511 Colorado Street
Austin, Texas 78701

Re: Section 106 Determination for Project Activities within Previously Developed Lands in Valero Refinery and West Hastings Oil Field; Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)
(Connected Action: Texas Antiquities Permit #5884)

Dear Ms. Beene:

This letter supplements my earlier communication to Mr. Mark Wolfe dated January 31, 2011, regarding the above-referenced Air Products and Chemicals, Inc. (APCI), carbon dioxide (CO_2) capture and sequestration project. As noted in my earlier letter, U. S. Department of Energy (DOE) National Energy Technology Laboratory is currently preparing a draft environmental assessment (EA) to comply with National Environmental Policy Act and Section 106 of the National Historic Preservation Act of 1966.

APCI's proposed project includes the following three primary components:

1) CO_2 capture, concentration, and purification at APCI's two Port Arthur, Texas hydrogen plants (PA1 and PA2), which are located within the Valero Port Arthur Refinery;
2) Transport of CO_2 within Jefferson County, Texas through a new 12.8-mile-long, 8-inch-diameter pipeline lateral that will interconnect with an existing CO_2 pipeline system for injection into a depleted oil field, the West Hastings Field in Brazoria County, Texas, for enhanced oil recovery; and
3) Implementation of a comprehensive monitoring, verification, and accounting program to monitor the impacts of injection and sequestration of the injected CO_2 at the West Hastings Field.

Please note that the 7-mile-long hydrogen pipeline lateral discussed in previous submittals to the Texas Historical Commission (THC) is no longer included in the project scope. The proposed pipeline route listed above as component (2) is being assessed through a Phase I cultural resource field investigation, partly under Texas Antiquities Permit #5884, which was issued by your office on February 23, 2011. DOE expects the results of that survey to be reported to you in the near future for separate comment.

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507
fred.pozzuto@netl.doe.gov • Voice (304) 285-5219 • Fax (304) 285-4216 • www.netl.doe.gov

APCI project components (1) and (3), as listed above, are described further in the enclosed document to afford the THC a reasonable opportunity to comment before the EA is issued. Given the level of existing land disturbance and the types of activities to be conducted as part of APCI project components (1) and (3), as described in the enclosed document, it is the opinion of DOE that the activities proposed in these two project areas will not impact historic properties meeting the criteria of significance for listing on the National Register of Historic Places. Please reply whether your office concurs with this determination of No Historic Properties Present or Affected. Again, please refer to the attached enclosure.

For any overall environmental project questions please call me at 304-285-5219. Should you have any technical questions please contact our NEPA contractor, Mr. Rob Lackowicz at 225-935-2974 or by email at rob_lackowicz@urscorp.com.

Sincerely,

SEE ATTACHED:
ASSESSMENT OF IMPACTS
TO HISTORIC PROPERTIES

Fred E. Pozzuto
Environmental Manager/NEPA Compliance Officer

Enclosures

Cc: THC (Mr. Mark Wolfe)
APCI (Messrs. Greg Frisby, Tom Houser, Steve Fisher and Kent Kisenbauer)
URS (Messrs. Pete Conwell and Rob Lackowicz)

ATTACHMENT 5/3/79

URS

Date: April 1, 2011

Air Products and Chemicals, Inc. (APCI) Port Arthur CO_2 Project:
Valero Refinery, Jefferson County and West Hastings Field, Brazoria County, Texas
Assessment of Project Activities Impacting Historic Properties

(Connected Action: Texas Antiquities Permit #5884)

Study Purpose

The purpose of this letter is to evaluate the above two project areas in Jefferson and Brazoria Counties, Texas (Figure 1) for their potential to contain and impact significant cultural resources, defined as historic properties under Section 106 of the National Historic Preservation Act (NHPA) and the National Register of Historic Places (NRHP) criteria for evaluation (36 CFR Part 800 and 36 CFR 60.4). Section 106 of the NHPA, as amended, requires the lead federal agency with jurisdiction over an undertaking to consider impacts to historic properties before the undertaking occurs. Undertakings in this sense include activities, projects, or programs that are directly or indirectly funded by a federal agency. The U.S. Department of Energy - National Energy Technology Laboratory (DOE-NETL) proposes to provide financial assistance to APCI for this project under the American Recovery and Reinvestment Act of 2009 (ARRA).

The NHPA defines a historic property as any archeological site, district, building, structure, or object that is included in, or eligible for inclusion in, the NRHP. Under this definition, other cultural resources may be present within a project's Area of Potential Effect but are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. To be eligible for the NRHP, a property generally must be greater than 50 years of age, although there are provisions for listing recent cultural resources if they are of exceptional federal, state or local importance.

Project Introduction

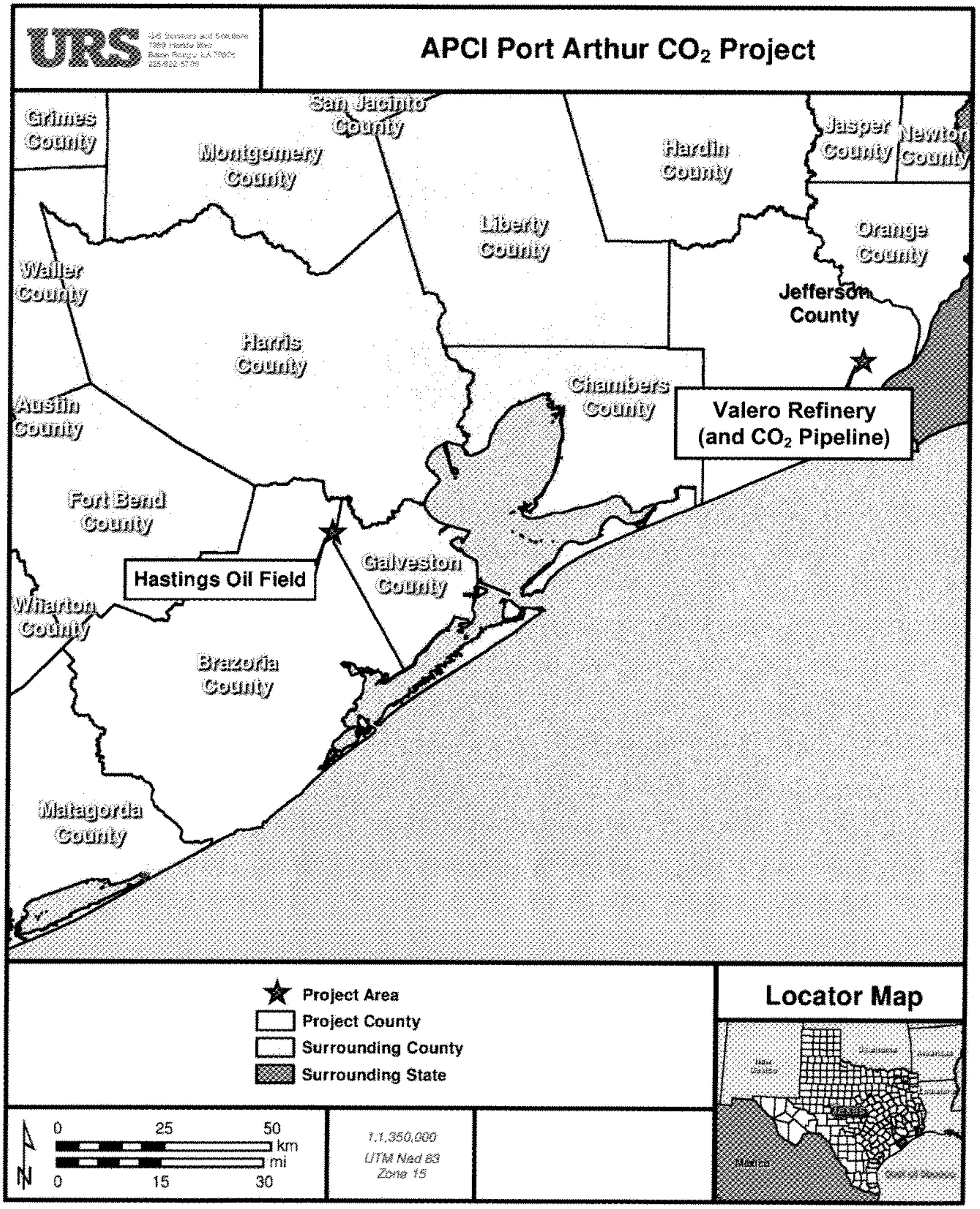
Under the ARRA, the DOE has made funding available for large-scale carbon dioxide (CO_2) projects that capture more than one million tons of CO_2 per year if they are operational by 2015. In June 2010 the DOE-NETL announced it had selected the APCI project discussed here to move to the project execution phase.

APCI's proposed project will involve the capture and sequestration of CO_2 from APCI's existing steam methane reformer (SMR) plants in Port Arthur, Texas, starting in November 2012, and transport of the captured CO_2 to oil fields in eastern Texas by pipeline where it will be used for enhanced oil recovery (EOR). APCI's project involves an integrated carbon capture, transport, injection, sequestration, and monitoring program that will capture approximately one million tons per year of CO_2, based on current engineering estimates. APCI's two Port Arthur, Texas plants (PA1 and PA2) in the existing Valero Refinery produce hydrogen, electric power, and steam. APCI's proposed project is subdivided into three major components:

1) CO_2 capture, concentration, and purification to be integrated with the existing SMR plants PA1 and PA2 within the existing Valero Refinery in Jefferson County;
2) Transport of CO_2 through a new, approximately 12.8 mile long, 8-inch diameter CO_2 pipeline, which, will interconnect with an existing CO_2 pipeline system for injection into the depleted Hastings Field in Brazoria County, Texas, for EOR; and

URS Group
7389 Florida Blvd., Suite 300
Baton Rouge, LA 70806
Tel: 225.922.5700
Fax: 225.922.5701
www.urscorp.com

Figure 1: General Overview of APCI Project Items, Valero Refinery and Hastings Field



3) Implementation of a comprehensive monitoring, verification, and accounting (MVA) program to monitor the impacts of injection and sequestration of the injected CO_2 at the West Hastings Field.

The proposed CO_2 pipeline, which parallels existing utility corridors along over 95% of its route, will be owned by APCI and will connect to the existing Denbury Onshore, LLC (Denbury) Green Pipeline. Denbury also owns and operates the Hastings Field and is partnering with APCI to conduct the Hastings Field MVA program.

The DOE-NETL has determined that an environmental assessment (EA) constitutes the appropriate level of National Environmental Policy Act review for the proposed project. APCI has contracted with URS Group, Inc. (URS) to provide environmental and cultural resources services in support of the project's permitting needs. The pipeline portion of this project, listed above as Project Component 2, was referred to the Texas Historical Commission (THC) for evaluation on January 17, 2011. It was assessed separately by URS through a Phase I cultural resource field investigation, partly under Texas Antiquities Permit #5884. The results of that survey will be reported to the THC upon the report's completion. The sections below examine Project Components (1) and (3), the project activities anticipated within the Valero Refinery and within the Hastings Field.

Location of APCI Project Areas, Planned Activities and Current Environment

(1) CO_2 Capture, Valero Refinery, Jefferson County

APCI's two Port Arthur, Texas plants (PA1 and PA2) are located within the fence line of the Valero Refinery, which is located at the southwest edge of the city of Port Arthur. The CO_2 capture component of the project will use vacuum swing adsorption (VSA) technology to capture CO_2 from the syngas generated by the SMR at each of the PA1 and PA2 locations shown in Figure 2. After compression and final drying, the CO_2 will exit the refinery limits and enter the new 12.8-mile-long CO_2 pipeline that was surveyed by URS as part of Texas Antiquities Permit #5884.

The specific components of APCI's proposed project that lie within the Valero Refinery are presented in Figure 2. They include the southern terminus of the 12.8-mile-long CO_2 pipeline, approximately 192 meters (630 feet) in length in this area and underground except at its tie-in; roughly 501 meters (1,643 feet) of aboveground pipe that will extend from the CO_2 tie-in to PA2; a 2.5-acre (1.1 hectare) expansion of the footprint of PA2; approximately 897 meters (2,942 feet) of aboveground CO_2 pipeline that will connect PA1 to PA2; and a 2.1-acre (0.9 hectare) expansion of the PA1 footprint. There will also be two laydown yards and workspaces, one northwest of PA2 that is approximately 1.8 acre (0.7 hectare) in area and one directly southwest of PA1 that is 1.6 acre (0.6 hectare) in area. Roughly 690 meters (2,262 feet) of an existing 5-inch-diameter liquid butane line will also be relocated during the course of the planned activities. All of the above listed project activities are situated within lands that have been extremely disturbed by ongoing refinery operations, including land fill and leveling, and road, building, and equipment construction.

A review was conducted by URS on March 11, 2011 of data on file at the THC via the online Texas Archeological Sites Atlas, along with the online records of the NRHP. This research was undertaken to identify previously completed cultural resources surveys and cultural resources recorded within one mile (1.6 km) of the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within one mile (1.6 km) of the proposed pipeline centerline. The closest is Site 41JF81, which is located approximately 1.1 mile southeast of the Valero facility on the banks of Taylor Bayou.

(2) West Hastings Field, MVA Program, Brazoria County

The Hastings Fields is located roughly 18 miles (30 km) south of Houston on the border of Brazoria and Galveston Counties (Figure 1). The first successful oil wells in the Hastings Field were drilled in the 1930s and it was a substantial producer of oil until the last few decades. The Hastings Fields is now considered a depleted field that can only produce oil with pumps and other artificial means. The CO_2 captured by APCI's proposed project will be used by Denbury within the West Hastings Field to recover oil through EOR. As this is a DOE-funded CO_2 capture and storage project, the project will involve an MVA program at the West Hastings Field. The MVA program will be carried out by Denbury or their representatives with some oversight by APCI since the MVA program is a component of APCI's proposed project.

Denbury plans to implement CO_2 injection into the West Hastings Field in a series of four phases. Phases 1 and 2, including pre-fieldwork preparatory activities, are planned to occur in the north end of the field in 2010–2012, in the central section during 2013-2014, and in the southern end during 2015-2016. A preliminary design has been made and estimates of the CO_2 storage capacity for the reservoir have been determined. Based on this schedule, the CO_2 supplied from the APCI Port Arthur project will be primarily used in the central and southern portions of the field.

There are currently 72 active wells, 113 inactive but accessible wells, 9 temporarily abandoned wells, and 110 plugged and abandoned wells in the central and south portions of the West Hastings Field. Prior to beginning CO_2 injection, Denbury will review well data and every active, inactive, and plugged and abandoned well will have its mechanical status defined. Existing wells that are unable to accommodate the pressure increase from the CO_2 injection will be remediated by Denbury prior to initiating CO_2 injection.

The plan currently prepared for Denbury for the MVA program proposes to use/convert existing oil field wells into use for CO_2 injection where possible. Some new wells will likely need to be installed and selected existing wells in the West Hastings Field will be re-entered and converted as needed to use for CO_2 injection. Based on existing available information, it is estimated that eight new well sites may be needed and six existing wells would be converted/utilized for injection. The current plan includes a series of inverted "9-spot" patterns, each comprised of a central injection well surrounded by nine oil production wells. The approximate locations of these proposed MVA well sites are shown in Figures 3 and 4. The final number of required new wells and existing wells to be adapted and re-used for injection may change somewhat during the final stages of the injection/production well system design. Initial plans are for Denbury to develop seven such 9-spot patterns in 2013 and seven more in 2014, resulting in a total of 14 CO_2 injection wells and 61 associated producing/observation wells. At this time, all of the MVA project activities are expected to be limited to the West Hastings Field.

A review of the online Texas Archeological Sites Atlas and National Register of Historic Places was performed by URS on March 11, 2011. This research was undertaken to identify previously completed surveys and cultural resources in proximity to the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within three miles (5 km) of this portion of the Hastings Field.

Findings and Recommendation

URS has conducted an office review of the potential for proposed APCI Port Arthur CO_2 Project activities within the Valero Refinery in Jefferson County, Texas and the Hastings Field in Brazoria County, Texas to contain and impact historic properties as defined under Section 106 of the National Historic Preservation Act (NHPA). A records review has found that no historic properties are currently plotted within the project areas.

Based on our review of the proposed project activities and their location, it is our opinion that a very low likelihood exists of unrecorded historic properties being situated within the Area of Potential Effect associated with these two proposed project areas. This opinion for the Valero Refinery is based on the level of existing ground disturbance within this operating facility, which includes extensive grading as well as construction of roads, buildings, and equipment. For the Hastings Field, our opinion is based on project plans that anticipate re-using six existing well sites for the proposed monitoring program, and eight new wells will be located within the defined limits of ongoing Hastings Field operations. We therefore recommend that no further archaeological or architectural studies are warranted for these project activities, as currently defined.

If you have any questions or concerns regarding this study, please do not hesitate to contact me at 225-935-2974 or by email at rob_lackowicz@urscorp.com.

Sincerely,

Rob Lackowicz, M.A.
Principal Investigator
URS Group, Inc.

CONCUR
by
for Mark Wolfe
State Historic Preservation Officer
Date 05/03/2011
Track# 201111960

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

U.S. DEPARTMENT OF ENERGY

April 27, 2011

Mr. Alton LeBlanc, Tribal Administrator
Alabama-Coushatta Tribe of Texas
571 State Park Road
Livingston, Texas 77351

RE: Request for Project Review and Comment Proposed Air Products and Chemicals, Inc. Project in Jefferson and Brazoria Counties Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)

Dear Mr. LeBlanc:

The U.S. Department of Energy (DOE) National Energy Technology Laboratory has made funding available for large-scale carbon dioxide (CO_2) projects that capture more than one million tons of CO_2 per year if they are operational by 2015. This funding will come from the American Recovery and Reinvestment Act of 2009. In June 2010, DOE announced it had selected the Air Products and Chemicals, Inc. (Air Products) project discussed here as one of three projects to be funded for construction. Air Products' proposed project has components located in Texas in Jefferson and Brazoria Counties (Figure 1). The formal name of the Air Products' proposed project is the *Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production*.

DOE has determined that an environmental assessment (EA) constitutes the appropriate level of review for the National Environmental Policy Act and Section 106 of the National Historic Preservation Act of 1966. As part of the EA process for Air Products' proposed project, I am providing this project description and our preliminary findings to you so that your Tribe may relate any potential concerns to the DOE regarding traditional and cultural sites that may be related to this proposed project. For your convenience, please find enclosed a response form. Any information you provide will assist the DOE in the preparation of the EA and all correspondence with your office will be included in an appendix to the EA report.

The proposed project will involve Air Products capturing CO_2 gas and transporting it using new and existing pipelines to a depleted oil field in east Texas. The CO_2 will be used for enhanced oil recovery (EOR) operations in this depleted field. The project includes the following three components:

1) CO_2 capture, concentration, and purification at the two Air Products' Port Arthur, Texas hydrogen plants (PA1 and PA2), which are located within the Valero Port Arthur Refinery;
2) Transport of the concentrated and purified CO_2 within Jefferson County, Texas through a new 12.8-mile-long, 8-inch-diameter pipeline lateral, which will transport the CO_2 from Air Products' plants at the Valero Refinery to the existing Denbury Resources LLC (Denbury)

Green Pipeline in Jefferson County and from there to the West Hastings Field in Brazoria County, Texas for use in EOR operations; and

3) Implementation of a comprehensive monitoring, verification, and accounting (MVA) program, conducted by Denbury at the West Hastings Field in Brazoria County, Texas to monitor injection and sequestration of CO_2.

These components are described in additional detail below:

1) CO_2 capture, Valero Refinery, Jefferson County

Air Products' two Port Arthur, Texas plants (PA1 and PA2) are located within the fence line of the existing Valero Refinery, which is located at the southwest edge of the city of Port Arthur. The CO_2 capture component of the project will use vacuum swing adsorption technology to capture CO_2 from the syngas generated by the steam methane reformer at each of the PA1 and PA2 locations shown in Figure 2. After compression and final drying, the CO_2 will exit the refinery limits and enter the new 12.8-mile-long CO_2 pipeline that is described below.

The specific components that lie within the Valero Refinery are shown in Figure 2. They include the southern terminus of the 12.8-mile-long CO_2 pipeline, approximately 630 feet in length in this area and underground except at its tie-in; roughly 1,643 feet of aboveground pipe that will extend from the CO_2 tie-in to PA2; a 2.5-acre expansion of the footprint of PA2; approximately 2,942 feet of aboveground CO_2 pipeline that will connect PA1 to PA2; and a 2.1-acre expansion of the PA1 footprint. There will also be two laydown yards and workspaces, one northwest of PA2 that is approximately 1.8 acre in area and one directly southwest of PA1 that is 1.6 acre in area. Roughly 2,262 feet of an existing 5-inch-diameter liquid butane line will also be relocated during the course of the planned activities. All of the above listed project activities are situated within lands that have been extremely disturbed by ongoing refinery operations, including land fill and leveling, and road, building, and equipment construction.

Air Products has contracted with URS Group, Inc. (URS) to provide environmental and cultural resources services in support of the project's permitting needs. A review was conducted by URS on March 11, 2011 of data on file at the Texas Historical Commission (THC) via the online Texas Archeological Sites Atlas, along with the online records of the National Register of Historic Places. This research was undertaken to identify any known cultural resources within one mile of the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within one mile of the proposed pipeline centerline. The closest is Site 41JF81, which is located approximately 1.1 mile southeast of the Valero Refinery on the banks of Taylor Bayou.

URS found a very low likelihood for unrecorded historic properties (including archaeological sites) being situated within the Area of Potential Effect for the Valero Refinery project activities. This opinion was based on the level of existing ground disturbance within this operating facility, which includes extensive grading as well as construction of roads, buildings, and equipment. URS recommended that no further archaeological or architectural studies are warranted for these project activities as currently defined. DOE concurs with this finding.

2) <u>12.8-mile-long CO_2 pipeline lateral, Jefferson County</u>

DOE and URS consulted with the THC on the appropriate level of survey effort and methods for Air Products' proposed new pipeline lateral from the Valero Refinery to the existing Denbury Green Pipeline. In February 2011, URS conducted a Phase I cultural resource survey and inventory of the proposed 12.8-mile-long, 8-inch-diameter CO_2 pipeline (Figure 3). Approximately 0.7 miles of the route crosses through state lands administered by the Texas Department of Criminal Justice. As required by state law, these state lands were evaluated under Texas Antiquities Permit #5884, issued by the THC on February 23, 2011. The purpose of the field investigation was to identify any cultural resources, such as historic and prehistoric archeological sites, historic standing structures and cemeteries that might be located within the boundaries of the proposed undertaking.

According to the Texas Archeological Site Atlas, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, historic buildings or historic structures were previously identified within one mile of the proposed pipeline centerline. The closest is Site 41JF81, which is located on the banks of Taylor Bayou, about 1.4 miles southeast of the pipeline's initiation point at the Valero Refinery. The northern terminus of the line is located just over one mile from the outer boundary defined for the Spindletop historic oil field district and National Historic Landmark.

Two state historic markers and a single contemporary cemetery were identified within one mile of the proposed survey corridor. The first marker is Atlas No. 5245012672, erected in 1966 to commemorate the historic impacts of the early oil pipelines to the state and nation. The other marker is Atlas No. 5245013118, erected in 2003 to commemorate the historic effects of the Spindletop oil field and early pipelines to Port Arthur. Neither of these features is located within 750 feet of the proposed survey corridor. The single known cemetery within the vicinity of the proposed undertaking is Live Oak Memorial (JF-C025), which is located on the opposite bank of Rhodair Bayou at Viterbo, west of the county's regional airport. It also will not be impacted by the project. Based on a review of the online National Park Service database, no historic properties listed on the National Register of Historic Places properties lie within one mile of the proposed survey corridor.

The general expected width of the right-of-way to be used by Air Products during pipeline construction is approximately 60 feet. However, a 200-foot-wide corridor was surveyed for the Phase I investigation to allow for potential changes in the pipeline design. The project also examined proposed access roads and workspaces outside of the 200-foot survey corridor. The field methods used by URS included visual inspections of ground exposures along with shovel tests, where buried archaeological sites were considered possible. No historic buildings or archaeological concerns were encountered during the field investigation. Based on these findings, URS recommended that no further cultural resource studies be required within the lands surveyed for the pipeline. DOE concurs with that finding.

3) <u>West Hastings Field, MVA Program, Brazoria County</u>

The Hastings Field is located roughly 18 miles south of Houston on the border of Brazoria and Galveston Counties (Figure 4). The first successful oil wells in the Hastings Field were drilled in the 1930s and it was a substantial producer of oil until the last few decades. The Hastings Field is now considered a depleted field that can only produce oil with pumps and other artificial means. The CO_2 captured by Air Products' proposed project will be used by Denbury within the West Hastings Field to recover oil through EOR. As this is a DOE

funded CO_2 capture and storage project, the project will involve an MVA program at the West Hastings Field. The MVA program will be carried out by Denbury or their representatives with some oversight by Air Products since the MVA program is a component of Air Products' proposed project.

Denbury plans to implement CO_2 injection into the West Hastings Field in a series of four phases. Phases 1 and 2, including pre-fieldwork preparatory activities, are planned to occur in the north end of the field in 2010–2012, in the central section during 2013-2014, and in the southern end during 2015-2016. A preliminary design has been made and estimates of the CO_2 storage capacity for the reservoir have been determined. Based on this schedule, the CO_2 supplied from the Air Products Port Arthur project will be primarily used in the central and southern portions of the field.

There are currently 72 active wells, 113 inactive but accessible wells, 9 temporarily abandoned wells, and 110 plugged and abandoned wells in the central and south portions of the West Hastings Field. Prior to beginning CO_2 injection, Denbury will review well data and every active, inactive, and plugged and abandoned well will have its mechanical status defined. Existing wells that are unable to accommodate the pressure increase from the CO_2 injection will be remediated by Denbury prior to initiating CO_2 injection.

A final plan for implementing CO_2 injection in the central and south portions of the West Hastings Field is currently being developed. Consequently, the precise locations and precise spacing and completion intervals of the proposed injection wells are not yet known. Denbury's preliminary development plan proposes to use/convert existing wells into CO_2 injection or oil producing wells where possible. If new wells are required, existing drill pads will be used if possible. Based on existing available information, it is estimated that eight new well sites may be needed and six existing wells will be converted and utilized for injection. The preliminary plan includes a series of inverted "9- spot" patterns, each comprised of a central injection well surrounded by nine oil production wells. The final number of required new wells and existing wells to be adapted and re-used for injection may change somewhat during the final stages of the injection/production well system design. Initial plans are for Denbury to develop seven such 9-spot patterns in 2013 and seven more in 2014, resulting in a total of 14 CO_2 injection wells and 61 associated producing/observation wells. At this time, all of the MVA project activities are expected to be limited to the West Hastings Field.

A review of the online Texas Archeological Sites Atlas and National Register of Historic Places was performed by URS on March 11, 2011. This research was undertaken to identify previously completed surveys and cultural resources in proximity to the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within three miles of this portion of the Hastings Field.

URS found a very low likelihood for unrecorded historic properties (including archaeological sites) being situated within the Area of Potential Effect for the West Hastings Field project activities. This opinion was based on the project plans of re-using six existing well sites for the proposed monitoring program and that the eight new wells will be located within the defined limits of ongoing Hastings Field operations. URS recommended that no further archaeological or architectural studies are warranted for these project activities as currently defined. DOE concurs with this finding.

If you have any questions or would like a copy of the draft EA sent to you, please telephone me at (304) 285-5219 or e-mail me at fred.pozzuto@netl.doe.gov. Thank you for your consideration on this matter.

Sincerely,

Fred E. Pozzuto
Environmental Manager/ NEPA Compliance Officer

Enclosures:

1. Questionnaire
2. Figure 1
3. Figure 2
4. Figure 3
5. Figure 4

Cc: Air Products - Mr. Kent Kisenbauer
URS - Mr. Pete Conwell

Questionnaire for Proposed Air Products CO_2 Project in Jefferson and Brazoria Counties, Texas.

Alabama-Coushatta Tribe of Texas
571 State Park Road
Livingston, Texas 77351
Tel: (936) 563-1101

We have reviewed the following proposed project: Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381) and have:

______ No comments

______ The following comments (attach sheets if preferred):

____

____

____

____

____

____

____

____

____

____

____

____

____

____
Signature

______________________________ ______________________________
Printed Name Date

Please return to: Mr. Fred Pozzuto, 3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507

Figure 1: General Overview of Air Products Project Activities

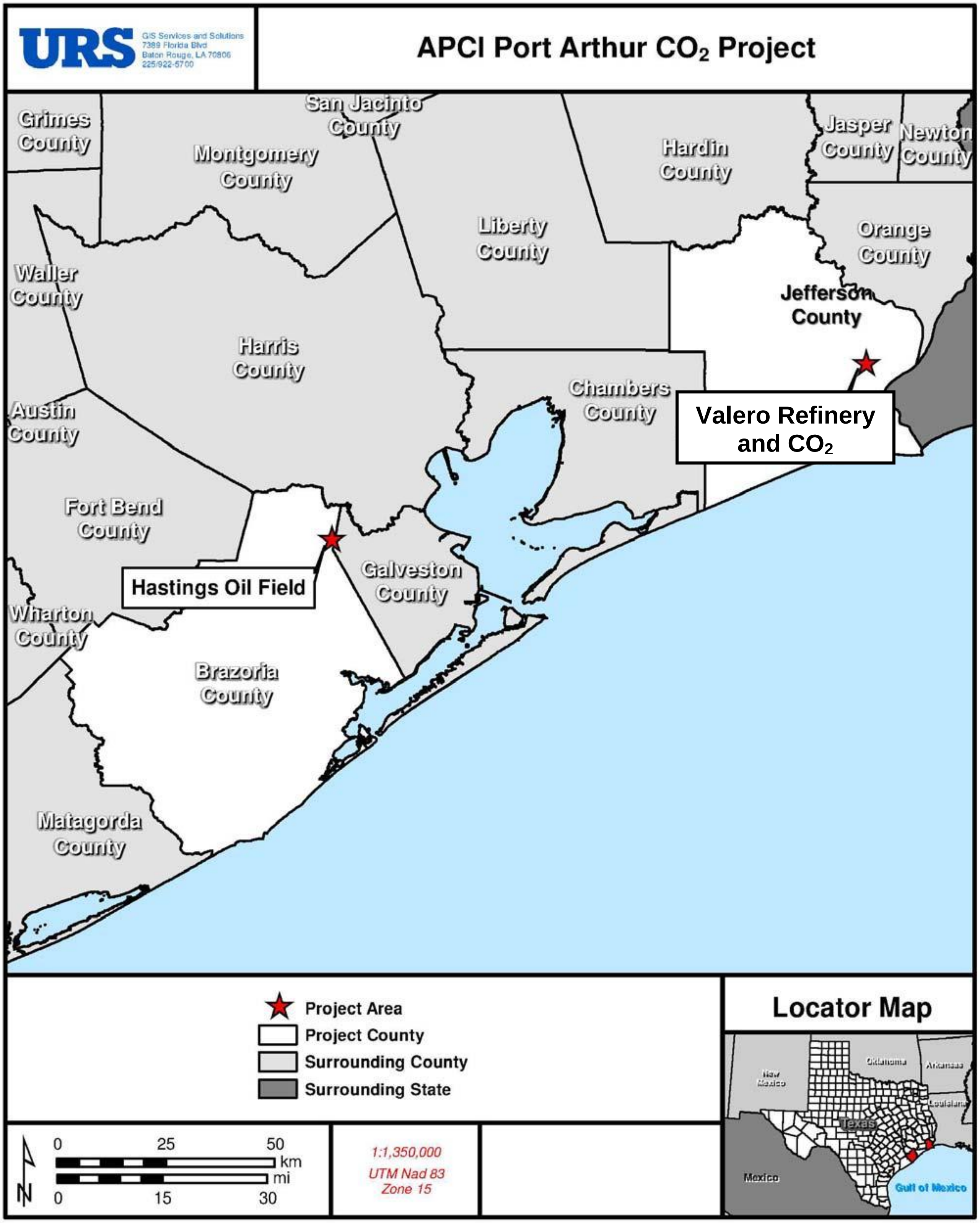


Figure 2: Proposed Air Products Project Activities within Valero Refinery, Jefferson County

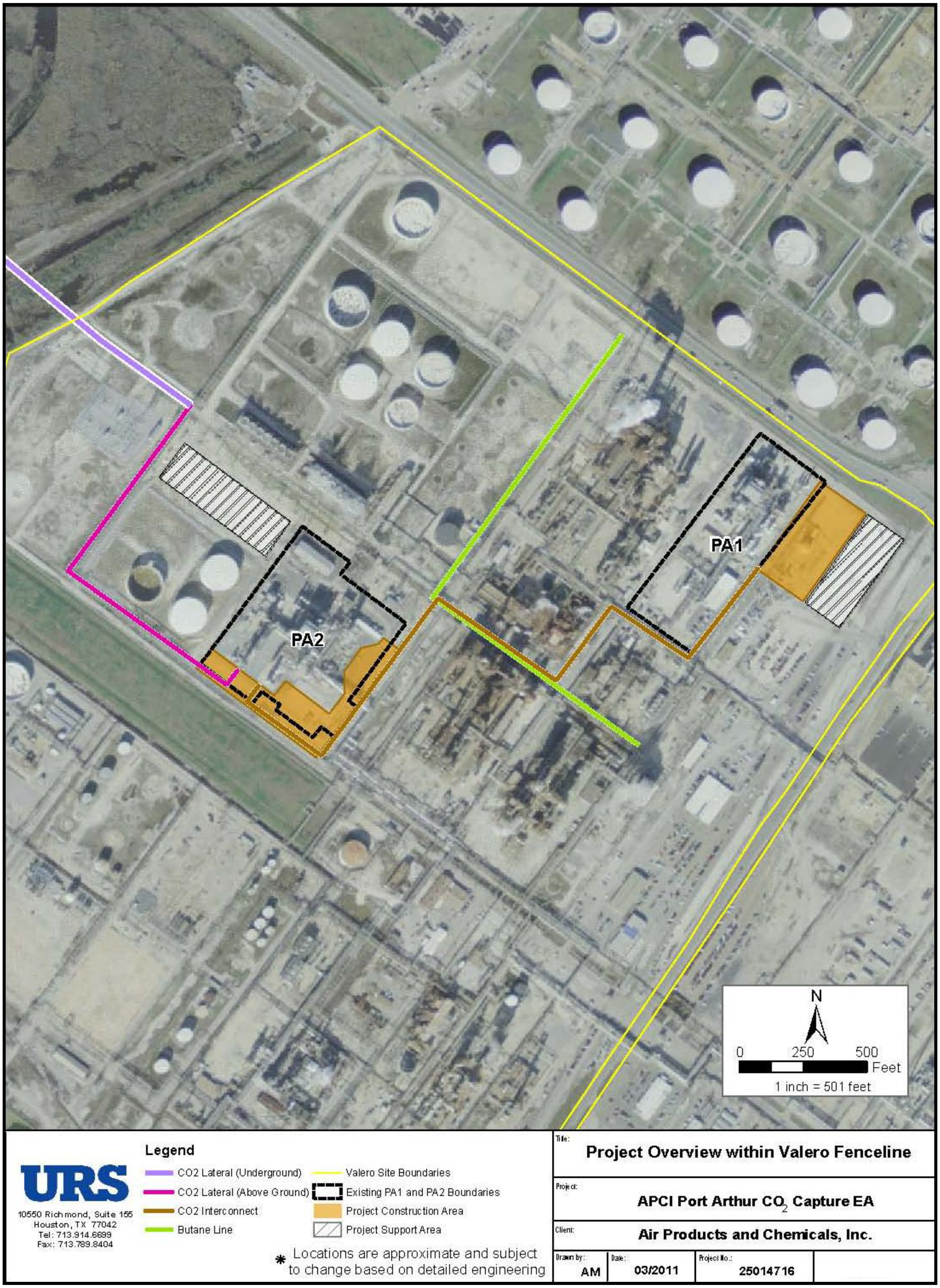


Figure 3: Overview of Air Products CO_2 Pipeline

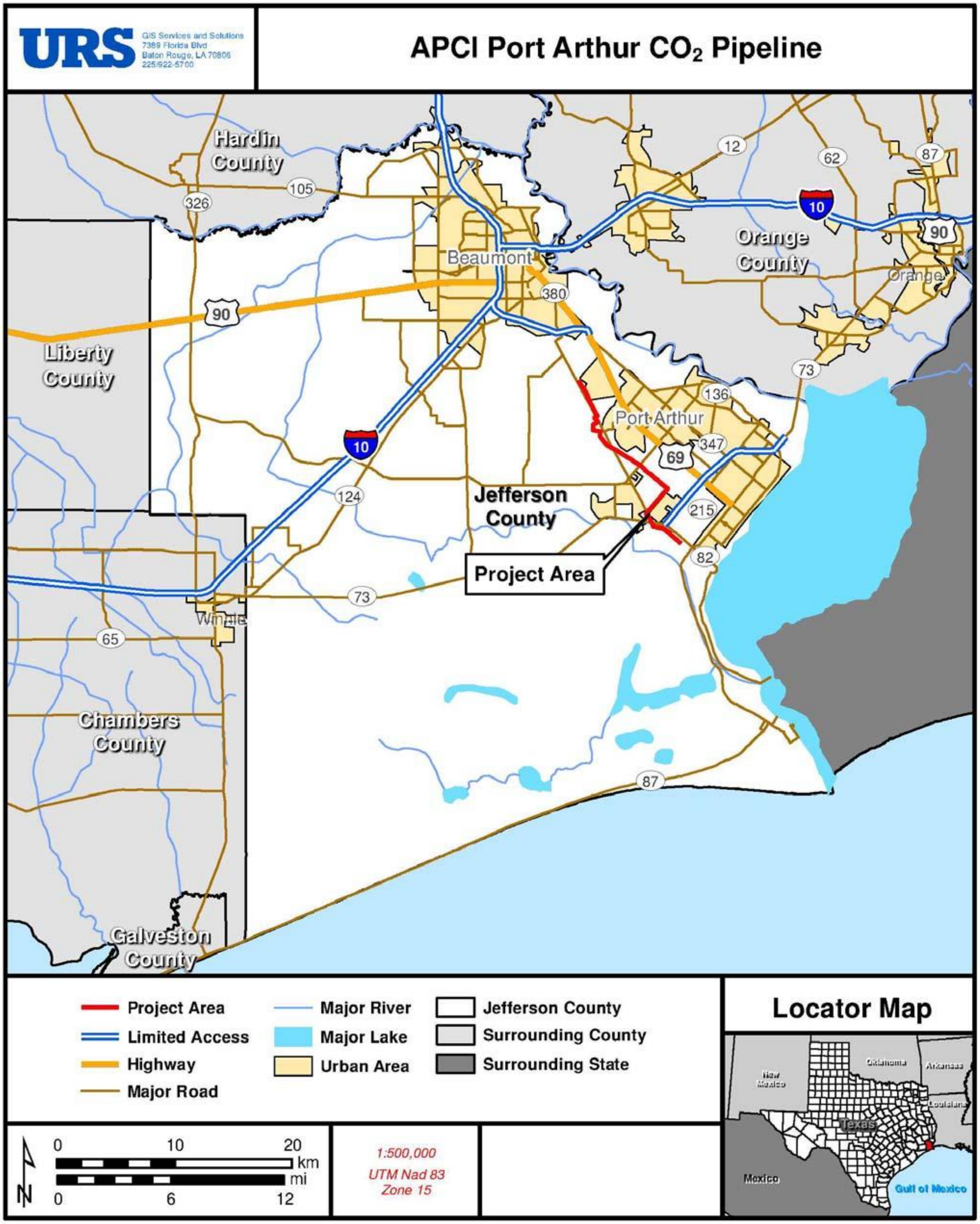
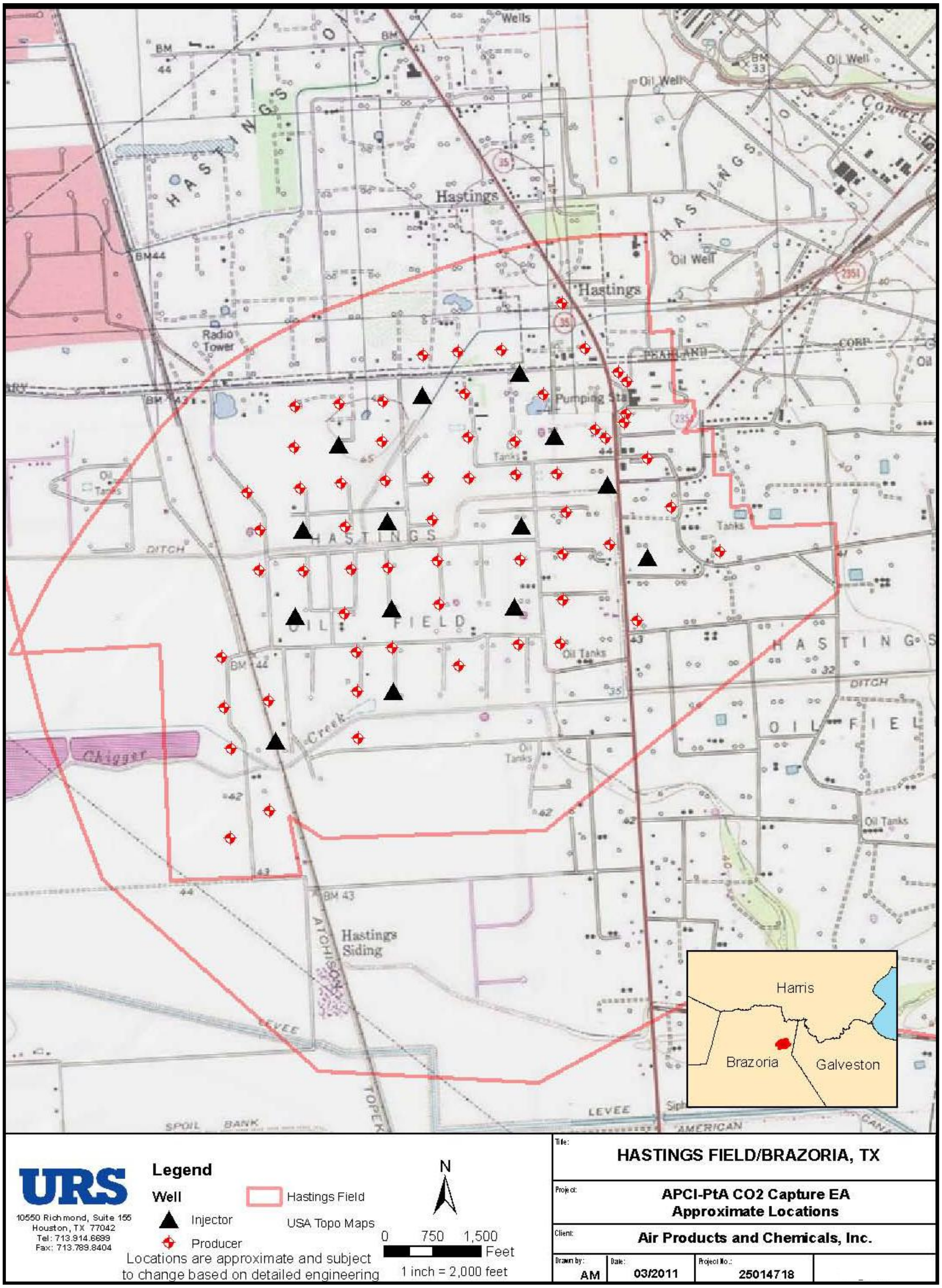


Figure 4: Overview of West Hastings Field, Brazoria County



NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA
U.S. DEPARTMENT OF ENERGY

April 27, 2011

Mr. Juan Garza, Jr., Chairman
Kickapoo Traditional Tribe of Texas
HCR 1 Box 9700
Eagle Pass, Texas 78852

RE: Request for Project Review and Comment Proposed Air Products and Chemicals, Inc. Project in Jefferson and Brazoria Counties Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)

Dear Mr. Garza:

The U.S. Department of Energy (DOE) National Energy Technology Laboratory has made funding available for large-scale carbon dioxide (CO_2) projects that capture more than one million tons of CO_2 per year if they are operational by 2015. This funding will come from the American Recovery and Reinvestment Act of 2009. In June 2010, DOE announced it had selected the Air Products and Chemicals, Inc. (Air Products) project discussed here as one of three projects to be funded for construction. Air Products' proposed project has components located in Texas in Jefferson and Brazoria Counties (Figure 1). The formal name of the Air Products' proposed project is the *Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production*.

DOE has determined that an environmental assessment (EA) constitutes the appropriate level of review for the National Environmental Policy Act and Section 106 of the National Historic Preservation Act of 1966. As part of the EA process for Air Products' proposed project, I am providing this project description and our preliminary findings to you so that your Tribe may relate any potential concerns to the DOE regarding traditional and cultural sites that may be related to this proposed project. For your convenience, please find enclosed a response form. Any information you provide will assist the DOE in the preparation of the EA and all correspondence with your office will be included in an appendix to the EA report.

The proposed project will involve Air Products capturing CO_2 gas and transporting it using new and existing pipelines to a depleted oil field in east Texas. The CO_2 will be used for enhanced oil recovery (EOR) operations in this depleted field. The project includes the following three components:

1) CO_2 capture, concentration, and purification at the two Air Products' Port Arthur, Texas hydrogen plants (PA1 and PA2), which are located within the Valero Port Arthur Refinery;
2) Transport of the concentrated and purified CO_2 within Jefferson County, Texas through a new 12.8-mile-long, 8-inch-diameter pipeline lateral, which will transport the CO_2 from Air Products' plants at the Valero Refinery to the existing Denbury Resources LLC (Denbury)

3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507
fred.pozzuto@netl.doe.gov • Voice (304) 285-5219 • Fax (304) 285-4403 • www.netl.doe.gov

Green Pipeline in Jefferson County and from there to the West Hastings Field in Brazoria County, Texas for use in EOR operations; and

3) Implementation of a comprehensive monitoring, verification, and accounting (MVA) program, conducted by Denbury at the West Hastings Field in Brazoria County, Texas to monitor injection and sequestration of CO_2.

These components are described in additional detail below:

1) CO_2 capture, Valero Refinery, Jefferson County

Air Products' two Port Arthur, Texas plants (PA1 and PA2) are located within the fence line of the existing Valero Refinery, which is located at the southwest edge of the city of Port Arthur. The CO_2 capture component of the project will use vacuum swing adsorption technology to capture CO_2 from the syngas generated by the steam methane reformer at each of the PA1 and PA2 locations shown in Figure 2. After compression and final drying, the CO_2 will exit the refinery limits and enter the new 12.8-mile-long CO_2 pipeline that is described below.

The specific components that lie within the Valero Refinery are shown in Figure 2. They include the southern terminus of the 12.8-mile-long CO_2 pipeline, approximately 630 feet in length in this area and underground except at its tie-in; roughly 1,643 feet of aboveground pipe that will extend from the CO_2 tie-in to PA2; a 2.5-acre expansion of the footprint of PA2; approximately 2,942 feet of aboveground CO_2 pipeline that will connect PA1 to PA2; and a 2.1-acre expansion of the PA1 footprint. There will also be two laydown yards and workspaces, one northwest of PA2 that is approximately 1.8 acre in area and one directly southwest of PA1 that is 1.6 acre in area. Roughly 2,262 feet of an existing 5-inch-diameter liquid butane line will also be relocated during the course of the planned activities. All of the above listed project activities are situated within lands that have been extremely disturbed by ongoing refinery operations, including land fill and leveling, and road, building, and equipment construction.

Air Products has contracted with URS Group, Inc. (URS) to provide environmental and cultural resources services in support of the project's permitting needs. A review was conducted by URS on March 11, 2011 of data on file at the Texas Historical Commission (THC) via the online Texas Archeological Sites Atlas, along with the online records of the National Register of Historic Places. This research was undertaken to identify any known cultural resources within one mile of the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within one mile of the proposed pipeline centerline. The closest is Site 41JF81, which is located approximately 1.1 mile southeast of the Valero Refinery on the banks of Taylor Bayou.

URS found a very low likelihood for unrecorded historic properties (including archaeological sites) being situated within the Area of Potential Effect for the Valero Refinery project activities. This opinion was based on the level of existing ground disturbance within this operating facility, which includes extensive grading as well as construction of roads, buildings, and equipment. URS recommended that no further archaeological or architectural studies are warranted for these project activities as currently defined. DOE concurs with this finding.

2) 12.8-mile-long CO_2 pipeline lateral, Jefferson County

DOE and URS consulted with the THC on the appropriate level of survey effort and methods for Air Products' proposed new pipeline lateral from the Valero Refinery to the existing Denbury Green Pipeline. In February 2011, URS conducted a Phase I cultural resource survey and inventory of the proposed 12.8-mile-long, 8-inch-diameter CO_2 pipeline (Figure 3). Approximately 0.7 miles of the route crosses through state lands administered by the Texas Department of Criminal Justice. As required by state law, these state lands were evaluated under Texas Antiquities Permit #5884, issued by the THC on February 23, 2011. The purpose of the field investigation was to identify any cultural resources, such as historic and prehistoric archeological sites, historic standing structures and cemeteries that might be located within the boundaries of the proposed undertaking.

According to the Texas Archeological Site Atlas, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, historic buildings or historic structures were previously identified within one mile of the proposed pipeline centerline. The closest is Site 41JF81, which is located on the banks of Taylor Bayou, about 1.4 miles southeast of the pipeline's initiation point at the Valero Refinery. The northern terminus of the line is located just over one mile from the outer boundary defined for the Spindletop historic oil field district and National Historic Landmark.

Two state historic markers and a single contemporary cemetery were identified within one mile of the proposed survey corridor. The first marker is Atlas No. 5245012672, erected in 1966 to commemorate the historic impacts of the early oil pipelines to the state and nation. The other marker is Atlas No. 5245013118, erected in 2003 to commemorate the historic effects of the Spindletop oil field and early pipelines to Port Arthur. Neither of these features is located within 750 feet of the proposed survey corridor. The single known cemetery within the vicinity of the proposed undertaking is Live Oak Memorial (JF-C025), which is located on the opposite bank of Rhodair Bayou at Viterbo, west of the county's regional airport. It also will not be impacted by the project. Based on a review of the online National Park Service database, no historic properties listed on the National Register of Historic Places properties lie within one mile of the proposed survey corridor.

The general expected width of the right-of-way to be used by Air Products during pipeline construction is approximately 60 feet. However, a 200-foot-wide corridor was surveyed for the Phase I investigation to allow for potential changes in the pipeline design. The project also examined proposed access roads and workspaces outside of the 200-foot survey corridor. The field methods used by URS included visual inspections of ground exposures along with shovel tests, where buried archaeological sites were considered possible. No historic buildings or archaeological concerns were encountered during the field investigation. Based on these findings, URS recommended that no further cultural resource studies be required within the lands surveyed for the pipeline. DOE concurs with that finding.

3) West Hastings Field, MVA Program, Brazoria County

The Hastings Field is located roughly 18 miles south of Houston on the border of Brazoria and Galveston Counties (Figure 4). The first successful oil wells in the Hastings Field were drilled in the 1930s and it was a substantial producer of oil until the last few decades. The Hastings Field is now considered a depleted field that can only produce oil with pumps and other artificial means. The CO_2 captured by Air Products' proposed project will be used by Denbury within the West Hastings Field to recover oil through EOR. As this is a DOE

funded CO_2 capture and storage project, the project will involve an MVA program at the West Hastings Field. The MVA program will be carried out by Denbury or their representatives with some oversight by Air Products since the MVA program is a component of Air Products' proposed project.

Denbury plans to implement CO_2 injection into the West Hastings Field in a series of four phases. Phases 1 and 2, including pre-fieldwork preparatory activities, are planned to occur in the north end of the field in 2010–2012, in the central section during 2013-2014, and in the southern end during 2015-2016. A preliminary design has been made and estimates of the CO_2 storage capacity for the reservoir have been determined. Based on this schedule, the CO_2 supplied from the Air Products Port Arthur project will be primarily used in the central and southern portions of the field.

There are currently 72 active wells, 113 inactive but accessible wells, 9 temporarily abandoned wells, and 110 plugged and abandoned wells in the central and south portions of the West Hastings Field. Prior to beginning CO_2 injection, Denbury will review well data and every active, inactive, and plugged and abandoned well will have its mechanical status defined. Existing wells that are unable to accommodate the pressure increase from the CO_2 injection will be remediated by Denbury prior to initiating CO_2 injection.

A final plan for implementing CO_2 injection in the central and south portions of the West Hastings Field is currently being developed. Consequently, the precise locations and precise spacing and completion intervals of the proposed injection wells are not yet known. Denbury's preliminary development plan proposes to use/convert existing wells into CO_2 injection or oil producing wells where possible. If new wells are required, existing drill pads will be used if possible. Based on existing available information, it is estimated that eight new well sites may be needed and six existing wells will be converted and utilized for injection. The preliminary plan includes a series of inverted "9- spot" patterns, each comprised of a central injection well surrounded by nine oil production wells. The final number of required new wells and existing wells to be adapted and re-used for injection may change somewhat during the final stages of the injection/production well system design. Initial plans are for Denbury to develop seven such 9-spot patterns in 2013 and seven more in 2014, resulting in a total of 14 CO_2 injection wells and 61 associated producing/observation wells. At this time, all of the MVA project activities are expected to be limited to the West Hastings Field.

A review of the online Texas Archeological Sites Atlas and National Register of Historic Places was performed by URS on March 11, 2011. This research was undertaken to identify previously completed surveys and cultural resources in proximity to the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within three miles of this portion of the Hastings Field.

URS found a very low likelihood for unrecorded historic properties (including archaeological sites) being situated within the Area of Potential Effect for the West Hastings Field project activities. This opinion was based on the project plans of re-using six existing well sites for the proposed monitoring program and that the eight new wells will be located within the defined limits of ongoing Hastings Field operations. URS recommended that no further archaeological or architectural studies are warranted for these project activities as currently defined. DOE concurs with this finding.

If you have any questions or would like a copy of the draft EA sent to you, please telephone me at (304) 285-5219 or e-mail me at fred.pozzuto@netl.doe.gov. Thank you for your consideration on this matter.

Sincerely,

Fred E. Pozzuto
Environmental Manager/ NEPA Compliance Officer

Enclosures:

1. Questionnaire
2. Figure 1
3. Figure 2
4. Figure 3
5. Figure 4

Cc: Air Products - Mr. Kent Kisenbauer
URS - Mr. Pete Conwell

Questionnaire for Proposed Air Products CO_2 Project in Jefferson and Brazoria Counties, Texas.

Kickapoo Traditional Tribe of Texas
HCR 1 Box 9700
Eagle Pass, Texas 78852

We have reviewed the following proposed project: Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381) and have:

______ No comments

______ The following comments (attach sheets if preferred):

____

____

____

____

____

____

____

____

____

____

____

____

____

____
Signature

______________________________ ______________________________
Printed Name Date

Please return to: Mr. Fred Pozzuto, 3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507

Figure 1: General Overview of Air Products Project Activities

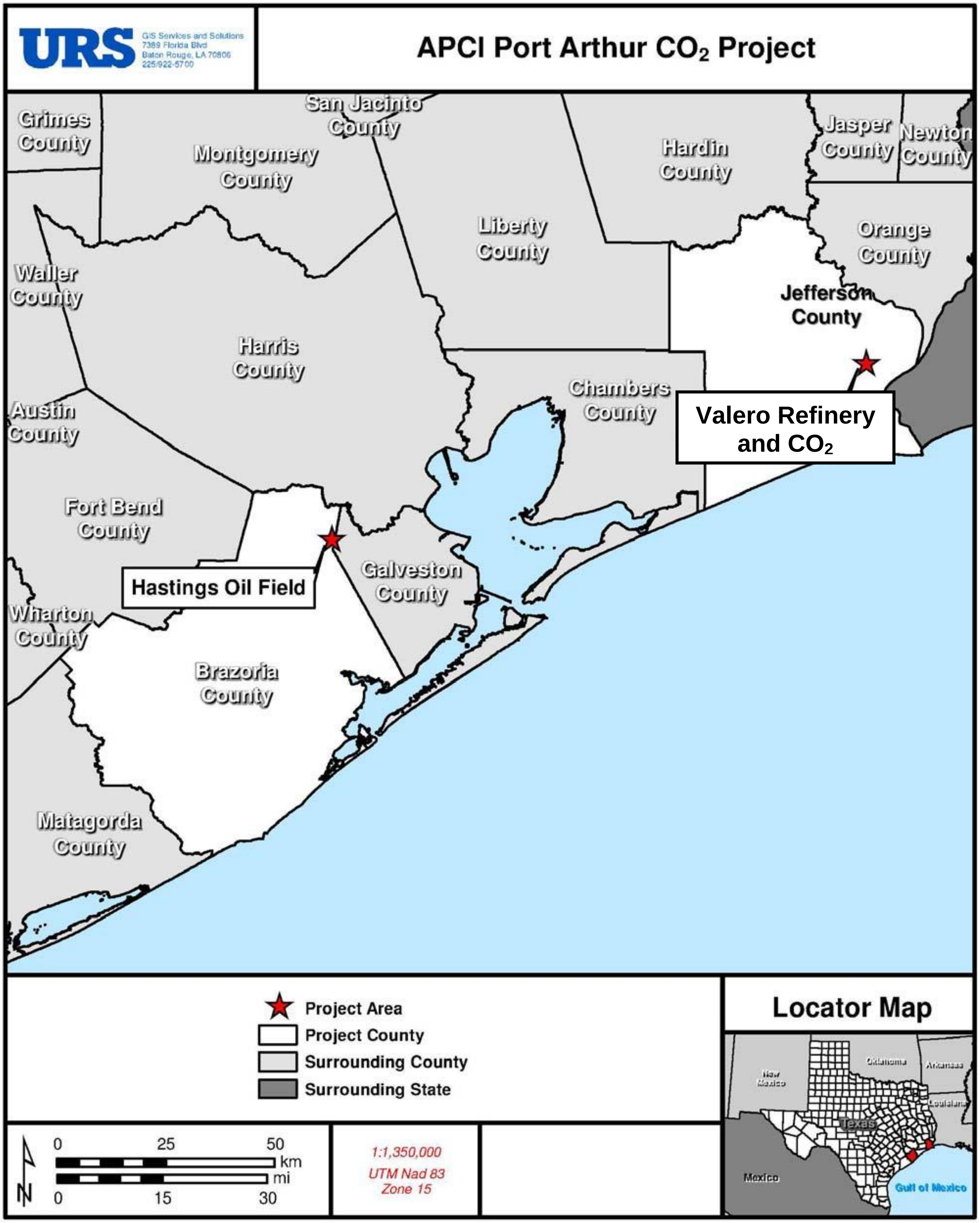


Figure 2: Proposed Air Products Project Activities within Valero Refinery, Jefferson County

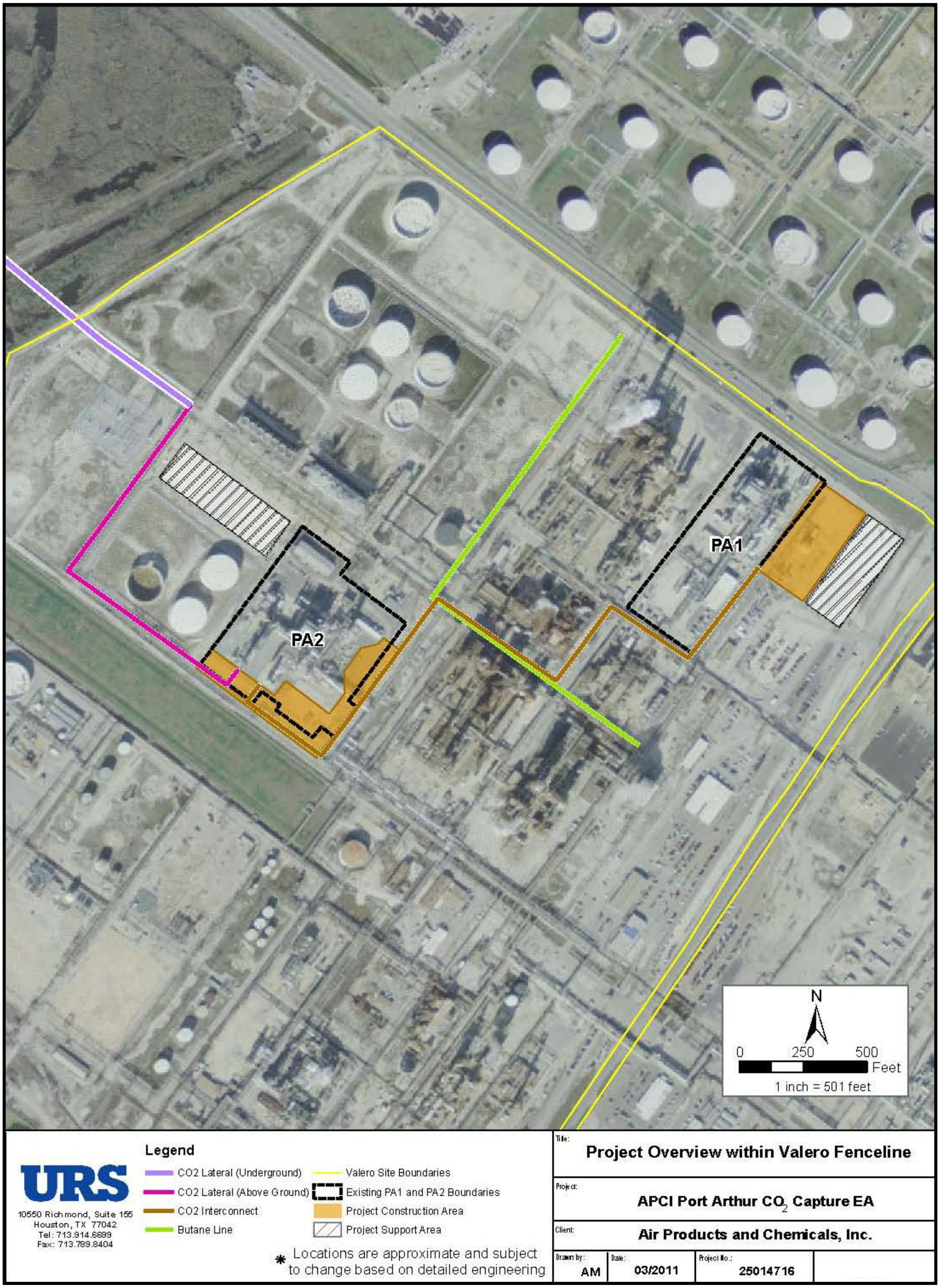


Figure 3: Overview of Air Products CO_2 Pipeline

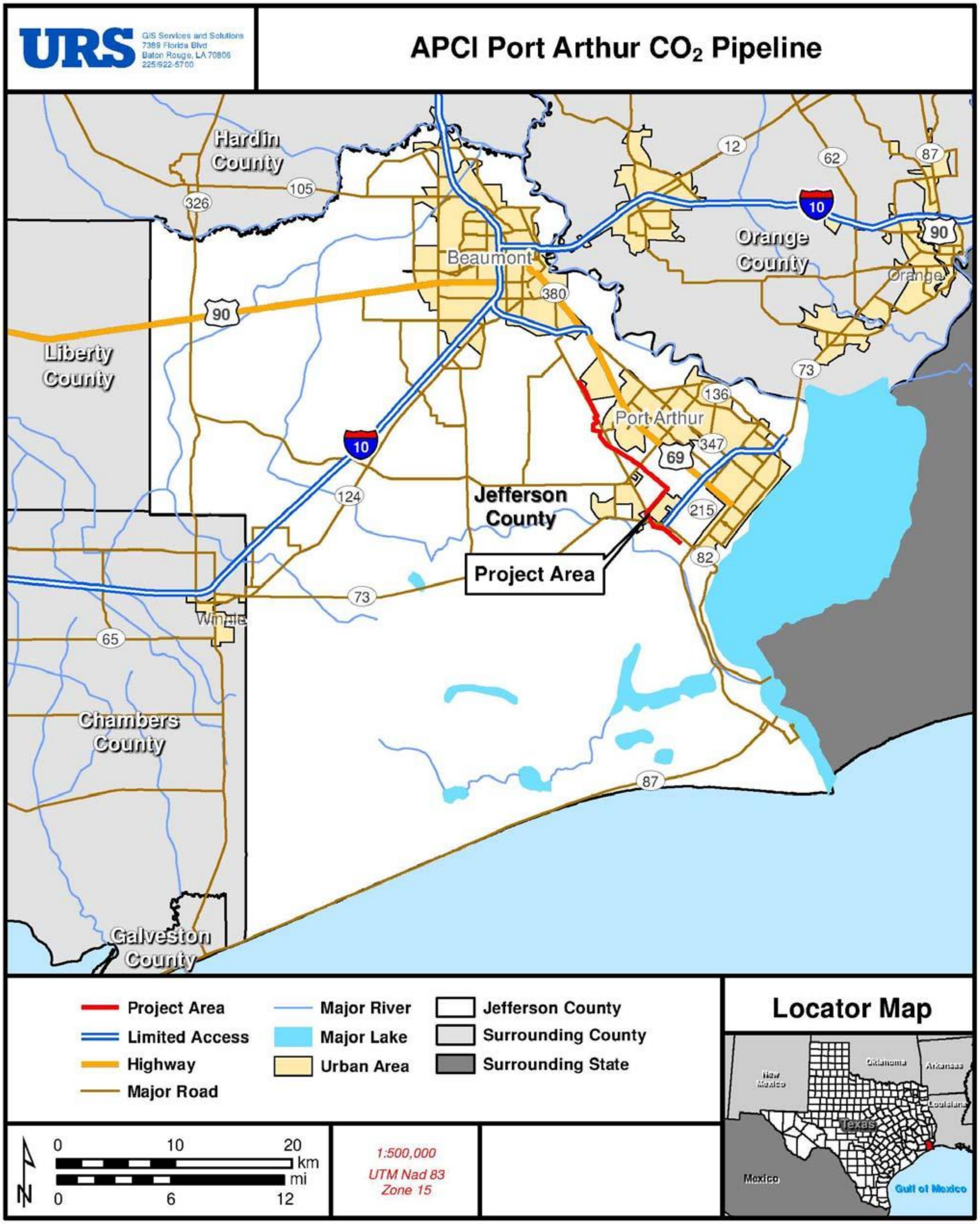
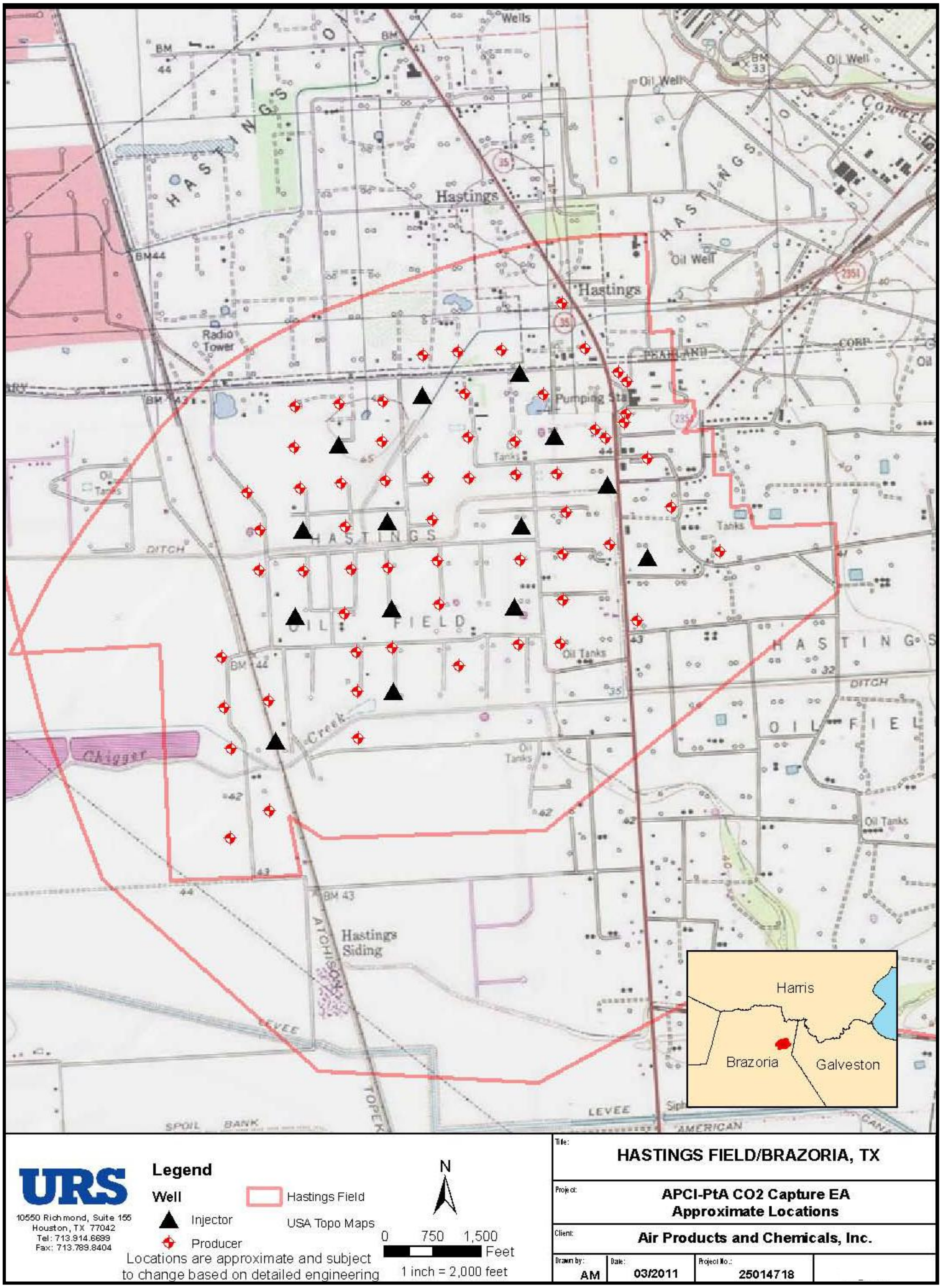


Figure 4: Overview of West Hastings Field, Brazoria County



TRADITIONAL COUNCIL

CHAIRMAN
Juan Garza, Jr., Kisisika

SECRETARY
Jesus Anico, Chakodata

TREASURER
Rogelio Elizondo, Apichicuea

MEMBERS
David J. Gonzalez, Kikekideah
Nanate Hernandez, Nanatea

KICKAPOO

TRADITIONAL TRIBE OF TEXAS

HCR 1 Box 9700
Eagle Pass, Texas 78852

Traditional Council

May 10, 2011

Fred E. Pozzuto
Environmental Manager/NEPA
Compliance Officer
3610 Collins Ferry Road
PO Box 880
Morgantown, WV 26507

Re: Request for Project Review and Comment Proposed Air Products and Chemicals, Inc. Project in Jefferson and Brazoria Counties Recovery Act: Demonstration of CO2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)

Dear Sir:

We received your letter dated on April 27, 2011, regarding the Request for Project Review and Comment Proposed Air Products and Chemicals, Inc. Project in Jefferson and Brazoria Counties Recovery Act: Demonstration of CO2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381).

Thank you for advising us about the proposed action. The Kickapoo Nation values its traditions and customs so we appreciate your taking the time to ask for our input in this matter. By keeping the lines of communication open we can peacefully co-exist yet attend to our respective businesses.

We do not have any objection or opposition to your project as we are unaware of any tribal sites in this area, therefore it does not affect our interests in any way. The Kickapoo Traditional Tribe of Texas wishes you success in your endeavor.

Should you have any further comments please do not hesitate to contact us.

Juan Garza, Jr., Chairman

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA

U.S. DEPARTMENT OF ENERGY

April 27, 2011

Mr. Kevin Sickey, Chairman
Coushatta Tribe of Louisiana
1940 C C Bel Road
Elton, Louisiana 70532

RE: Request for Project Review and Comment Proposed Air Products and Chemicals, Inc. Project in Jefferson and Brazoria Counties Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381)

Dear Mr. Sickey:

The U.S. Department of Energy (DOE) National Energy Technology Laboratory has made funding available for large-scale carbon dioxide (CO_2) projects that capture more than one million tons of CO_2 per year if they are operational by 2015. This funding will come from the American Recovery and Reinvestment Act of 2009. In June 2010, DOE announced it had selected the Air Products and Chemicals, Inc. (Air Products) project discussed here as one of three projects to be funded for construction. Air Products' proposed project has components located in Texas in Jefferson and Brazoria Counties (Figure 1). The formal name of the Air Products' proposed project is the *Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production*.

DOE has determined that an environmental assessment (EA) constitutes the appropriate level of review for the National Environmental Policy Act and Section 106 of the National Historic Preservation Act of 1966. As part of the EA process for Air Products' proposed project, I am providing this project description and our preliminary findings to you so that your Tribe may relate any potential concerns to the DOE regarding traditional and cultural sites that may be related to this proposed project. For your convenience, please find enclosed a response form. Any information you provide will assist the DOE in the preparation of the EA and all correspondence with your office will be included in an appendix to the EA report.

The proposed project will involve Air Products capturing CO_2 gas and transporting it using new and existing pipelines to a depleted oil field in east Texas. The CO_2 will be used for enhanced oil recovery (EOR) operations in this depleted field. The project includes the following three components:

1) CO_2 capture, concentration, and purification at the two Air Products' Port Arthur, Texas hydrogen plants (PA1 and PA2), which are located within the Valero Port Arthur Refinery;
2) Transport of the concentrated and purified CO_2 within Jefferson County, Texas through a new 12.8-mile-long, 8-inch-diameter pipeline lateral, which will transport the CO_2 from Air Products' plants at the Valero Refinery to the existing Denbury Resources LLC (Denbury)

Green Pipeline in Jefferson County and from there to the West Hastings Field in Brazoria County, Texas for use in EOR operations; and

3) Implementation of a comprehensive monitoring, verification, and accounting (MVA) program, conducted by Denbury at the West Hastings Field in Brazoria County, Texas to monitor injection and sequestration of CO_2.

These components are described in additional detail below:

1) <u>CO_2 capture, Valero Refinery, Jefferson County</u>
Air Products' two Port Arthur, Texas plants (PA1 and PA2) are located within the fence line of the existing Valero Refinery, which is located at the southwest edge of the city of Port Arthur. The CO_2 capture component of the project will use vacuum swing adsorption technology to capture CO_2 from the syngas generated by the steam methane reformer at each of the PA1 and PA2 locations shown in Figure 2. After compression and final drying, the CO_2 will exit the refinery limits and enter the new 12.8-mile-long CO_2 pipeline that is described below.

The specific components that lie within the Valero Refinery are shown in Figure 2. They include the southern terminus of the 12.8-mile-long CO_2 pipeline, approximately 630 feet in length in this area and underground except at its tie-in; roughly 1,643 feet of aboveground pipe that will extend from the CO_2 tie-in to PA2; a 2.5-acre expansion of the footprint of PA2; approximately 2,942 feet of aboveground CO_2 pipeline that will connect PA1 to PA2; and a 2.1-acre expansion of the PA1 footprint. There will also be two laydown yards and workspaces, one northwest of PA2 that is approximately 1.8 acre in area and one directly southwest of PA1 that is 1.6 acre in area. Roughly 2,262 feet of an existing 5-inch-diameter liquid butane line will also be relocated during the course of the planned activities. All of the above listed project activities are situated within lands that have been extremely disturbed by ongoing refinery operations, including land fill and leveling, and road, building, and equipment construction.

Air Products has contracted with URS Group, Inc. (URS) to provide environmental and cultural resources services in support of the project's permitting needs. A review was conducted by URS on March 11, 2011 of data on file at the Texas Historical Commission (THC) via the online Texas Archeological Sites Atlas, along with the online records of the National Register of Historic Places. This research was undertaken to identify any known cultural resources within one mile of the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within one mile of the proposed pipeline centerline. The closest is Site 41JF81, which is located approximately 1.1 mile southeast of the Valero Refinery on the banks of Taylor Bayou.

URS found a very low likelihood for unrecorded historic properties (including archaeological sites) being situated within the Area of Potential Effect for the Valero Refinery project activities. This opinion was based on the level of existing ground disturbance within this operating facility, which includes extensive grading as well as construction of roads, buildings, and equipment. URS recommended that no further archaeological or architectural studies are warranted for these project activities as currently defined. DOE concurs with this finding.

2) 12.8-mile-long CO_2 pipeline lateral, Jefferson County

DOE and URS consulted with the THC on the appropriate level of survey effort and methods for Air Products' proposed new pipeline lateral from the Valero Refinery to the existing Denbury Green Pipeline. In February 2011, URS conducted a Phase I cultural resource survey and inventory of the proposed 12.8-mile-long, 8-inch-diameter CO_2 pipeline (Figure 3). Approximately 0.7 miles of the route crosses through state lands administered by the Texas Department of Criminal Justice. As required by state law, these state lands were evaluated under Texas Antiquities Permit #5884, issued by the THC on February 23, 2011. The purpose of the field investigation was to identify any cultural resources, such as historic and prehistoric archeological sites, historic standing structures and cemeteries that might be located within the boundaries of the proposed undertaking.

According to the Texas Archeological Site Atlas, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, historic buildings or historic structures were previously identified within one mile of the proposed pipeline centerline. The closest is Site 41JF81, which is located on the banks of Taylor Bayou, about 1.4 miles southeast of the pipeline's initiation point at the Valero Refinery. The northern terminus of the line is located just over one mile from the outer boundary defined for the Spindletop historic oil field district and National Historic Landmark.

Two state historic markers and a single contemporary cemetery were identified within one mile of the proposed survey corridor. The first marker is Atlas No. 5245012672, erected in 1966 to commemorate the historic impacts of the early oil pipelines to the state and nation. The other marker is Atlas No. 5245013118, erected in 2003 to commemorate the historic effects of the Spindletop oil field and early pipelines to Port Arthur. Neither of these features is located within 750 feet of the proposed survey corridor. The single known cemetery within the vicinity of the proposed undertaking is Live Oak Memorial (JF-C025), which is located on the opposite bank of Rhodair Bayou at Viterbo, west of the county's regional airport. It also will not be impacted by the project. Based on a review of the online National Park Service database, no historic properties listed on the National Register of Historic Places properties lie within one mile of the proposed survey corridor.

The general expected width of the right-of-way to be used by Air Products during pipeline construction is approximately 60 feet. However, a 200-foot-wide corridor was surveyed for the Phase I investigation to allow for potential changes in the pipeline design. The project also examined proposed access roads and workspaces outside of the 200-foot survey corridor. The field methods used by URS included visual inspections of ground exposures along with shovel tests, where buried archaeological sites were considered possible. No historic buildings or archaeological concerns were encountered during the field investigation. Based on these findings, URS recommended that no further cultural resource studies be required within the lands surveyed for the pipeline. DOE concurs with that finding.

3) West Hastings Field, MVA Program, Brazoria County

The Hastings Field is located roughly 18 miles south of Houston on the border of Brazoria and Galveston Counties (Figure 4). The first successful oil wells in the Hastings Field were drilled in the 1930s and it was a substantial producer of oil until the last few decades. The Hastings Field is now considered a depleted field that can only produce oil with pumps and other artificial means. The CO_2 captured by Air Products' proposed project will be used by Denbury within the West Hastings Field to recover oil through EOR. As this is a DOE

funded CO_2 capture and storage project, the project will involve an MVA program at the West Hastings Field. The MVA program will be carried out by Denbury or their representatives with some oversight by Air Products since the MVA program is a component of Air Products' proposed project.

Denbury plans to implement CO_2 injection into the West Hastings Field in a series of four phases. Phases 1 and 2, including pre-fieldwork preparatory activities, are planned to occur in the north end of the field in 2010–2012, in the central section during 2013-2014, and in the southern end during 2015-2016. A preliminary design has been made and estimates of the CO_2 storage capacity for the reservoir have been determined. Based on this schedule, the CO_2 supplied from the Air Products Port Arthur project will be primarily used in the central and southern portions of the field.

There are currently 72 active wells, 113 inactive but accessible wells, 9 temporarily abandoned wells, and 110 plugged and abandoned wells in the central and south portions of the West Hastings Field. Prior to beginning CO_2 injection, Denbury will review well data and every active, inactive, and plugged and abandoned well will have its mechanical status defined. Existing wells that are unable to accommodate the pressure increase from the CO_2 injection will be remediated by Denbury prior to initiating CO_2 injection.

A final plan for implementing CO_2 injection in the central and south portions of the West Hastings Field is currently being developed. Consequently, the precise locations and precise spacing and completion intervals of the proposed injection wells are not yet known. Denbury's preliminary development plan proposes to use/convert existing wells into CO_2 injection or oil producing wells where possible. If new wells are required, existing drill pads will be used if possible. Based on existing available information, it is estimated that eight new well sites may be needed and six existing wells will be converted and utilized for injection. The preliminary plan includes a series of inverted "9- spot" patterns, each comprised of a central injection well surrounded by nine oil production wells. The final number of required new wells and existing wells to be adapted and re-used for injection may change somewhat during the final stages of the injection/production well system design. Initial plans are for Denbury to develop seven such 9-spot patterns in 2013 and seven more in 2014, resulting in a total of 14 CO_2 injection wells and 61 associated producing/observation wells. At this time, all of the MVA project activities are expected to be limited to the West Hastings Field.

A review of the online Texas Archeological Sites Atlas and National Register of Historic Places was performed by URS on March 11, 2011. This research was undertaken to identify previously completed surveys and cultural resources in proximity to the proposed project activities. According to these sources, no archaeological sites, State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures have been identified within three miles of this portion of the Hastings Field.

URS found a very low likelihood for unrecorded historic properties (including archaeological sites) being situated within the Area of Potential Effect for the West Hastings Field project activities. This opinion was based on the project plans of re-using six existing well sites for the proposed monitoring program and that the eight new wells will be located within the defined limits of ongoing Hastings Field operations. URS recommended that no further archaeological or architectural studies are warranted for these project activities as currently defined. DOE concurs with this finding.

If you have any questions or would like a copy of the draft EA sent to you, please telephone me at (304) 285-5219 or e-mail me at fred.pozzuto@netl.doe.gov. Thank you for your consideration on this matter.

Sincerely,

Fred E. Pozzuto
Environmental Manager/ NEPA Compliance Officer

Enclosures:

1. Questionnaire
2. Figure 1
3. Figure 2
4. Figure 3
5. Figure 4

Cc: Air Products - Mr. Kent Kisenbauer
URS - Mr. Pete Conwell

Questionnaire for Proposed Air Products CO_2 Project in Jefferson and Brazoria Counties, Texas.

Coushatta Tribe of Louisiana
1940 C C Bel Road
Elton, Louisiana 70532

We have reviewed the following proposed project: Recovery Act: Demonstration of CO_2 Capture and Sequestration for Steam Methane Reforming Process Gas for Large-Scale Production (DOE Cooperative Agreement DE-FE0002381) and have:

______ No comments

______ The following comments (attach sheets if preferred):

____

____

____

____

____

____

____

____

____

____

____

____

____

____
Signature

______________________________________ ______________________________________
Printed Name Date

Please return to: Mr. Fred Pozzuto, 3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507

Figure 1: General Overview of Air Products Project Activities

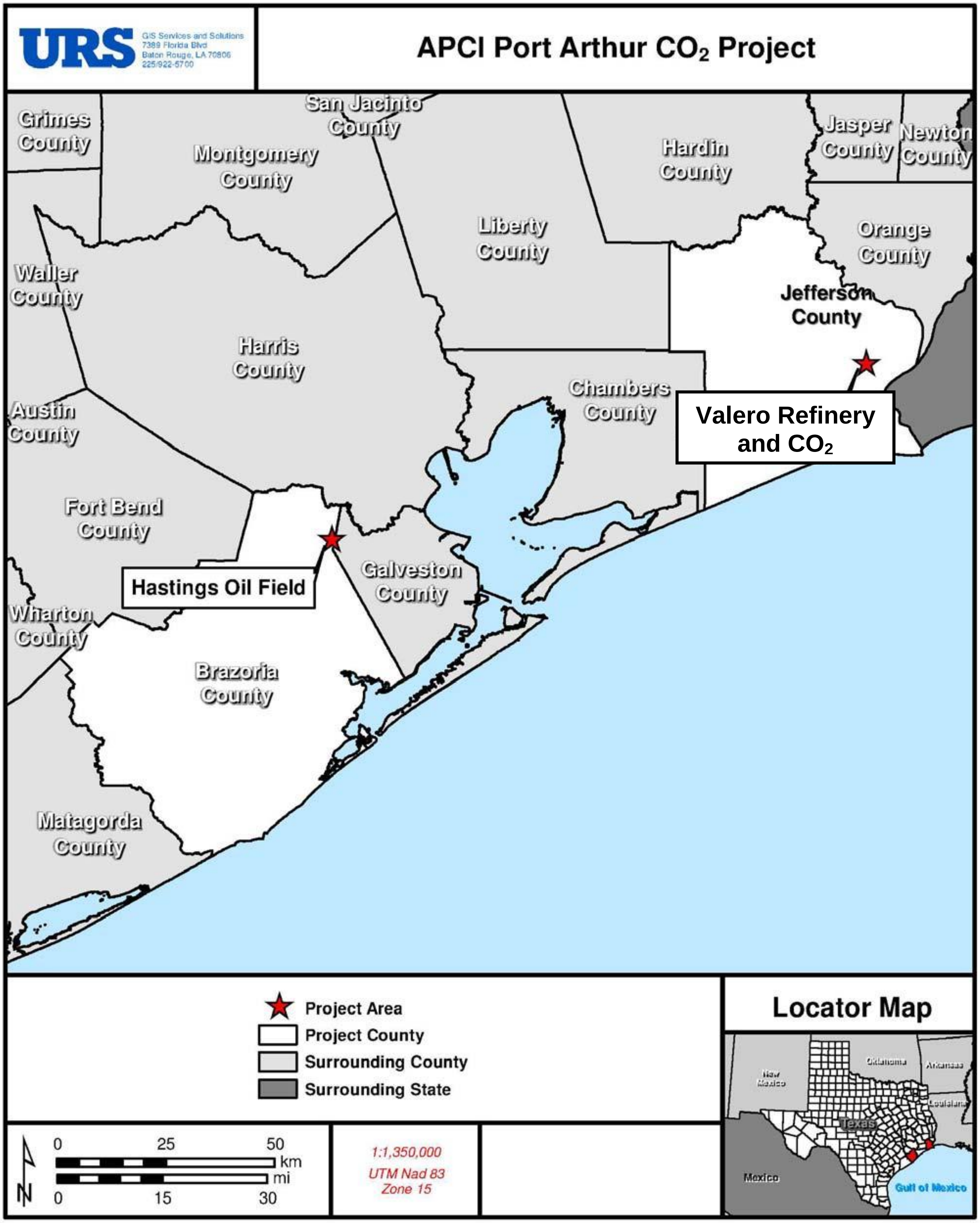


Figure 2: Proposed Air Products Project Activities within Valero Refinery, Jefferson County

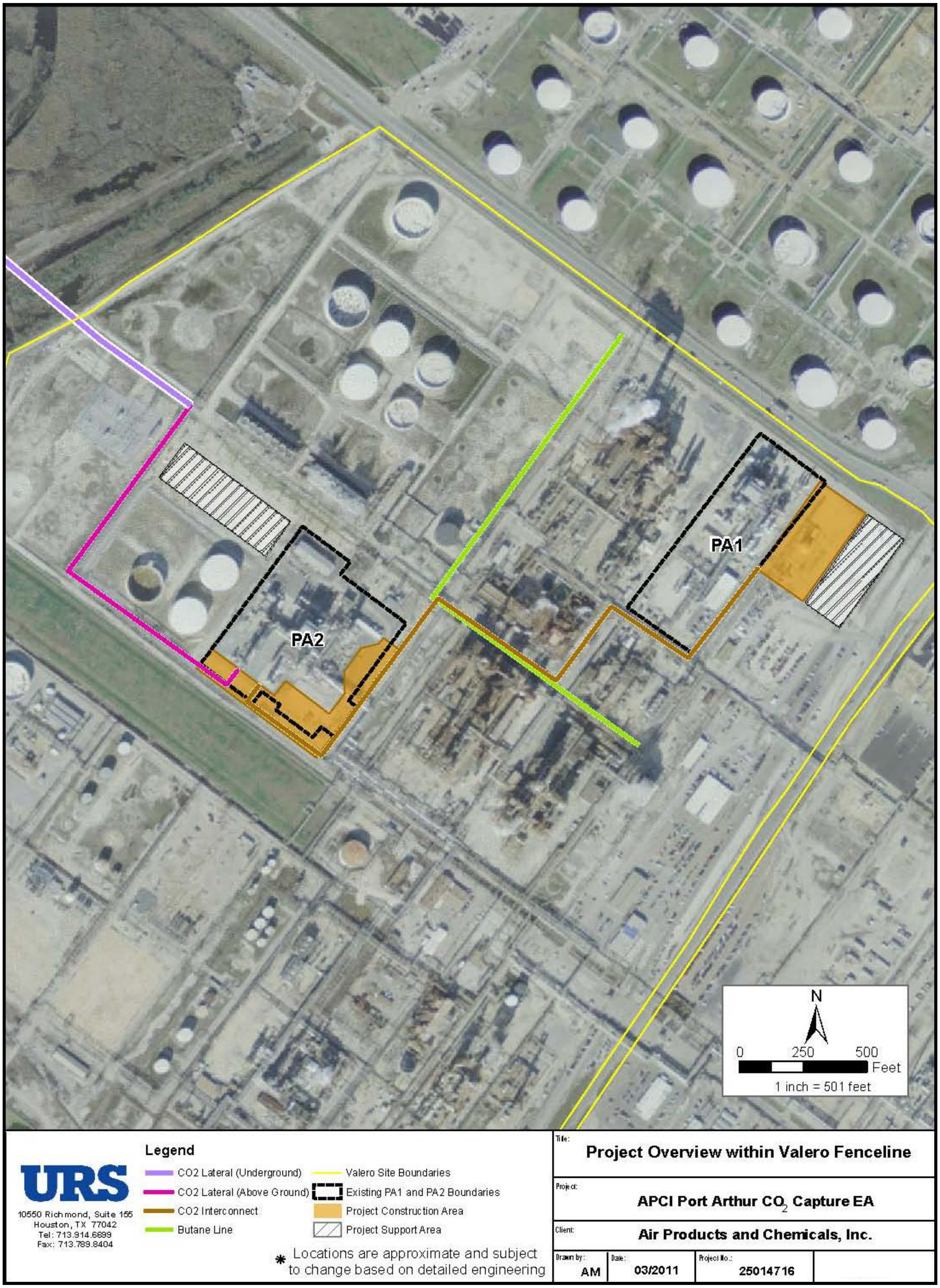


Figure 3: Overview of Air Products CO_2 Pipeline

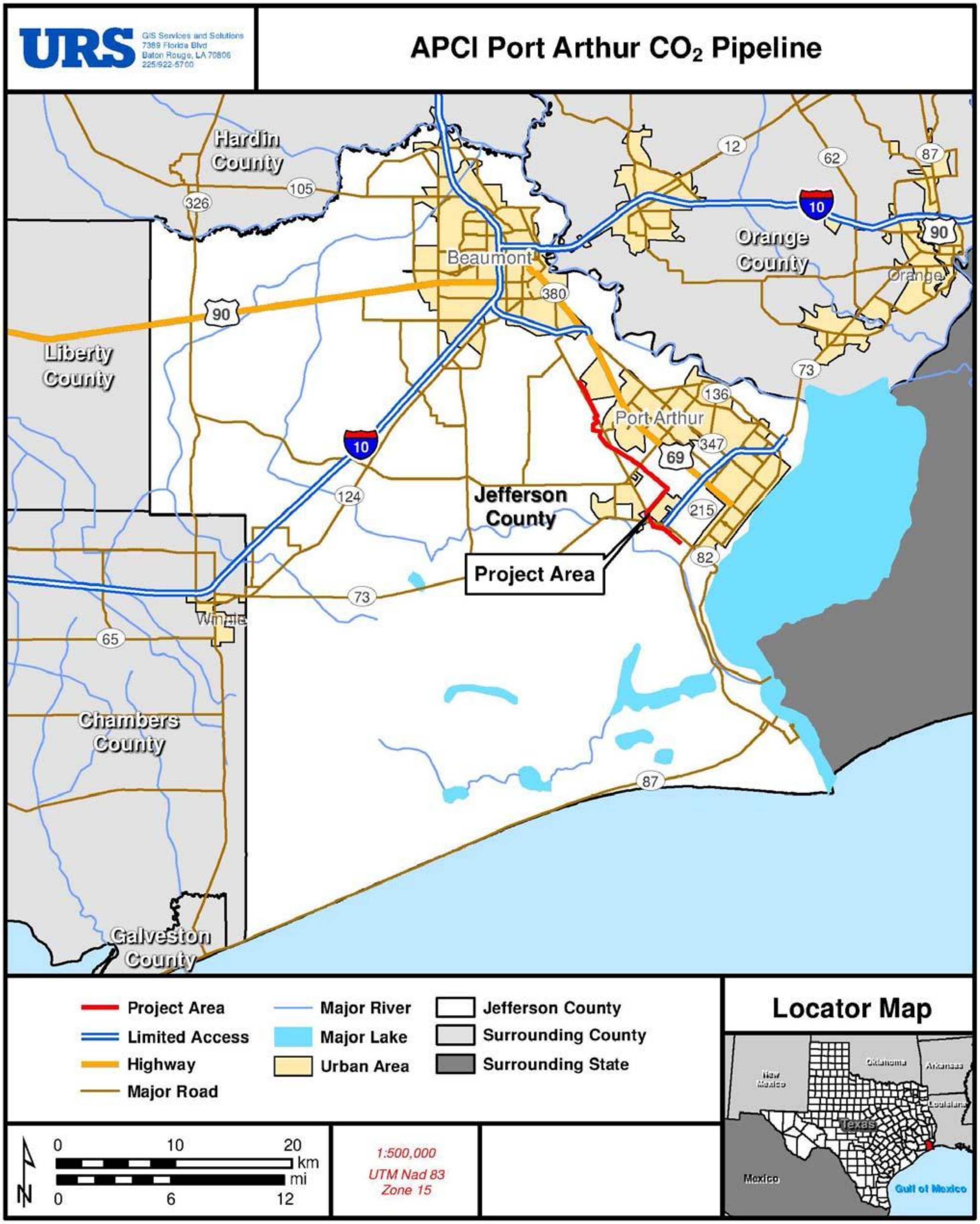
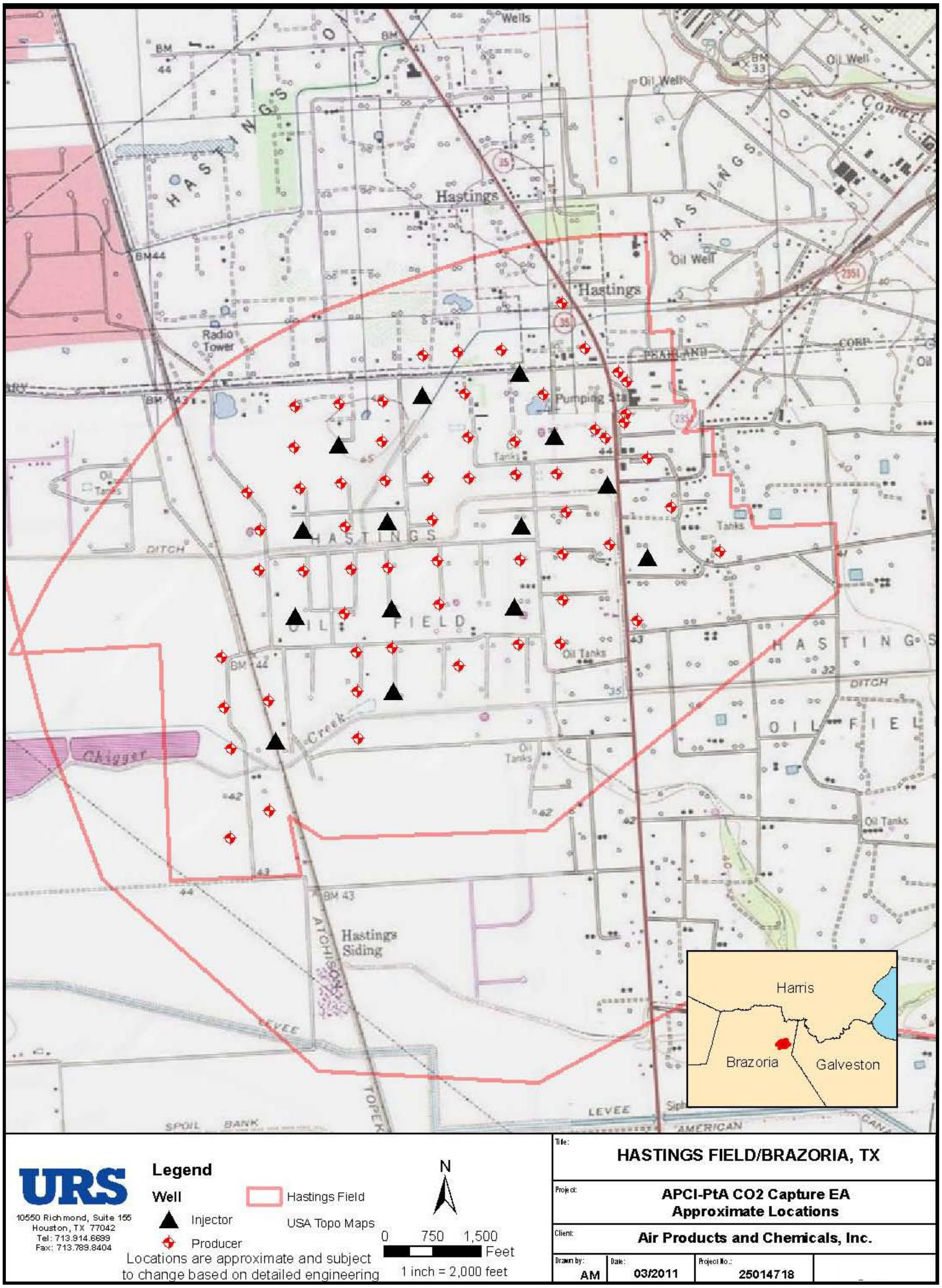


Figure 4: Overview of West Hastings Field, Brazoria County



URS

June 15, 2011

Ms. Elizabeth Shelton
North Evaluation Section - Galveston District
U.S. Army Corps of Engineers
2000 Fort Point Road
Galveston, Texas, 77550

Re: Request for Authorization
Air Products and Chemicals, Inc. Port Arthur (TX) CO_2 Pipeline
Jefferson County, Texas
SWG-2011-00252

Dear Ms. Shelton:

On behalf of our client, Air Products and Chemicals, Inc. (Air Products or APCI), URS Group, Inc. (URS) submits this letter and the attached information as pre-construction notification of Air Products' request for authorization under Nationwide Permit (NWP) 12 for construction of the Port Arthur (TX) CO_2 Pipeline Project (project). To assist you in your evaluation of this request, the following sections provide a general project description, a summary of field assessments conducted for the project, a description of the proposed construction procedures, and a summary of impacts to potentially jurisdictional areas. Attached, you will also find:

- Exhibit 1: ENG Form 4345
- Exhibit 2: Waterbody and Wetland Crossings Table
- Exhibit 3: Landowner Contact Information
- Exhibit 4: Project Route Maps
- Exhibit 5: Construction Drawings
- Exhibit 6: Proposed Jurisdictional Determination
- Exhibit 7: Biological Resources Report
- Exhibit 8: Cultural Resources Report

Project Description

As part of the U.S. Department of Energy's (DOE's) mission to advance the national, economic, and energy security of the United States, through support from the DOE's National Energy Technology Laboratory (NETL), Air Products is proposing a project that will capture and sequester carbon dioxide (CO_2) produced by existing steam methane reformers at an Air Products facility near Port Arthur, Jefferson County, Texas. Air Products' proposed project involves an integrated carbon capture, transport, injection, sequestration, and monitoring program that will capture approximately one million short tons per year of CO_2. A proposed CO_2 pipeline lateral will connect the Air Products facility near Port Arthur to an existing pipeline, known as the Green Pipeline, for delivery of the captured CO_2 to the West Hastings Field. This proposed new pipeline lateral is known as the Air Products Port Arthur (TX) CO_2 Pipeline and is the project for which this permit application is submitted. The Green Pipeline will transport the CO_2 to the West Hastings Field, in Brazoria County, Texas, for use in an enhanced oil recovery (EOR) process. Denbury Green Pipeline Texas, LLC owns and operates the pipeline portions in Texas. Denbury Onshore, LLC, which is partnering with Air Products to implement Air Products' proposed project, also owns and operates the West Hastings Field and will conduct the West Hastings Field monitoring, verification, and accounting program. The overall project is known as the *Recovery Act: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production*.

URS Group, Inc.
10550 Richmond Avenue, Suite 155
Houston, TX 77042
Tel: 713.789.9801
Fax: 713.789.8404
www.urscorp.com

The proposed project for which this permit application is submitted includes a new, approximately 12.8-mile, eight-inch diameter pipeline lateral from Air Products' Port Arthur, Texas facility to an interconnect with the Green Pipeline, which is located approximately three miles southeast of Beaumont, Texas. The proposed pipeline lateral, which parallels existing utility corridors along the majority (i.e., over 95%) of its route, will be owned and operated by Air Products. The project also includes six valves, located at approximately mileposts 1.9, 3.5, 6.0, 7.7, 10.0, and 12.8; a meter station located approximately 250 feet south of the interconnect with the Green Pipeline (approximately milepost 12.8); and an approximately 45-foot by 50-foot launcher site to be constructed within the additional temporary work space (ATWS) at the south end of pipeline lateral (i.e., milepost 0.0). The project also includes 20 horizontal directional drills (HDDs) and the potential for additional HDDs at three crossings, as indicated in Exhibit 4. Each HDD includes ATWS at the HDD launcher/receiver locations, as illustrated in the HDD schematic in Exhibit 5. Workspace at the receiver end of the drill includes area in which to string the pipe sections. Construction of the pipeline lateral would begin between March 30, 2012 and June 1, 2012 and will be completed approximately fourteen weeks after construction commences. The construction corridor would be 60 feet wide, and a permanent easement would be maintained free of woody vegetation over the pipeline lateral centerline, as discussed under Construction Procedures below. ATWS's are required for equipment setup and to provide additional space at road, highway, and waterbody crossings.

Route Evaluation

URS evaluated the route for Waters of the United States, biological resources, and cultural resources. These evaluations are described below.

***Waters of the United States* -** URS scientists surveyed the project study area from February 14 to February 26, 2011. These surveys included the identification and delineation of wetlands and other water features in accordance with the protocol outlined in the *1987 U.S. Army Corps of Engineers Wetlands Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region*. Data was collected following the Galveston District's Standard Operating Procedures (SOP) for Recording Jurisdictional Determinations Using Global Positioning Systems. The results of this evaluation are presented in the attached *Proposed Jurisdictional Determination* (Exhibit 6). A total of 43 wetlands and 60 other water features were identified within the survey area, which included a 200-foot-wide corridor centered on the pipeline lateral centerline, a 100-foot-wide corridor centered on access roads to be improved, and ATWS areas. However, project impacts will be limited to the construction easement and ATWS, which crosses 82 Waters of the United States, including 38 wetlands and 44 other water features (2 ephemeral streams, 4 perennial streams, 35 drainage ditches and canals, and 3 artificial ponds). These crossings constitute 25 single and complete projects. A Preliminary Jurisdictional Determination Data Form was completed for the project site. All wetlands and other waters in the study area are either themselves traditional navigable waters (TNWs), or adjacent or tributaries of TNWs, and would therefore likely be considered jurisdictional. URS and Air Products elect to use a Preliminary Jurisdictional Determination to indicate that there may be waters of the US, including wetlands, on the project site (Exhibit 6, Appendix C).

***Biological Resources* -** URS biologists evaluated the project study area (as defined in the above Waters of the United States section) from February 14 to February 26, 2011 for the presence of federally listed threatened and endangered species and their critical habitats. The results of this evaluation are provided in the attached *Biological Resources Report* (Exhibit 7). Federally-listed threatened and endangered species occurring in Jefferson County are: piping plover, Atlantic hawksbill sea turtle, green sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. The bald eagle has been delisted due to recovery. None of these threatened or endangered species, or habitats suitable for these species, were observed in the project area. Bald eagles use tall trees near large open bodies of water and piping plovers rely on coastal habitats. The five sea turtle species are found in oceans and shorelines. None of these required habitat types are found in the project area. No State-listed species were observed within the study area, and the habitat types observed were unlikely to support populations of State-listed species. Therefore, no project-related impacts to threatened or endangered species are anticipated.

Cultural Resources - URS conducted a cultural resources inventory for the proposed new CO_2 pipeline lateral in February 2011. The results of the cultural resources evaluation are provided in the attached *Cultural Resources Survey Report* (Exhibit 8). In summary, impacts to cultural resources are not expected. There are no historic properties as defined by the National Historic Preservation Act identified on the Texas Archeological Site Atlas or the National Register of Historic Places within 1.0 mile of the proposed pipeline lateral. Based on the conclusions of this cultural resources study, DOE determined that no historic properties would be affected by the Air Products project. DOE conducted consultation with the Texas Historical Commission (the State Historic Preservation Office [SHPO]), the Alabama-Coushatta Tribe, the Kickapoo Traditional Tribe of Texas, and the Coushatta Tribe of Louisiana. Consultation is ongoing; however, the SHPO and the Native American Tribes contacted have not stated any concerns with the project to date.

Construction Procedures

Wetlands and small ditches will be crossed using conventional open cut methods or HDD and all canals and streams will be crossed using HDDs. The attached table (Exhibit 2) lists the crossing methods proposed for each wetland and other water feature delineated within the construction corridor. Typical drawings for the construction procedures to be utilized on the proposed project are attached.

- ***Conventional Open Cut*** - Installation of approximately 68% (45,969 feet) of the proposed CO_2 pipeline lateral will be accomplished using conventional open cut construction methods. This includes crossings of 40 wetlands and other waters, for a length of 25,125 feet. During conventional open cut construction in wetland areas, a 60-foot-wide construction corridor will be used, and most of the construction corridor will be cleared of vegetation and graded. The pipeline trench will be excavated to a depth of approximately four feet to accommodate the diameter of the pipe and provide additional cover. Within wetland areas, topsoil and subsoil will be separated and placed in separate piles within 20 feet of the center of the trench. The other 40 feet of the construction corridor will be used for pipeline installation equipment work space. The trench will be refilled following installation of the pipeline lateral, with the topsoil replaced on the top of the trench. Pre-construction contours will be restored in wetland areas within 180 days. Mats will be placed in wetland areas where site conditions are appropriate for their use; particularly where standing water is present and soils are susceptible to rutting. At open cut waterbody crossings, the construction contractor will maintain a 10-foot-wide vegetated buffer along streams and ditches to minimize erosion. This buffer will be maintained for the duration of construction except for the portion that occurs over the trench and in the travel lane. These areas will be cleared at the time of the crossing and restored immediately following installation. Most conventional open cut stream crossings will be installed within 24 hours. Following installation, the stream banks will be restored and stabilized with vegetation and material controls.

- ***Horizontal Directional Drill*** – Installation of approximately 32% (21,843 feet) of the proposed CO_2 pipeline lateral will be accomplished using HDD methods. This includes crossings of 65 wetlands and other waters, for a length of 11,312 feet. All roads, railroads, and major waterbodies will be crossed using HDD methods. An HDD is a smaller version of the drilling rigs used for oil and gas wells that is mounted on a semi-trailer or crawler carriage. This rig drills a pilot hole according to a set profile from an entry point to an exit point. The hole is then reamed to a larger diameter that can accommodate the pipe. The pipe is pulled through the void to the other side. The primary advantage to HDD is that there is minimal disturbance of the surface between the entry and exit points. Several of the HDD crossings would require a travel corridor for movement of equipment, which would result in temporary impacts, as shown in the attached figures. Vegetation will be cleared, as necessary, to maintain an inspection corridor in areas crossed using HDD methods, as described in Exhibit 2.

In some areas, improvements to existing access roads will be required. These improvements could include placing gravel and smoothing the road surface to restore pre-project conditions. All access road improvements will be limited to the existing roadbed and no work will be done to culverts or roadside ditches. By limiting access road improvements to the existing roadbed, no impacts to any wetlands or other waters due to access road improvement are anticipated.

For three crossings, the crossing type requested in this permit is open cut. However, if determined to be appropriate and constructible, a secondary option for accomplishing these crossings would be use of HDD methods. Crossings with HDD as a secondary option are shown in the attached figures and crossing table (Exhibits 2 and 4).

Impact and Mitigation Summary

The pipeline lateral route was selected to avoid or minimize impacts to intact wetlands by paralleling existing, disturbed utility corridor rights-of-way for the majority (i.e., over 95%) of the route. A total of 9.37 acres of scrub-shrub (PSS) wetlands, 149.02 acres of palustrine emergent (PEM) wetlands, no palustrine forested (PFO) wetlands, and 15.96 acres of other water features were identified within the survey area.

Impacts to wetlands and other waters identified within the study corridor will be avoided by limiting construction activities in improved access roads to the existing roadbed and the use of HDD. As described above, no impacts to wetlands or other waters are anticipated as a result of access road improvements. HDD techniques will be used to avoid impacts to 11.49 acres of Waters of the United States.

Impacts will be minimized by limiting the construction corridor to a width of 60 feet. This corridor width will result in the minimum impacted area, while allowing for segregation of topsoil in wetland areas, and sufficient workspace to safely install the pipeline. The 60-foot corridor width also accounts for establishment of a trench for installation of the pipeline in wetland soils that are likely to be soft and could require a wider trench to maintain the stability of the sideslopes. Impacts to wetlands within the construction corridor will be minimized by the use of mats in areas that are susceptible to rutting. During construction, the project will result in a total of 45.39 acres of temporary impacts and 0.29 acres of permanent impacts within the construction corridor and ATWS. Temporary impacts would occur in PEM wetlands, which will be restored following construction. Permanent impacts would occur in PSS wetlands that would be converted to PEM wetlands, and in PEM wetlands that would be impacted by the meter station and two of the valves. Exhibit 2 lists Waters of the United States that would be permanently impacted, temporarily impacted, and avoided by the proposed project.

Stream banks will be restored and stabilized and the pre-construction contours of all wetlands temporarily affected by construction of the pipeline lateral will be restored within 180 days. Disturbed areas will then be either reseeded with a mix of seeds for grasses and forbs native to Jefferson County, as recommended by the Texas Parks and Wildlife Department; reseeded with a seed mixture requested by the landowner; or allowed to revegetate naturally from existing seed and rootstock, as appropriate. Within wetland areas, topsoil segregation will encourage regeneration from the seed bank and minimize impacts to the soil in the area where the trench was cut. To facilitate re-vegetation in wetland areas (except where safety precautions prohibit), best management practices will be utilized to minimize erosion and sedimentation during construction. Pipeline construction is not expected to have more than minor impacts on PEM wetlands because these habitats will be restored to near pre-construction conditions within the first growing season. A 15-foot-wide permanent easement will be maintained free of woody vegetation for the life of the project. In order to reduce wetland impacts, the permanent easement would be narrowed to approximately 4.5 feet in PSS wetlands in Crossing #1 and to approximately 10 feet in PSS wetlands in Crossing #4. No single and complete project would result in permanent impacts to greater than 0.1 acre of wetlands.

URS

Authorization Request

As outlined above, the project will cross a total of 82 Waters of the United States, which constitute 25 "single and complete" projects (as defined by 33 CFR 330.2(i)) for which authorization is requested under NWP 12. Exhibit 2 provides a list of these single and complete projects and the individual Waters of the United States included in each single and complete project. The attached route maps also show the Waters of the United States located within the construction right-of-way and the location of each single and complete project (Exhibit 4).

URS and Air Products appreciate your efforts to review and process this request for authorization. If I can be of any assistance during your review, please do not hesitate to contact me at 713-914-6575 or by email at aaron_boers@urscorp.com.

Sincerely,

URS Group, Inc.

Aaron Boers

Aaron Boers, PhD
Environmental Scientist

Attachments (8)

cc: Air Products (Messrs. Greg Frisby, Steve Fisher, Tom Houser, and Kent Kisenbauer)
URS (Mr. Pete Conwell)

NATIONAL ENERGY TECHNOLOGY LABORATORY
Albany, OR • Morgantown, WV • Pittsburgh, PA
U.S. DEPARTMENT OF ENERGY

June 10, 2011

Mr. Don Rao
Jefferson County Floodplain Administrator
1149 Pearl Street, 5th Floor
Beaumont, Texas 77701

Re: Request for Project Review and Comment - Proposed Air Products and Chemicals, Inc. Project in Jefferson and Brazoria Counties

Subject: Recovery Act: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production (DOE Cooperative Agreement No. DE-FE0002381)

Dear Mr. Rao:

The U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) intends to provide financial assistance for a large scale carbon dioxide (CO_2) project that would capture approximately one million tons of CO_2 per year when operational by 2015. This funding has been made available through the American Recovery and Reinvestment Act of 2009. In June 2010, DOE announced it had selected the Air Products and Chemicals, Inc. (Air Products) project, as one of three projects to be funded for construction and operation under this program. Air Products' proposed project has components located in Texas in Jefferson and Brazoria Counties (Figure 1). The formal name of the Air Products' proposed project is *Recovery Act: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production*. The project goal is to advance Carbon Capture and Sequestration technologies from the demonstration stage to commercial scale viability for beneficial use.

The proposed project will involve Air Products capturing CO_2 gas from a process gas stream used in a world-class scale hydrogen production facility and transporting the CO_2 via new and existing pipelines to an existing oil field in east Texas. The CO_2 will be used for enhanced oil recovery (EOR) operations in this oil field. The project includes the following three components:

1) CO_2 capture, concentration, and purification at the two Air Products Port Arthur, Texas hydrogen plants (PA1 and PA2), which are located within the Valero Port Arthur Refinery;

2) Transport of the concentrated and purified CO_2 within Jefferson County, Texas through a new 12.8 mile long, 8 inch diameter pipeline lateral, which will transport the CO_2 from Air Products' plants at the Valero Refinery to the existing Denbury Onshore, LLC

(Denbury) Green Pipeline in Jefferson County and from there to the West Hastings Field in Brazoria County, Texas for use in EOR operations; and

3) Implementation of a comprehensive monitoring, verification, and accounting (MVA) program, conducted by Denbury at the West Hastings Field in Brazoria County, Texas to monitor injection and sequestration of CO_2.

This consultation letter is submitted to you in regards to work that would be done within the Federal Emergency Management Agency (FEMA) 100-year floodplain as part of the second project component described above, the 12.8 mile CO_2 pipeline lateral shown in Figure 2. Construction of the pipeline lateral is not expected to result in any permanent impacts to the floodplain because there will be no net change in the volume of fill within the floodplain following construction.

As part of the pipeline lateral installation project, some improvements to existing access roads will be required. Three of the access roads that are proposed to be improved are located within the floodplain. As shown in Figure 2, these roads intersect the proposed pipeline lateral route near mileposts 6.4, 7.0, and 11.2. These access road improvements could include the placement of rock or gravel fill within the floodplain, as necessary to restore the roads to their preconstruction condition. These roads would not be widened, so impacts would be limited to the footprint of the existing road. At each of these access roads the existing ditches and drainage features would remain in their existing condition, so no changes in water flow patterns are anticipated. The improvements to these roads are not expected to encourage further development within the floodplain or to create any back water effect.

A draft environmental assessment (EA), DOE/EA-1846D, for the project described above was made available for public review and at the Port Arthur Public Library (4615 Ninth Ave., Port Arthur, TX 77642, 409-985-8838) beginning May 17, 2011. The EA is also available on DOE's NETL web site, http://www.netl.doe.gov/publications/others/nepa/ea.html, and DOE's National Environmental Policy Act web site at http://nepa.energy.gov/DOE_NEPA_documents.htm. The public comment period for this draft EA ends on June 17, 2011.

If you have any comments or questions regarding this proposed project, please telephone me at (304) 285-5219 or e-mail me at fred.pozzuto@netl.doe.gov. Thank you for your consideration in this matter.

Sincerely,

Fred E. Pozzuto
Environmental Manager / NEPA Compliance Officer

Cc: Air Products (Messrs. Greg Frisby, Steve Fisher, Tom Houser, and Kent Kisenbauer)
URS (Mr. Pete Conwell)

Figure 1: General Overview of Air Products Project Activities

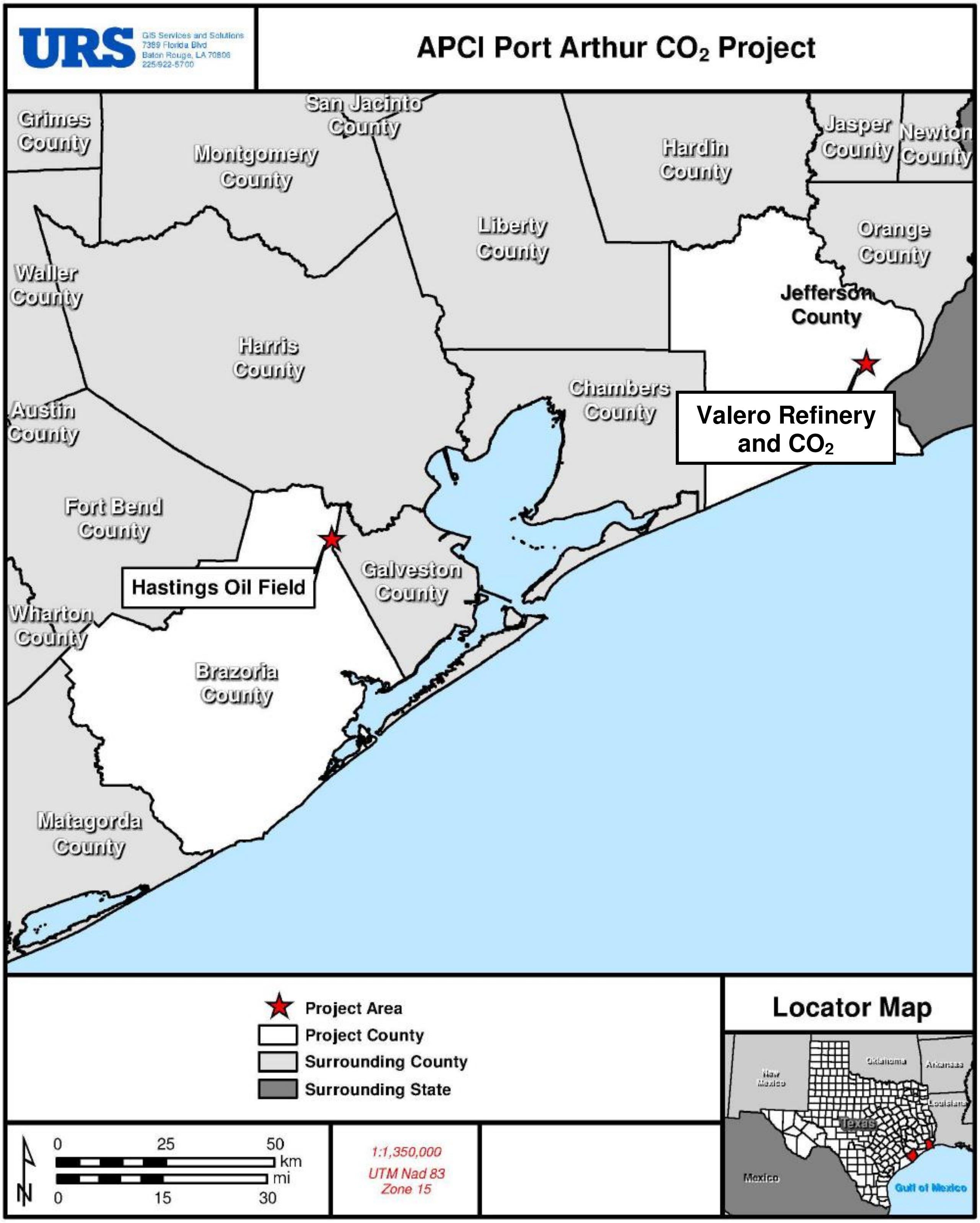


Figure 2 (1 of 2): Air Products CO_2 Pipeline Lateral and Access Roads

K:\ENV\ENV10\25014716\GIS\MXD\15APR11_Flood.mxd

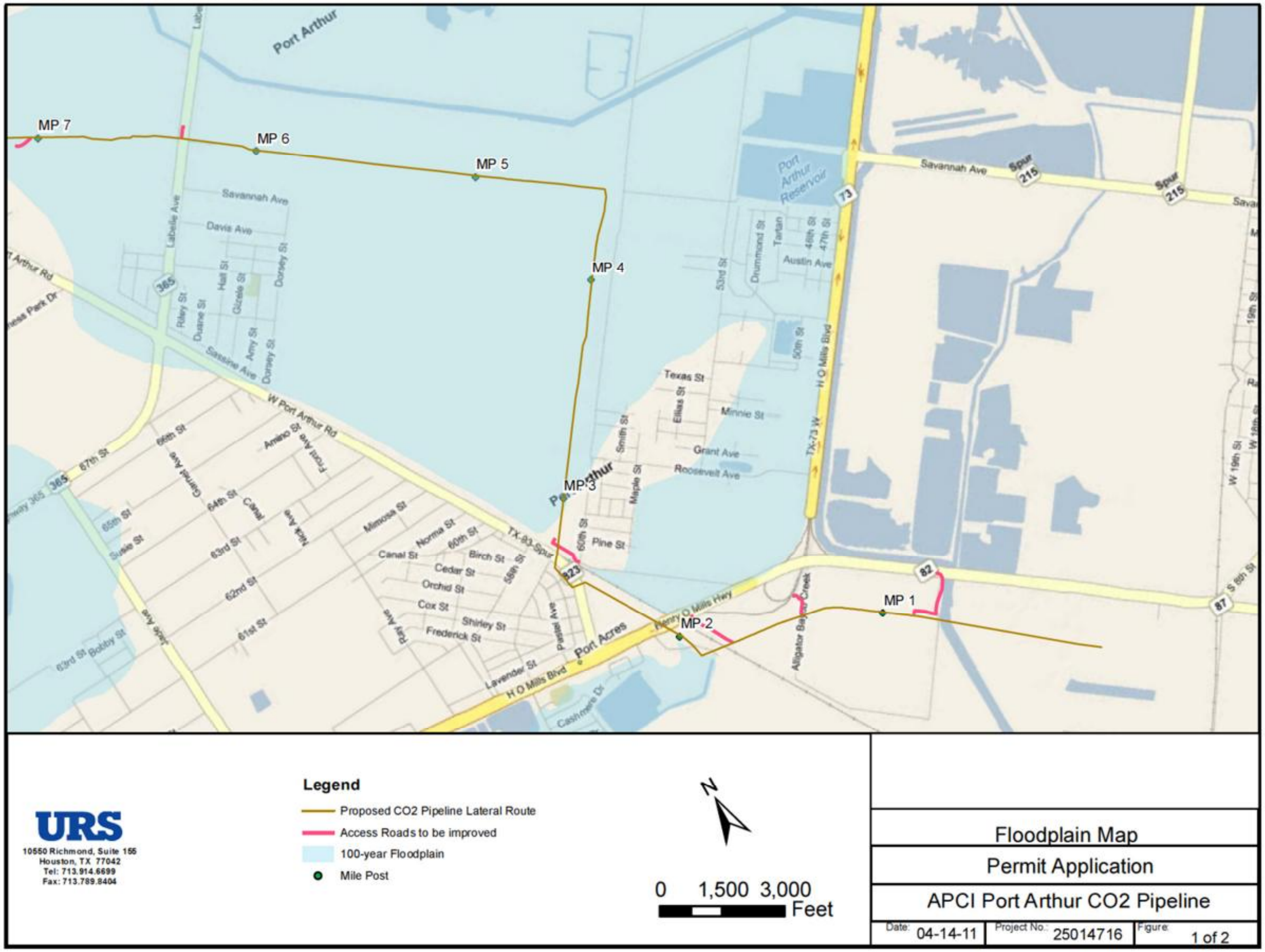
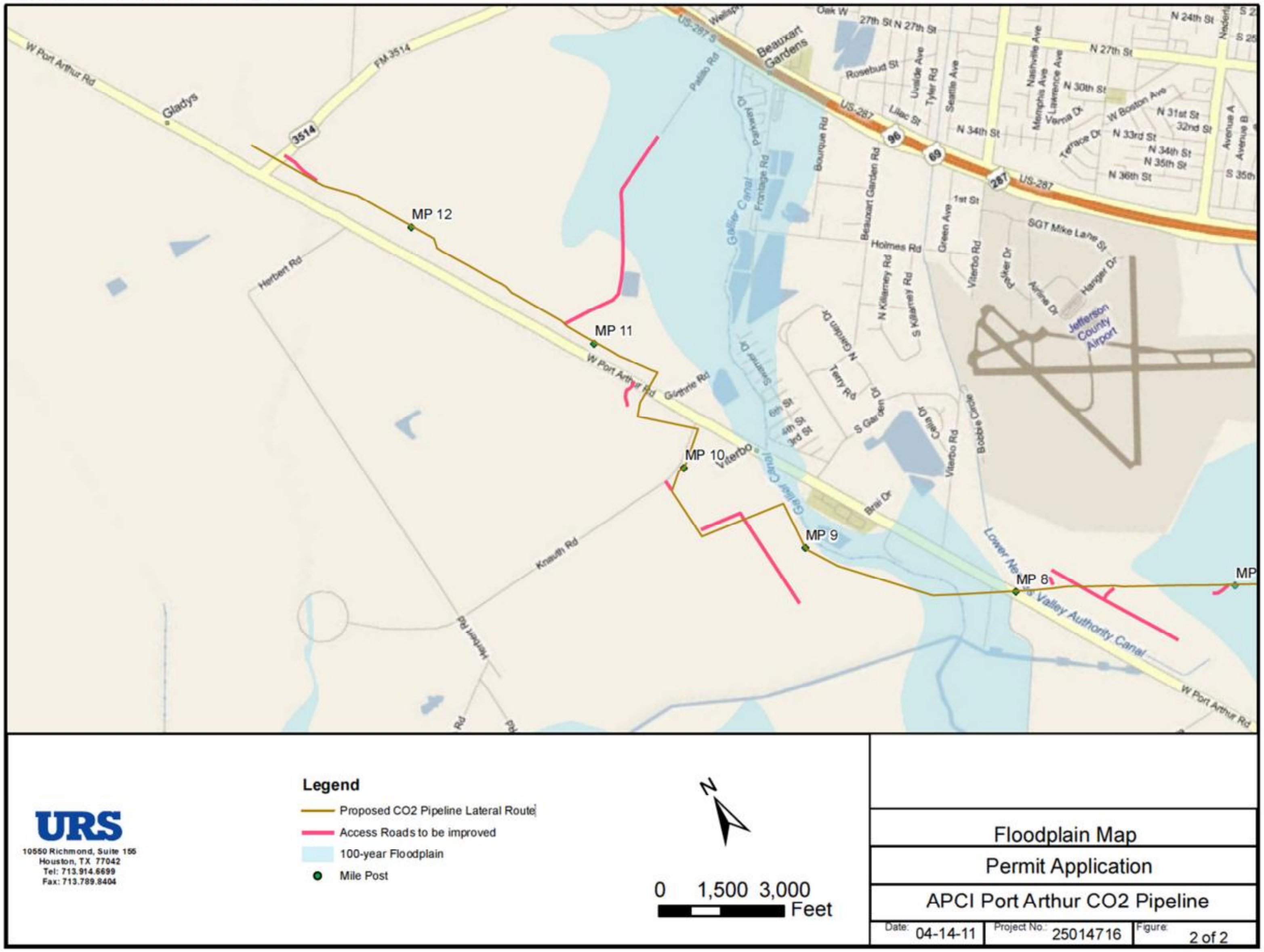


Figure 2 (2 of 2): Air Products CO_2 Pipeline Lateral and Access Roads

K:\ENV\ENV10\25014716\GIS\MXD\15APR11_Flood.mxd



APPENDIX C

BIOLOGICAL RESOURCES SUPPLEMENTAL INFORMATION

BIOLOGICAL RESOURCES REPORT
RECOVERY ACT: DEMONSTRATION OF CO2 CAPTURE AND SEQUESTRATION OF STEAM METHANE REFORMING PROCESS GAS USED FOR LARGE SCALE HYDROGEN PRODUCTION

AIR PRODUCTS AND CHEMICALS, INC. PORT ARTHUR CO2 PIPELINE

Prepared For:

Air Products and Chemicals, Inc.
7201 Hamilton Blvd.
Allentown, Pennsylvania 18195

Prepared by:

URS Group, Inc.
10550 Richmond Avenue, Suite 155
Houston, Texas 77042

Rev. 1, June 2011

URS Project No. 25014717

Table of Contents

Figures

Tables

Attachments

1.0 INTRODUCTION

As part of the U.S. Department of Energy's (DOE) mission to advance the national, economic, and energy security of the United States, through support from the DOE's National Energy Technology Laboratory (NETL), Air Products and Chemicals, Inc. (Air Products or APCI) is proposing to develop a project that will capture and sequester anthropogenic carbon dioxide (CO_2) that is a by-product produced by existing steam methane reformers at an existing Air Products facility in Port Arthur, Texas. Starting in November 2012, Air Products expects to transport the captured CO_2 to an oil field in eastern Texas by pipeline where it will be used in an enhanced oil recovery (EOR) operation and sequestered. This project is known as the *Recovery Act: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large Scale Hydrogen Production* (Air Products' proposed project). Federal funding may be committed by NETL for Air Products' proposed project and the federal action (i.e., DOE's proposed action) is to provide approximately $284 million of American Recovery and Reinvestment Act (ARRA) of 2009 funds to implement Air Products' proposed project in Jefferson County and Brazoria County, Texas.

Air Products' proposed project involves an integrated carbon capture, transport, injection, sequestration, and monitoring program that will capture approximately one million tons per year (tpy) of CO_2 from Air Products' two Port Arthur, Texas hydrogen plants (PA1 and PA2).

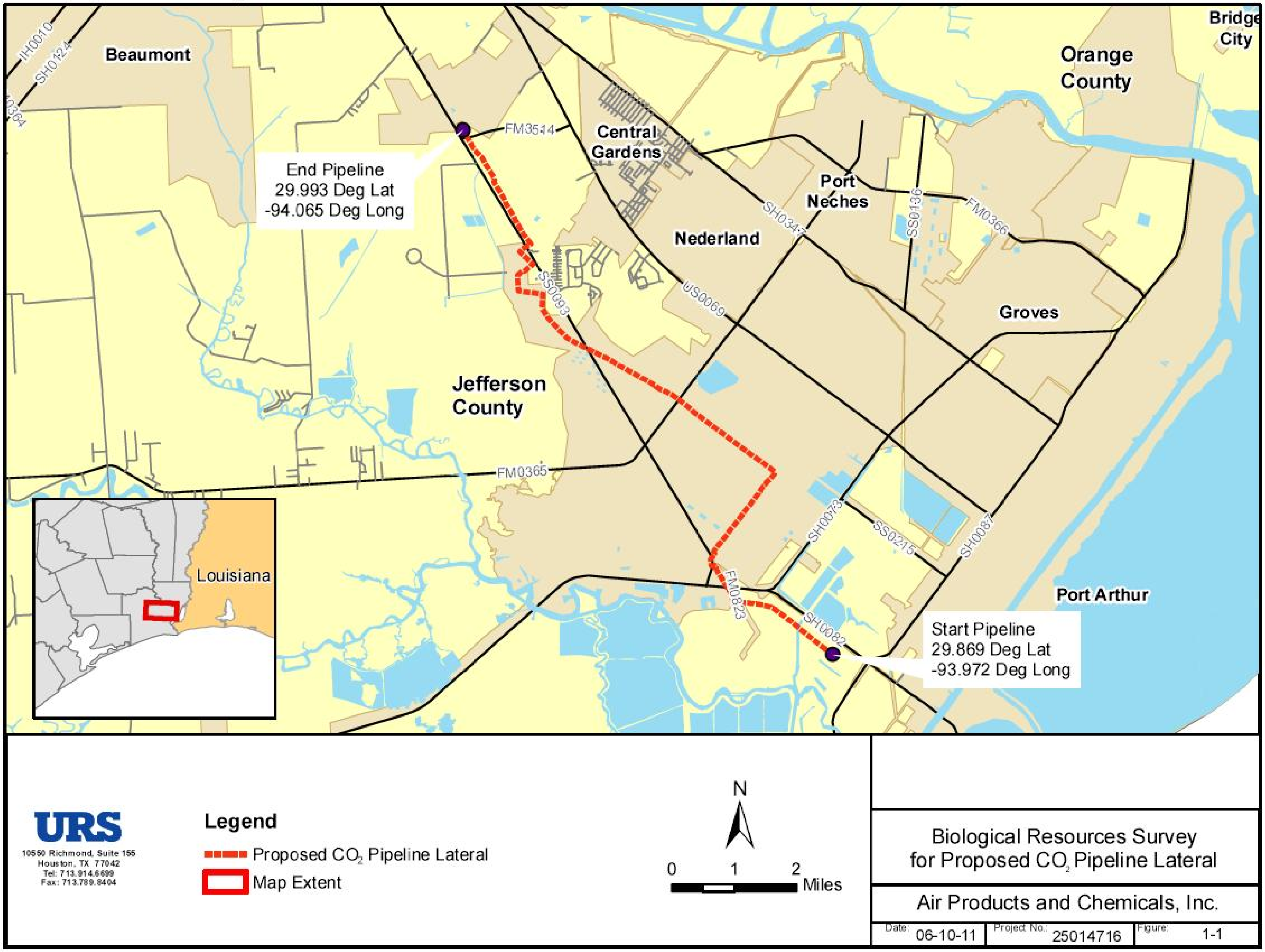
The primary components of this Air Products project include the following:

1. CO_2 capture, concentration, and purification at Air Products plants PA1 and PA2;

2. Transport of CO_2 within Jefferson County, Texas through the construction of a new approximately 12.8-mile-long, eight-inch-diameter pipeline lateral that will interconnect with an existing CO_2 pipeline system for injection into an oil field, the West Hastings Field, in Brazoria County, Texas, for use in the EOR operation;

3. Implementation of a comprehensive monitoring, verification, and accounting (MVA) program to monitor CO_2 injection and sequestration at the West Hastings Field.

The proposed pipeline lateral, which parallels existing utility corridors along the majority of its route, will be owned and operated by Air Products. A map showing the proposed 12.8-mile pipeline lateral's route is provided in **Figure 1-1**. The CO_2 pipeline lateral will connect to a trunk pipeline, known as the Green Pipeline, which is owned and operated by Denbury Resources LLC (Denbury). Denbury, which is partnering with Air Products to implement Air Products' proposed project, also owns and operates the Hastings Field and will conduct the West Hastings Field MVA program.


Beaumont
Bridge City
Orange County
Central Gardens
Port Neches
Nederland
Groves
Jefferson County
Port Arthur
Louisiana
End Pipeline
29.993 Deg Lat
-94.065 Deg Long
Start Pipeline
29.869 Deg Lat
-93.972 Deg Long
FM3514
FM0365
FM0366
FM0823
SS0093
US0069
SH0347
SS0136
SH0073
SS0215
SH0087
SH0082
IH0010
SH0124
URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404
Legend
Proposed CO_2 Pipeline Lateral
Map Extent
N
0 1 2 Miles
Biological Resources Survey
for Proposed CO_2 Pipeline Lateral
Air Products and Chemicals, Inc.
Date: 06-10-11
Project No.: 25014716
Figure: 1-1

URS Group, Inc. (URS) has prepared this *Biological Resources Report* on behalf of Air Products to assess the potential impact on biological resources of the proposed 12.8-mile pipeline lateral.

1.1 STUDY AREA

The proposed pipeline route extends approximately 12.8 miles through Jefferson County, Texas from the PA1 and PA2 plants, which are located within the Valero Port Arthur Refinery to the south of the city of Port Arthur, to the Green Pipeline interconnect, which is located northwest of the city of Port Arthur (**Figure 1-1**). The biological study area included a 200-foot-wide corridor centered on the pipeline centerline, additional temporary workspaces (ATWS), and a 100-foot-wide corridor centered on the centerline of access roads that would be improved. The study area encompassed approximately 364.1 acres.

1.2 PURPOSE OF DOCUMENT

The purpose of this *Biological Resources Report* is to describe the findings of biological surveys conducted in the study area between February 14, 2011 and February 26, 2011, and to evaluate potential impacts to threatened and endangered species that might result from this project.

1.3 ENVIRONMENTAL SETTING

The study area is within Jefferson County, Texas, in the Sabine Lake Watershed (hydrologic unit code: 12040201). The following environmental setting information for this county was taken from the Online Handbook of Texas (http:// http://www.tshaonline.org/handbook).

1.3.1 Jefferson County

Jefferson County, on Interstate Highway 10 in the Coastal Plain or Gulf Prairie region of extreme southeastern Texas, is bounded by Orange County on the northeast, by Hardin County on the north, by Liberty and Chambers counties on the west, and by the Gulf of Mexico on the south. To the east, the county line is formed by the Neches River, Sabine Lake, and Sabine Pass, and to the north by Pine Island Bayou. A series of lakes extends across the southern part of the county, and beaches overlook the Gulf. The county comprises 937 square miles, mainly of grassy plains, though a dense forest belt crosses the northwest part. The southern third of the county consists of marshy saltgrass terrain good for cattle raising, the middle third is coastal prairie used for grazing and rice culture, and the northern third is heavily forested with hardwoods and southern yellow pine. The terrain is low and flat, with altitudes rising from sea level to about fifty feet. Beach sands and ocean sediments make up soils along the coast. The northern border is surfaced by light-colored, loamy soils over deep, reddish clayey or loamy subsoils with hardened calcium deposits, and the remainder of the county has light to dark loamy surfaces over clayey subsoils or gray to black, clayey soils. Geologically, the county is noted for its Beaumont Clay formation and the Spindletop and Big Hill salt domes, which contain sulfur and petroleum. The mean annual temperature is 69° F, and the average annual rainfall is 53 inches. The subtropical, humid climate features warm, moist summers tempered by Gulf breezes. The growing season averages 225 days a year. Vegetation includes pine, white oak, red oak, pin oak, ash, beech, magnolia, gum, cypress, bunchgrasses, marsh millet, seashore saltgrass and cordgrasses. Between 1 and 10 percent of the land is considered prime farmland. Among the principal streams are Taylor's, Hillebrandt, and Pine Island Bayous. Lake B. A. Steinhagen and Sam Rayburn Reservoir provide water for municipal use and industry, and the bayous are used for irrigation by rice growers. Natural resources in the county include ceramic clays, industrial sand, oil and gas, sulfur, and pine and hardwood. The county seat, Beaumont, is located on the Neches River at the county's approximate midpoint (at 30°05' N, 94°06' W). Incorporated towns include Beaumont, Bevil Oaks, China, Groves, Nederland, Nome, Port Arthur, and Port Neches. Beaumont, Port Arthur, and neighboring Orange, cities of the "Golden Triangle," have been the principal cities of the Sabine area and major manufacturing centers.

1.3.2 Ecoregions

The Project is located within the Western Gulf Coastal Plain EPA Level III ecoregion. Level IV ecoregions crossed from north to south are: Northern Humid Gulf Coastal Prairies and Texas-Louisiana Coastal Marshes.

The following descriptions of the EPA Level III and Level IV ecoregions crossed by the proposed pipeline route come from EPA (2011).

Level III Ecoregion:

Western Gulf Coastal Plain

The principal distinguishing characteristics of the Western Gulf Coastal Plain are its relatively flat coastal plain topography and mainly grassland potential natural vegetation. Inland from this region the plains are older, more irregular, and have mostly forest or savanna-type vegetation potentials. Largely because of these characteristics, a higher percentage of the land is in cropland than in bordering ecological regions. Urban and industrial land uses have expanded greatly in recent decades, and oil and gas production is common.

Level IV Ecoregions:

Northern Humid Gulf Coastal Prairies

Quaternary-age deltaic sands, silts, and clays underlie much of the Northern Humid Gulf Coastal Prairies on this gently sloping coastal plain. The original vegetation was mostly grasslands with a few clusters of oaks, known as oak mottes or maritime woodlands. Little bluestem, yellow Indiangrass, brownseed paspalum, gulf muhly, and switchgrass were the dominant grassland species, with some similarities to the grasslands of Ecoregion 32. Almost all of the coastal prairies have been converted to cropland, rangeland, pasture, or urban land uses. The exotic Chinese tallow tree and Chinese privet have invaded large areas in this region. Some loblolly pine occurs in the northern part of the region in the transition to Ecoregion 35. Soils are mostly fine-textured: clay, clay loam, or sandy clay loam. Within the region, there are some differences from the higher Lissie Formation to the lower Beaumont Formation, both of Pleistocene age. The Lissie Formation has lighter colored soils, mostly Alfisols with sandy clay loam surface texture, while darker, clayey soils associated with Vertisols are more typical of the Beaumont Formation. Annual precipitation varies from 37 inches in the southwest portion to 58 inches in the northeast, with a summer maximum.

Texas-Louisiana Coastal Marshes

The Texas-Louisiana Coastal Marshes region is distinguished from Ecoregions 34h and 34i by its extensive freshwater and saltwater coastal marshes, lack of barrier islands and fewer bays, and its wetter, more humid climate. Annual precipitation is 48 to 54 inches in Texas and up to 60 inches in Louisiana. There are many rivers, lakes, bayous, tidal channels, and canals. The streams and rivers that supply nutrients and sediments to this region are primarily from the humid pine belt of Ecoregion 35. Extensive cordgrass marshes occur. The estuarine and marsh complex supports marine life, supplies wintering grounds for ducks and geese, and provides habitat for small mammals and American alligators. Brown shrimp, the most commercially important marine species in Texas, is common along the whole coast, but in this northern coastal zone white shrimp are also commercially important. Eastern oysters and blue crabs are also common and commercially important in the region. Sport fishery species such as red drum, black drum, southern flounder, and spotted seatrout occur throughout the coastal bays of this region and Ecoregion 34h.

2.0 METHODS

URS field biologists conducted field surveys and general habitat assessments between February 14, 2011 and February 26, 2011. Field surveys were conducted within the extent of the project area, as described above and in **Figure 1-1**. Surveys were conducted by foot, between 8:00 am and 5:00 pm. Potentially suitable habitats for threatened or endangered species were determined by the presence of diagnostic habitat elements. Plant species that could not be identified in the field were collected for closer inspection and positive identification. Wildlife species were either observed directly, or detected from calls, tracks, scat, or other signs.

3.0 RESULTS

The following section discusses the existing plant communities and the potential for threatened or endangered species to occur within the project area, shown in **Figure 1-1**.

3.1 PLANT COMMUNITIES OBSERVED

The proposed project occurs within the Gulf Coast Natural Region of Texas. Biologists documented the plant communities within the study area. Variations in species composition and densities were noted, but for the purposes of this report the communities were assessed in broader categories. The vegetation communities listed below were observed in the study area.

More than 95% of the proposed route for the CO_2 pipeline lateral is located adjacent to existing pipelines. Because of recent construction and maintenance activities related to the existing pipelines, the plant communities along the proposed route are typical of recently disturbed areas and have low diversity. The study area was dominated by invasive species and other weedy species that colonize disturbed areas quickly. The quality of the plant communities was low due to this recent disturbance and development in portions of the study area.

All wetlands and Waters of the U.S. that occur within the project area will be addressed in a proposed jurisdictional determination report and submitted to the Galveston District of the U.S. Army Corps of Engineers for review and comments. A series of maps indicating the locations of wetlands and Waters of the U.S. along the proposed pipeline lateral route, as delineated by URS survey personnel between February 14, 2011 and February 26, 2011, are provided in **Attachment A**. Additionally, a tabular summary of wetlands and Water of the U.S., including the acreage of wetland impacts related to the proposed project, is provided in **Attachment B**.

Wetlands were classified using the Cowardin classification system (Cowardin, *et al.* 1979). According to this classification system, two types of wetlands were identified: palustrine emergent (PEM) and palustrine scrub-shrub (PSS). PEM wetlands are defined as those wetlands 100 percent dominated by erect, rooted, herbaceous plants. These wetlands are commonly dominated by sedges, rushes, grasses, and various forbs. PSS wetlands are defined as those wetlands dominated by woody vegetation less than 20 feet tall. These wetlands are commonly dominated by bushy bluestem (*Andropogon glomeratus*), eastern baccharis (*Baccharis halimifolia*), young Chinese tallow, young loblolly pine, and shrubs. These wetlands contain less than 5 percent herbaceous vegetation.

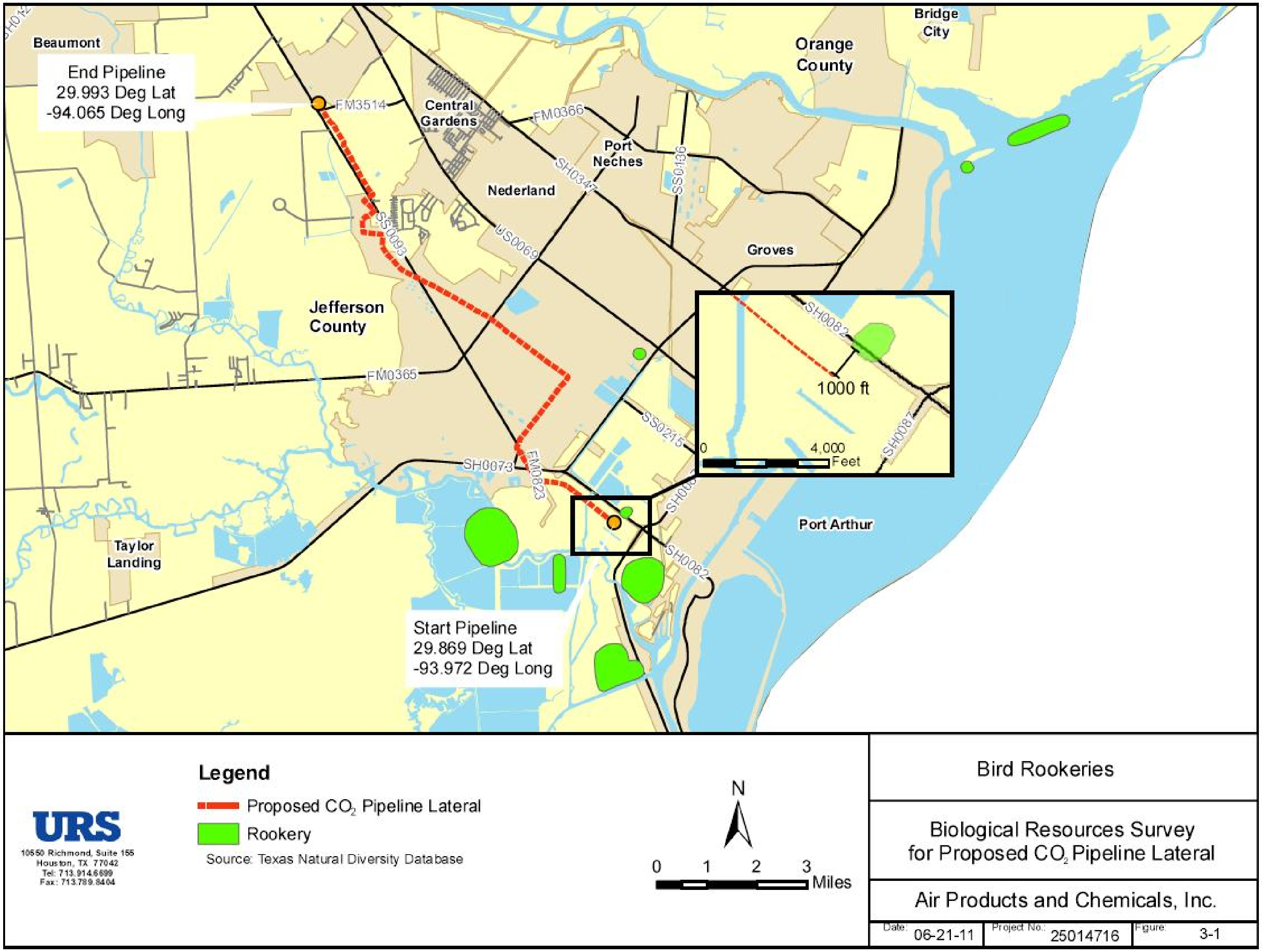
Approximately 40% of the study area is classified as PEM wetlands. From milepost 0 to approximately milepost 1.7, the majority of the study area is PEM that is inundated. The other PEM wetlands in the study area have varying levels of soil saturation, but did not have standing water at the time of the survey (i.e., from February 14, 2011 to February 26, 2011). Typical species in the PEM wetlands include: bulrush (*Schoenoplectus californicus*), cattail (*Typha latifolia*), spikerush (*Eleocharis palustris*), and green flatsedge (*Cyperus virens*). The large PEM wetland area from approximately milepost 3.5 to milepost 6 is currently used for cattle grazing. PSS wetlands accounted for approximately 2.5% of the study area. The PSS wetlands had similar plant species to the PEM wetlands, with the addition of the invasive shrub/small tree Chinese tallow (*Triadica sebifera*).

The remaining approximately one half of the study area is an upland that is dominated by rangeland used for cattle grazing. These areas are kept clear of woody vegetation, and are dominated by grasses. Typical species in upland areas include bushy bluestem (*Andropogon glomeratus*) and little bluestem (*Schizachyrium scoparium*).

3.2 WILDLIFE

Due to the disturbed nature of the study area, the wildlife habitat provided is low quality. Reptiles such as alligators and turtles were observed in the canals and ditches that cross the study area. The large inundated wetland area near the southern end of the study area provided foraging habitat for herons, egrets and other wetland bird species. Nutria were also observed in the inundated wetland areas. The study area could also provide habitat for other species commonly found in recently disturbed areas such as small mammals, crayfish, snakes, and various bird species.

The study area does not provide favorable habitat for colonial waterbirds, and no rookery sites were observed within the study area during the survey conducted between February 14, 2011 and February 26, 2011. The Texas Natural Diversity Database (TXNDD) was reviewed to assess the potential for rookeries in the study area. Several observations of rookeries were recorded in the TXNDD near the southern portion of the proposed pipeline lateral (Figure 3-1). The nearest rookery to the study area indicated by the TXNDD is located approximately 1,000 feet north of the southern terminus (i.e., outside of the study area), and represents an observation from 1989. Three other previously observed rookeries recorded in the TXNDD are located approximately one mile south of the southern portion of the study area.


Beaumont
End Pipeline
29.993 Deg Lat
-94.065 Deg Long
FM3514
Central Gardens
FM0366
Port Neches
SS0136
SH0347
Nederland
SS0093
US0069
Orange County
Bridge City
Groves
Jefferson County
FM0365
SH0082
1000 ft
0
4,000
Feet
SH0087
SS0215
SH0073
FM0823
Port Arthur
Taylor Landing
SH0082
Start Pipeline
29.869 Deg Lat
-93.972 Deg Long
Legend
Proposed CO2 Pipeline Lateral
Rookery
Source: Texas Natural Diversity Database
URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404
N
0 1 2 3
Miles
Bird Rookeries
Biological Resources Survey
for Proposed CO2 Pipeline Lateral
Air Products and Chemicals, Inc.
Date: 06-21-11
Project No.: 25014716
Figure: 3-1

3.2.1 Threatened and Endangered Species

Seven federally listed threatened and endangered species are known to occur in Jefferson County (**Table 3-1**).

Table 3-1. Federally-Listed Threatened and Endangered Species Occurring in Jefferson County, Texas

Common Name	Scientific Name	Federal Status
Birds		
Bald eagle	*Haliaeetus leucocephalus*	DM
Piping plover	*Charadrius melodus*	T
Reptiles		
Atlantic hawksbill sea turtle	*Eretmochelys imbricate*	E
Green sea turtle	*Chelonia mydas*	T
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Loggerhead sea turtle	*Caretta caretta*	T

U.S. Fish and Wildlife Service

E = Endangered

T = Threatened

DM = Delisted due to recovery

The Jefferson County, Texas State endangered species list is included as **Attachment C**. None of the State-listed species were observed in the study area. Based on the location of the study area, habitat types observed, and presence of existing developed areas adjacent to the study site, no project-related impacts to any State-listed species are anticipated.

*3.2.1.1 Bald Eagle (*Haliaeetus leucocephalus*)*

Bald eagles are known to occur in quiet coastal areas, rivers, or lakeshores with large, tall trees. Man-made reservoirs have provided excellent habitat. Bald eagles are opportunistic predators feeding primarily on fish, but also eat a variety of waterfowl and other birds, small mammals, and turtles. Carrion is also common in the diet, particularly in younger birds.

Males generally measure 3 ft from head to tail, weigh 7 to 10 pounds, and have a wingspan of 6 to 7 ft. Females are larger, some reaching 14 pounds, with a wingspan of up to 8 ft. Adults have a white head, neck, and tail, and a large yellow bill. Bald eagles are believed to live up to 30 years or more in the wild. The typical bald eagle nest is constructed of large sticks, with softer materials such as leaves, grass, and Spanish moss used as nest lining. Nests are typically used for a number of years, with the birds adding nest material every year. Bald eagle nests are often very large, measuring up to 6 ft in width and weighing hundreds of pounds. Eagles often have one or more alternative nests within their territories. Young eagles can fly in 11 to 12 weeks, but the parents continue to feed them for 4 to 6 more weeks while they learn to hunt. In Texas, bald eagles nest from October to July.

Since 1981, the Texas Parks and Wildlife Department (TPWD) has conducted extensive aerial surveys to monitor bald eagle nesting activity. The 2003 survey identified 117 active nests, which fledged at least 144 young. This compares with only 7 known nest sites in 1971. Midwinter bald eagle counts coordinated by TPWD and conducted by birding enthusiasts throughout the state reported 325 eagles in 2002. From 1986-1989, midwinter counts averaged less than 15 bald eagles per survey site. Since 1990, the average number of eagles per survey site has increased to 18. Bald eagle populations have increased to the extent that they have been delisted from the Federal Endangered Species List. However, the species is protected by the Bald and Golden Eagle Act and the Migratory Bird Treaty Act.

Neither this species, nor potentially suitable habitat for this species, was observed within the project area during field surveys. There is a potential for the bald eagle to occur in the vicinity of the proposed project, but the project site does not provide suitable foraging or nesting habitats for this species. Bald eagles use tall trees in close proximity to large bodies of water for nesting and roosting.

*3.2.1.2 Piping Plover (***Charadrius melodus***)*

The piping plover is a small shorebird, about 7 1/4 inches long with a 15 inch wingspan. Distinguishing characteristics include sandy-colored feathers with grayish-brown crowns and backs, white foreheads, and dark bands across their crowns. Dark, but incomplete rings encircle their necks. These little birds have yellow-orange legs, black bands across their foreheads from eye to eye, and black rings around the base of their necks. They are small, stocky, sandy-colored birds that resemble sandpipers, with short, stubby bills. Piping plovers nest in shallow depressions scraped into beach and lakeshore sand about 1 by 2.5 inches (2.5 by 6 cm).

There are just over 5,000 known pairs of breeding piping plovers. Texas is the wintering home for 35 percent of the known population of piping plovers. They begin arriving in late July or early August, and will remain for up to nine months. The piping plover's diet includes marine worms, beetles, spiders, crustaceans, mollusks and other small marine animals. Their typical life span is less than five years, but on occasion, up to 14 years.

Piping plovers live on sandy beaches and lakeshores. These shorebirds migrate through the Great Lakes along the river systems through the Bahamas and West Indies. They are currently found along the Atlantic Coast from Canada to North Carolina and along the shorelines of Lakes

Michigan and Superior. Gulf Coast beaches from Florida to Mexico and Atlantic coast beaches from Florida to North Carolina provide winter homes for plovers. There is no sandy beach or lakeshore habitat occurring within the project area; therefore, no project-related impacts to piping plovers are anticipated.

3.2.1.3 Sea Turtles

The Atlantic hawksbill sea turtle (*Eretmochelys imbricate*), green sea turtle (*Chelonia mydas*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*) are each listed as either threatened or endangered, both Federally and in the state of Texas. Sea turtles are found only in oceans and coastal areas. The project area does not include these areas; therefore, no project-related impacts to any of the listed sea turtles are anticipated.

4.0 SUMMARY

The project area includes scrub-shrub wetlands, emergent wetlands, and recently disturbed cleared upland areas. Impacts to wetlands and other Waters of the U.S. are addressed in a separate *Proposed Jurisdictional Determination of Waters of the United States* document.

Federally-listed threatened and endangered species occurring in Jefferson County are: piping plover, Atlantic hawksbill sea turtle, green sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. The bald eagle has been delisted due to recovery. None of these threatened or endangered species, or habitats suitable for these species, were observed in the project area. Bald eagles use tall trees near large open bodies of water and piping plovers rely on coastal habitats. The five sea turtle species are found in oceans and shorelines. None of these required habitat types are found in the project area. No State-listed species were observed within the study area, and the habitat types observed were unlikely to support populations of State-listed species. Therefore, no project-related impacts to threatened or endangered species are anticipated.

5.0 REFERENCES

Cowardin, L.M., Carter, V., Golet, F.C., and LaRoe, E.T. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Government. Printing Office, Washington, D.C. 103 pp.

Handbook of Texas Online. 2010. Jefferson County.
http://www.tshaonline.org/handbook/online/articles/hcj05

Land Resource Regions and Major Land Resource Areas of the United States". United States Department of Agriculture Soil Conservation Service Handbook 296. Dec. 1981.

Texas Parks and Wildlife Department. 2010. Endangered and Threatened Species. http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/

United States Environmental Protection Agency, 2011. Level III and IV Ecoregions of the Continental United States. http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm. Accessed 2/23/2011.

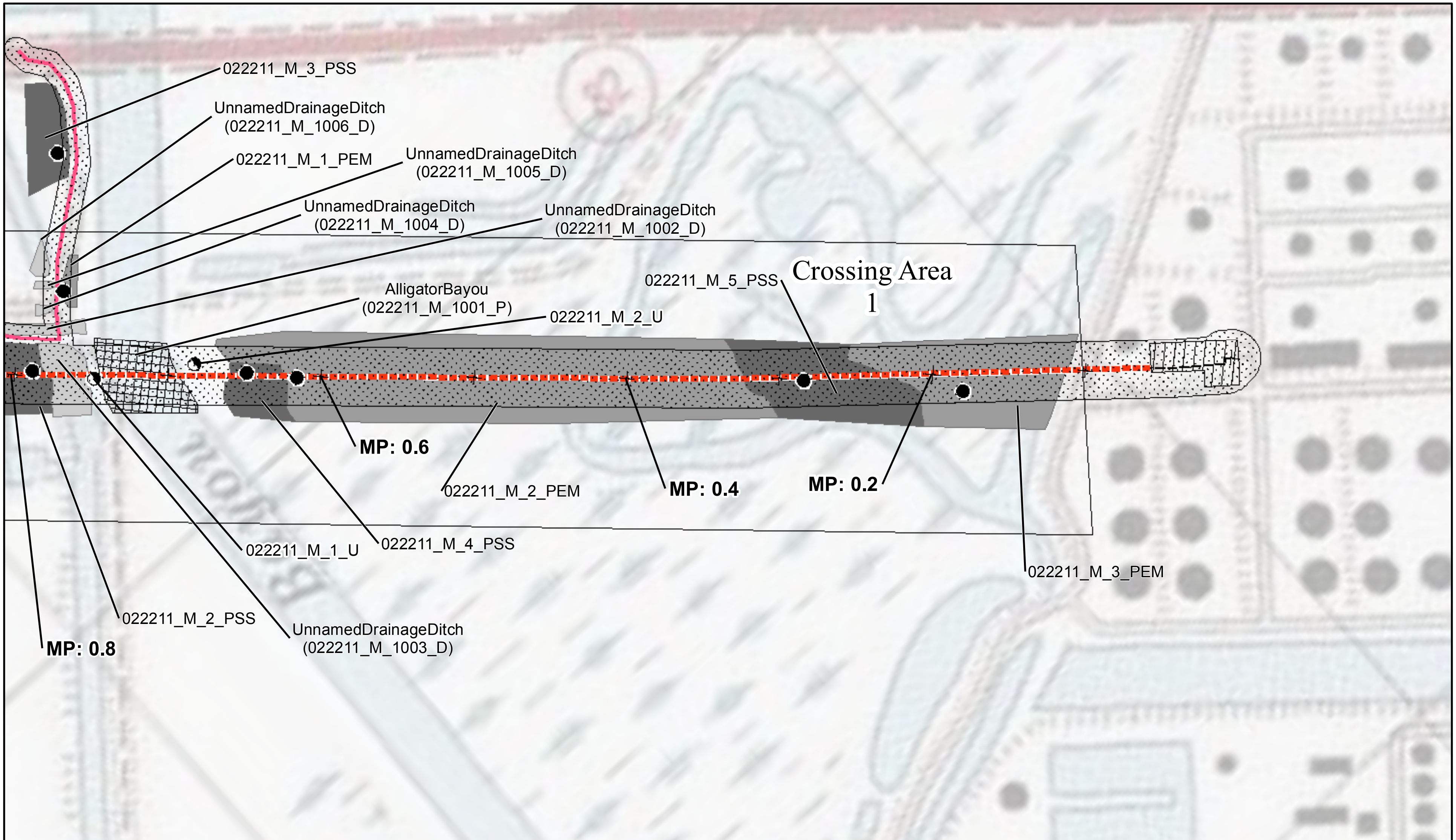
United States Fish and Wildlife Service. 2010. Endangered Species List. http://www.fws.gov/southwest/es/EndangeredSpecies/lists

United States Department of Agriculture; Natural Resources Conservation Service. 2010. Plants Database. http://plants.usda.gov/

Attachment A

Surveyed Wetlands and Other Waters

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

Mile Post

Soil Pits

Wetland

Upland

Proposed CO2 Pipeline Lateral

Access Roads to be improved

HDD

HDD as Secondary Option

Valves

Meter Station

Crossing Areas

Construction Limits

Additional Temporary Work Space

Study Area

100-year Floodplain

Surveyed Wetlands and Other Waters

Drainage Ditch

Emergent Wetlands

Scrub-Shrub Wetlands

Pond

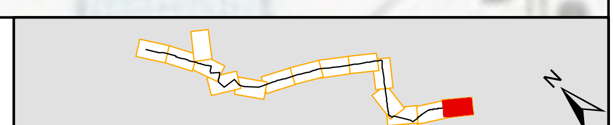
Stream

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS

10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



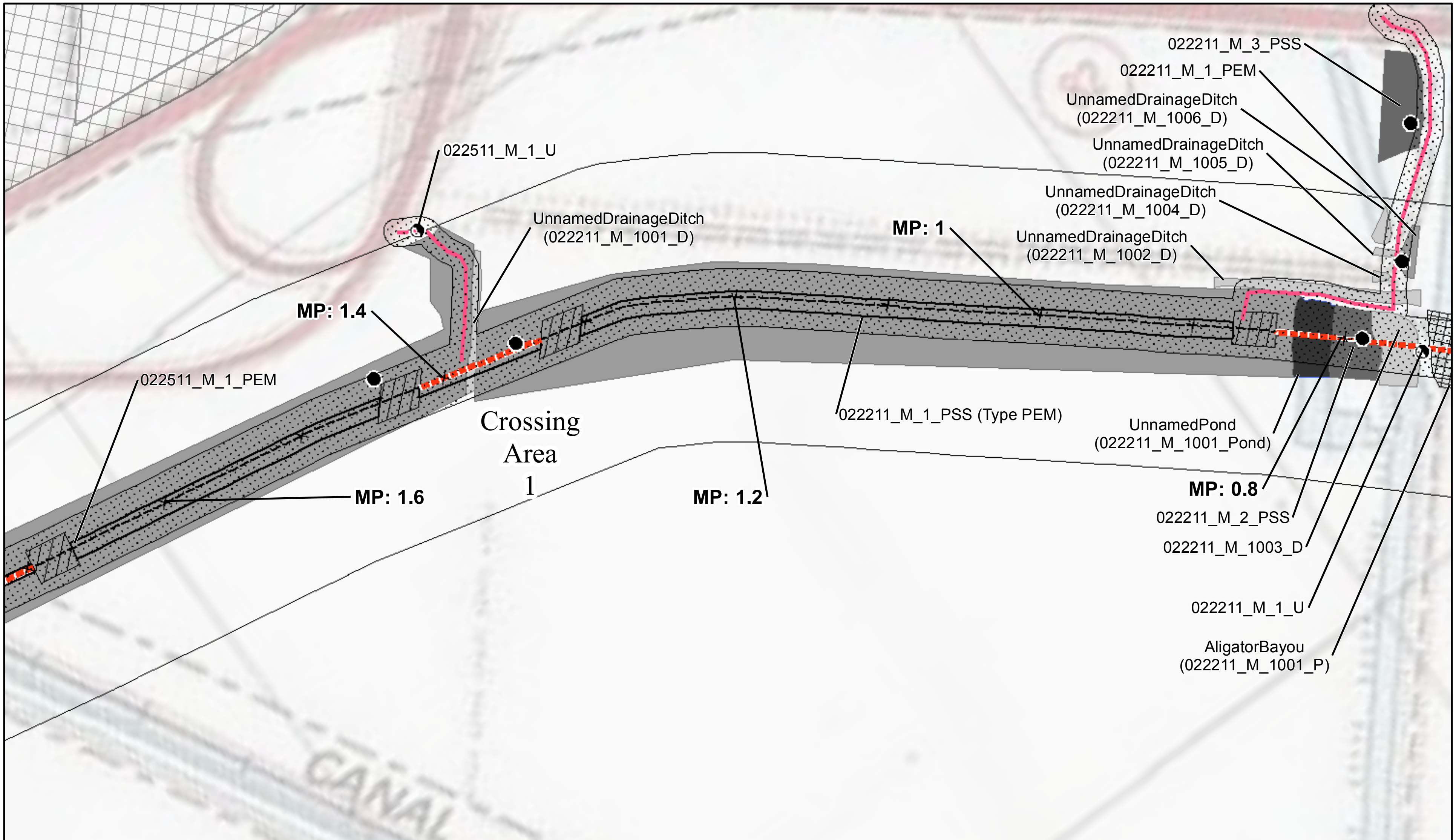
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date:	Project No.:	Figure:
06-10-11	25014716	1 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

× Mile Post

Soil Pits
- Wetland
- Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option

- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

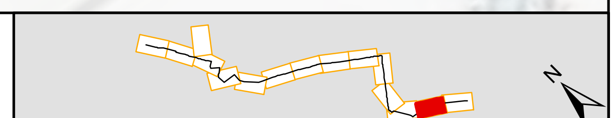
Surveyed Wetlands and Other Waters
- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

N

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



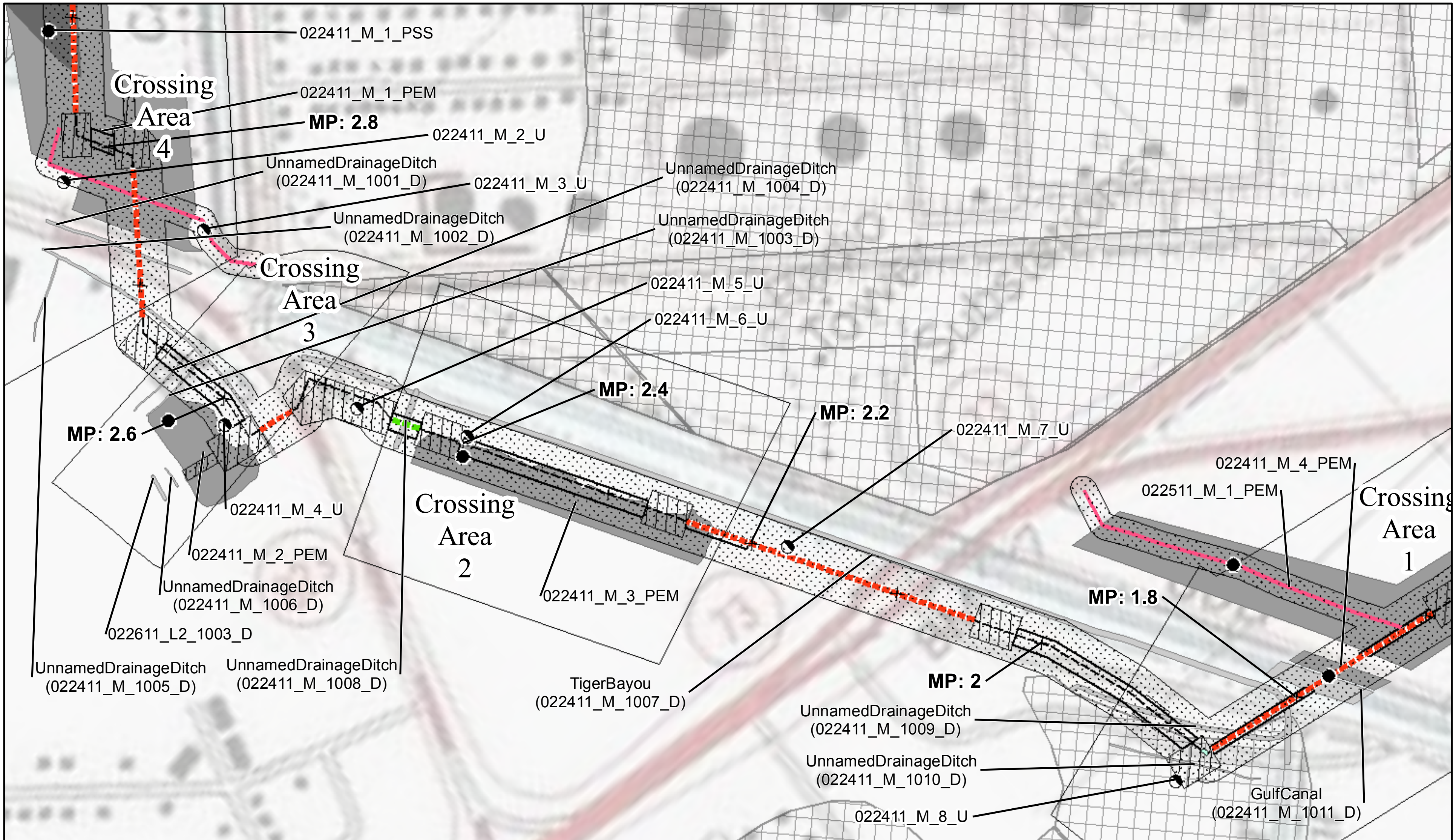
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date:	Project No.:	Figure:
06-10-11	25014716	2 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



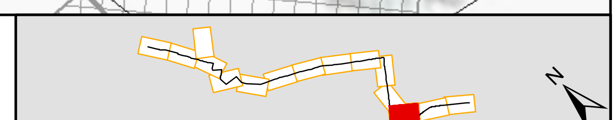
Legend

Mile Post	Valves	**Surveyed Wetlands and Other Waters**
Soil Pits	Meter Station	Drainage Ditch
Wetland	Crossing Areas	Emergent Wetlands
Upland	Construction Limits	Scrub-Shrub Wetlands
Proposed CO2 Pipeline Lateral	Additional Temporary Work Space	Pond
Access Roads to be improved	Study Area	Stream
HDD	100-year Floodplain	
HDD as Secondary Option		

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

0 250 500 Feet

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



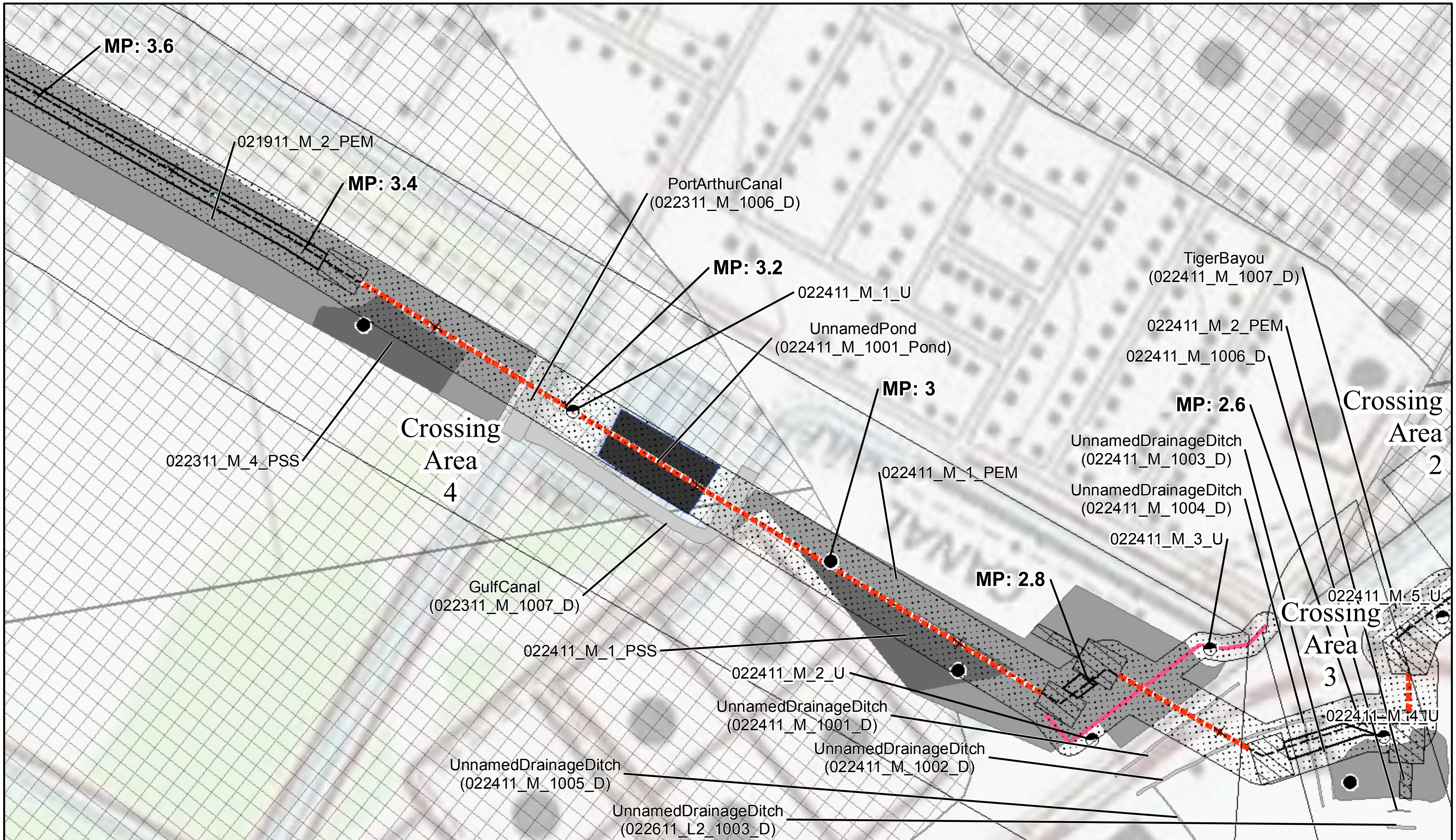
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11 | Project No.: 25014716 | Figure: 3 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

Mile Post

Soil Pits

Wetland

Upland

Proposed CO2 Pipeline Lateral

Access Roads to be improved

HDD

HDD as Secondary Option

Valves

Meter Station

Crossing Areas

Construction Limits

Additional Temporary Work Space

Study Area

100-year Floodplain

Surveyed Wetlands and Other Waters

Drainage Ditch

Emergent Wetlands

Scrub-Shrub Wetlands

Pond

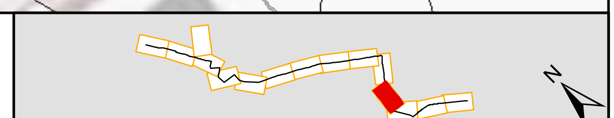
Stream

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404

N

0 250 500 Feet



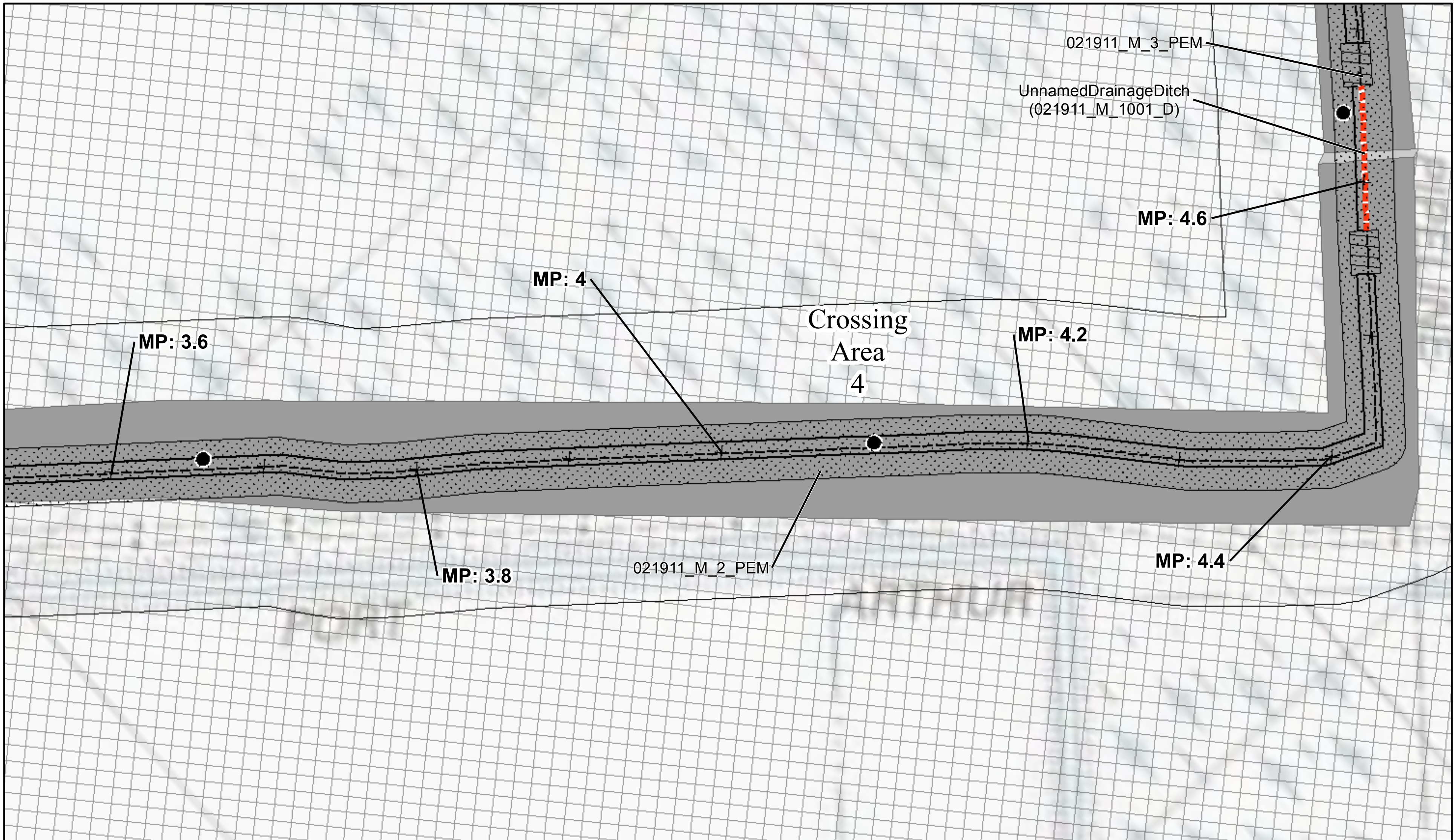
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date:	Project No.:	Figure:
06-10-11	25014716	4 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

Mile Post

Soil Pits

- Wetland
- Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option
- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

Surveyed Wetlands and Other Waters

- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

0 250 500 Feet

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404

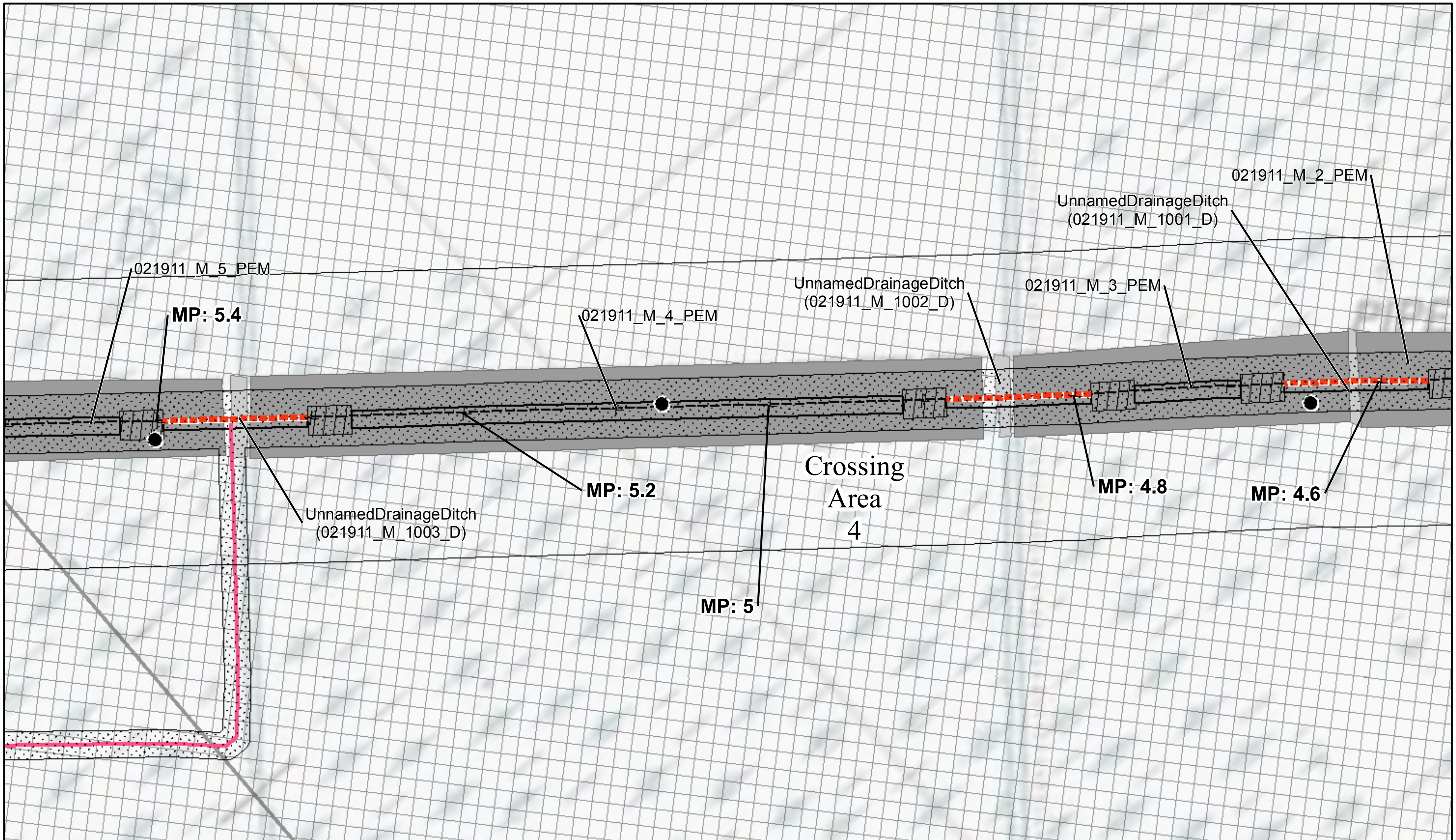
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11 | Project No.: 25014716 | Figure: 5 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



URS

10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404

Legend

- Mile Post

Soil Pits

- Wetland
- Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option
- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

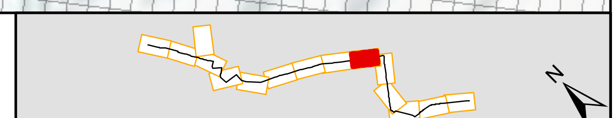
Surveyed Wetlands and Other Waters

- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

N

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.



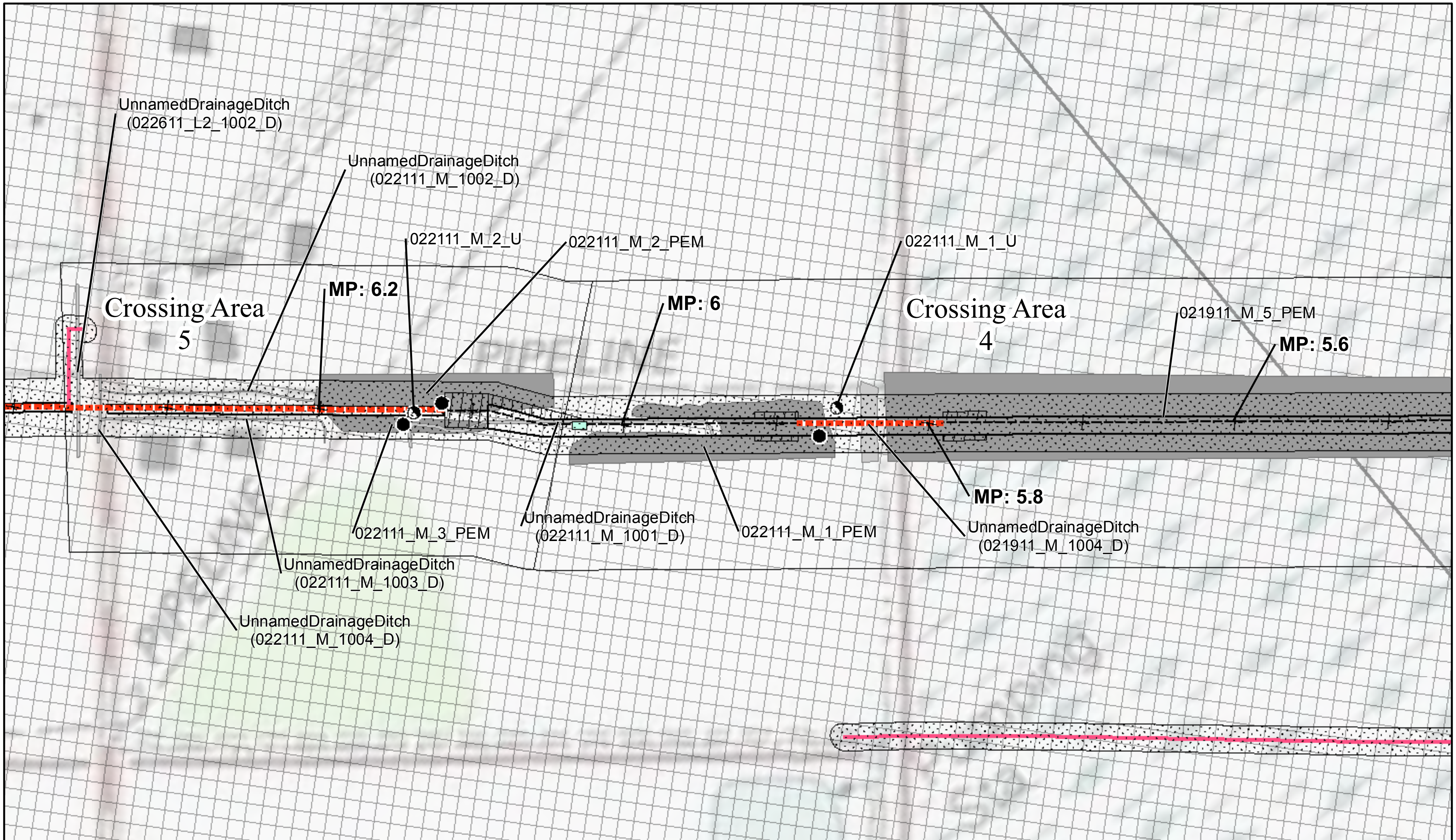
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11	Project No.: 25014716	Figure: 6 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

- Mile Post
- **Soil Pits**
- Wetland
- Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option
- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

Surveyed Wetlands and Other Waters

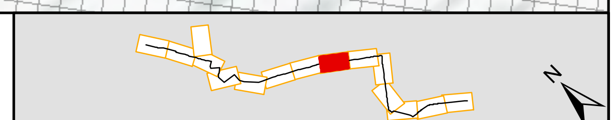
- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

0 250 500 Feet

N

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



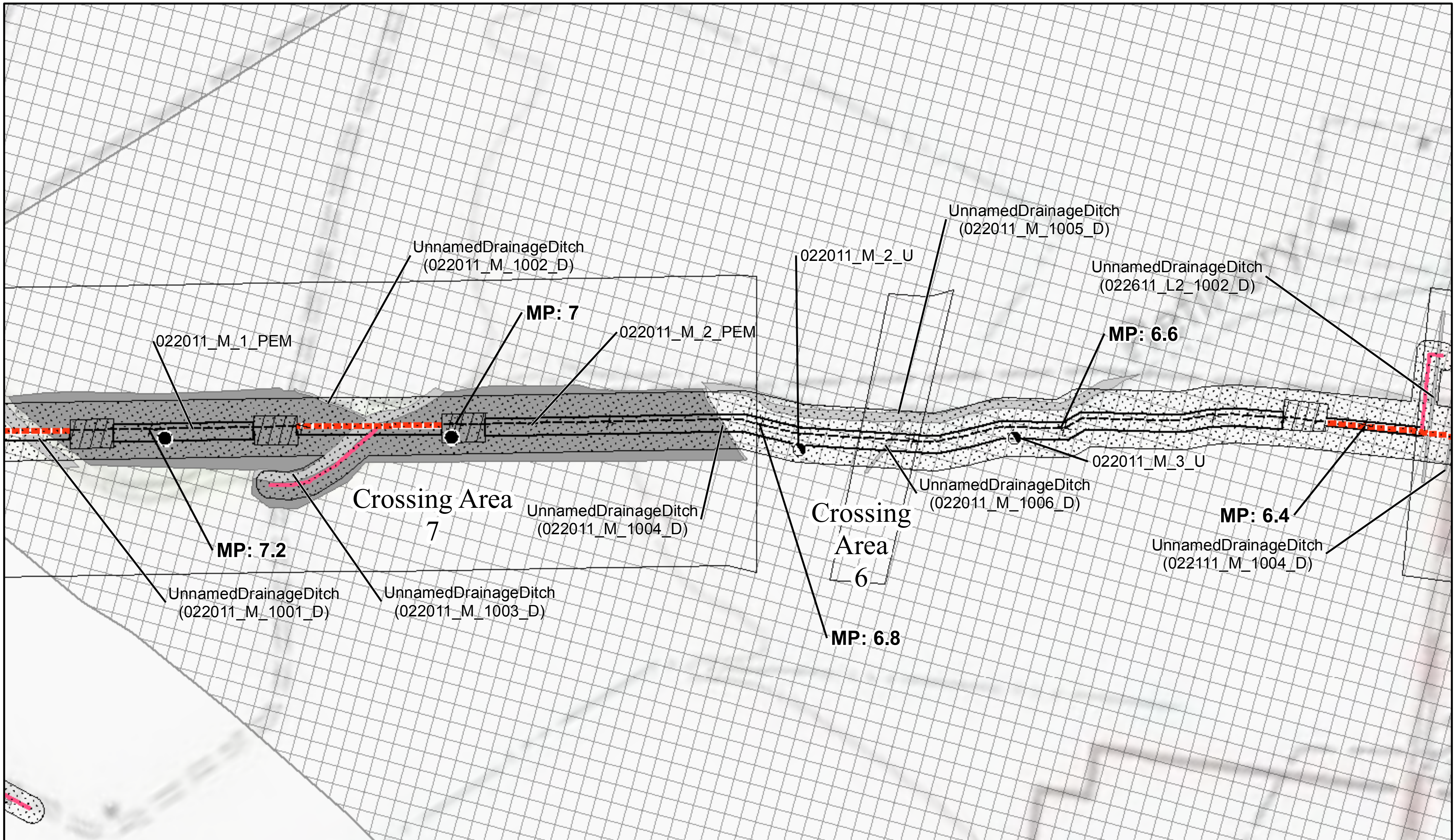
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date:	Project No.:	Figure:
06-10-11	25014716	7 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

Mile Post

Soil Pits

Wetland

Upland

Proposed CO2 Pipeline Lateral

Access Roads to be improved

HDD

HDD as Secondary Option

Valves

Meter Station

Crossing Areas

Construction Limits

Additional Temporary Work Space

Study Area

100-year Floodplain

Surveyed Wetlands and Other Waters

Drainage Ditch

Emergent Wetlands

Scrub-Shrub Wetlands

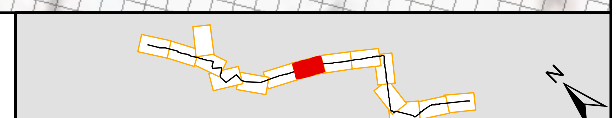
Pond

Stream

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



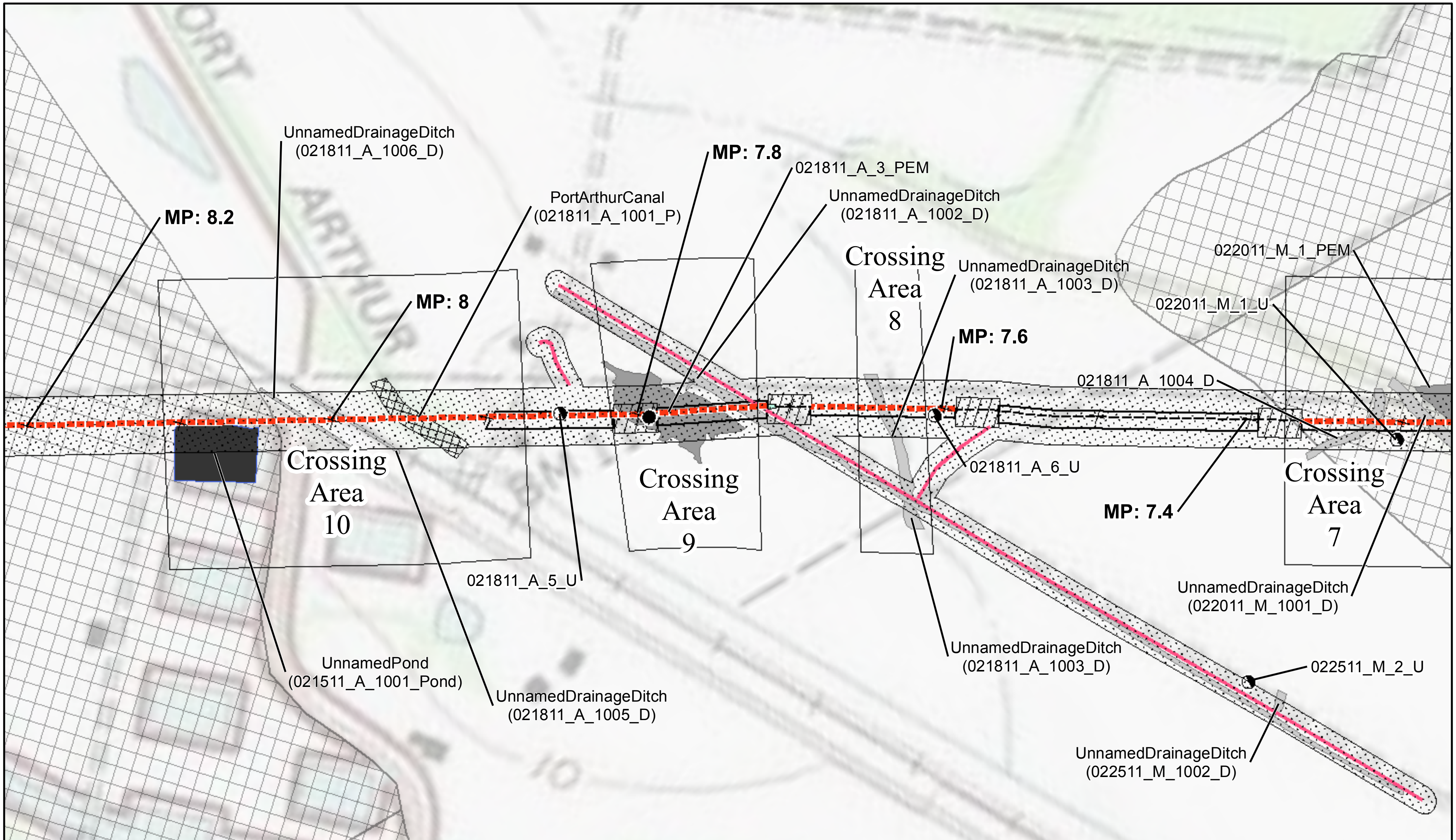
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11 | Project No.: 25014716 | Figure: 8 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

Mile Post

Soil Pits

Wetland

Upland

Proposed CO2 Pipeline Lateral

Access Roads to be improved

HDD

HDD as Secondary Option

Valves

Meter Station

Crossing Areas

Construction Limits

Additional Temporary Work Space

Study Area

100-year Floodplain

Surveyed Wetlands and Other Waters

Drainage Ditch

Emergent Wetlands

Scrub-Shrub Wetlands

Pond

Stream

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS

10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404

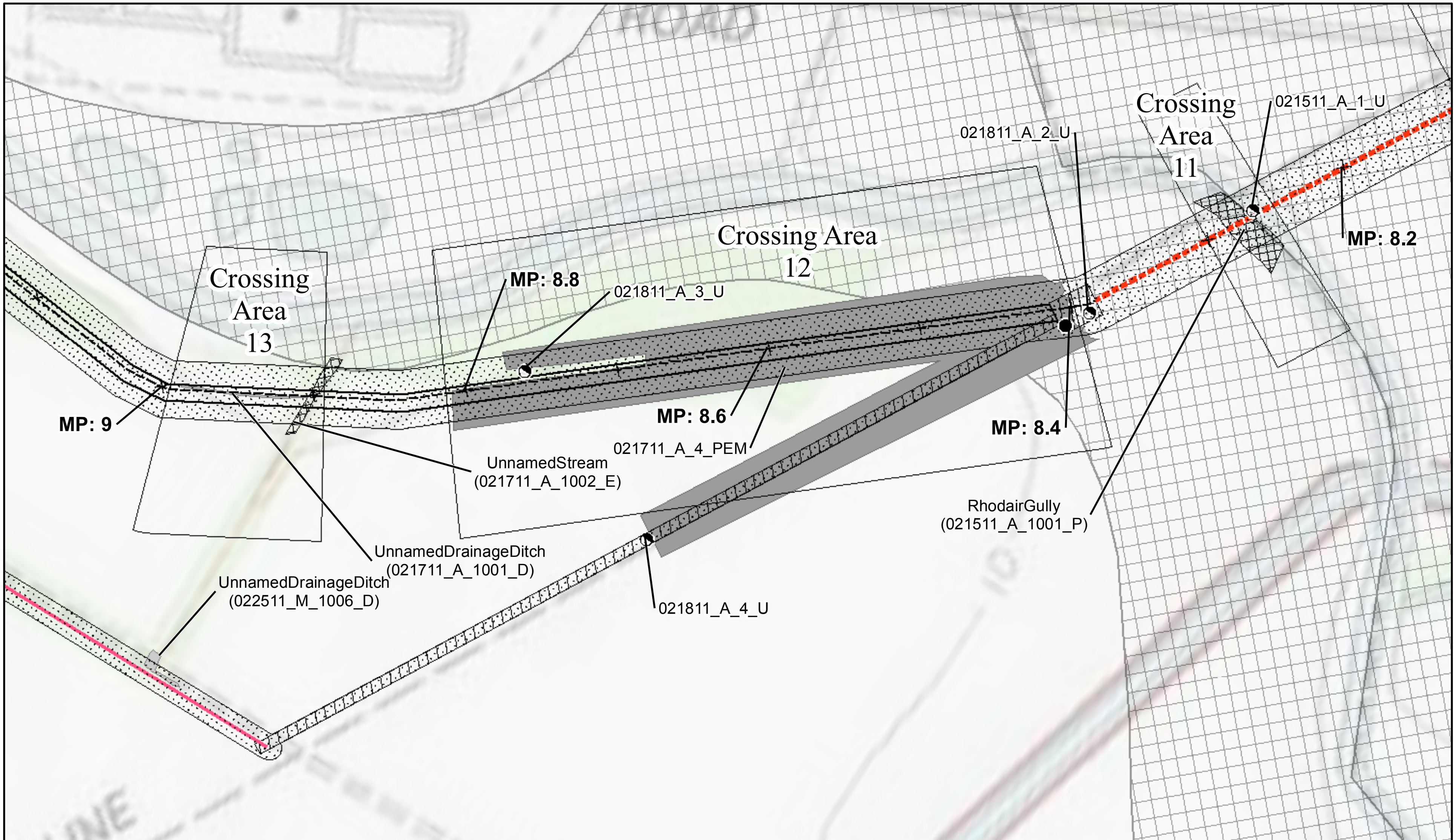
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11 | Project No.: 25014716 | Figure: 9 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

- Mile Post
- **Soil Pits**
  - Wetland
  - Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option
- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

Surveyed Wetlands and Other Waters

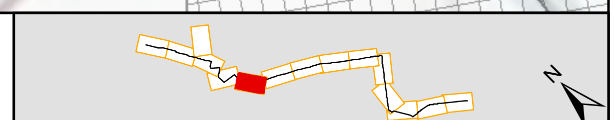
- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

N

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



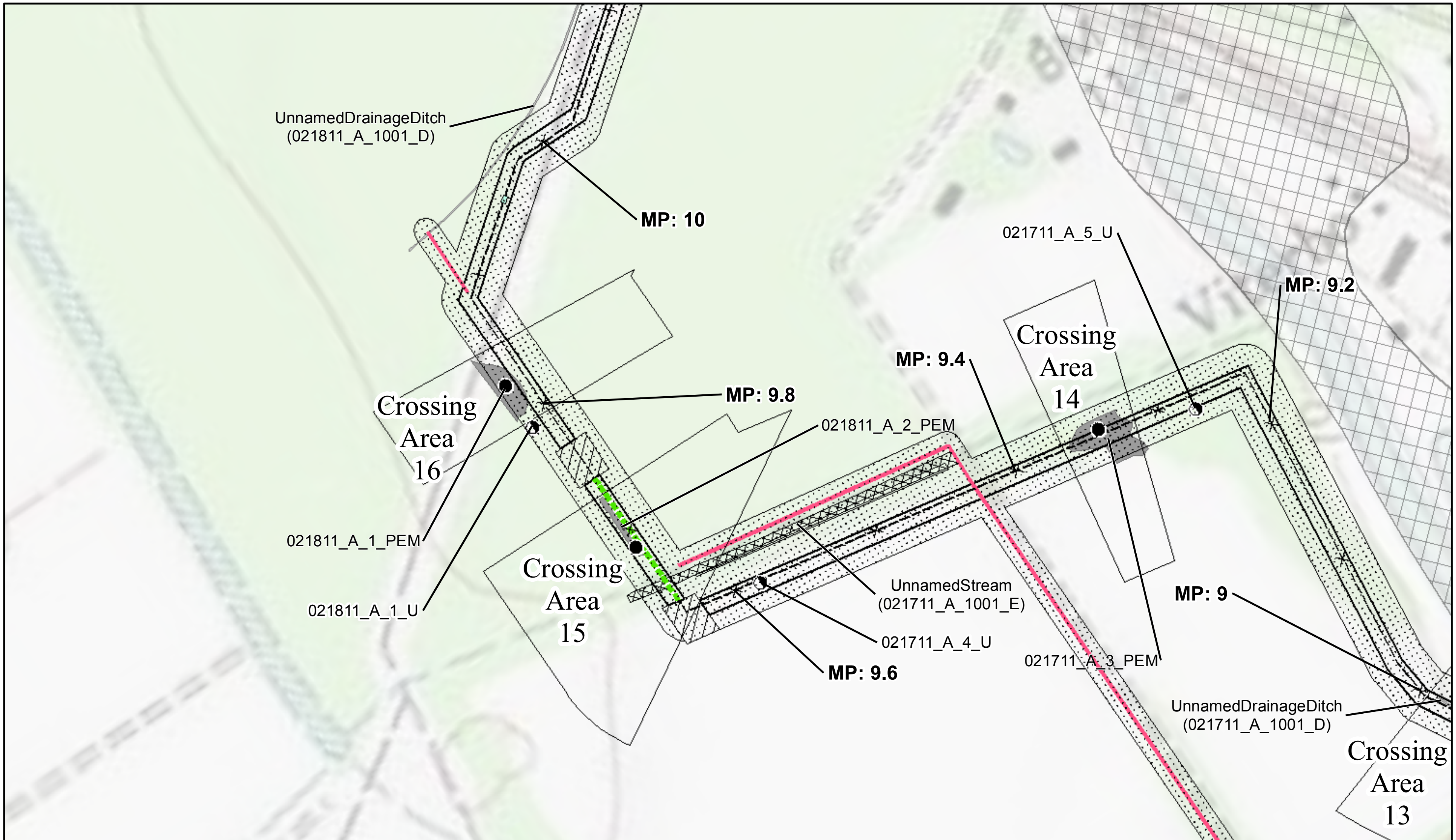
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11	Project No.: 25014716	Figure: 10 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404

Legend

- Mile Post

Soil Pits

- Wetland
- Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option
- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

Surveyed Wetlands and Other Waters

- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

N

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

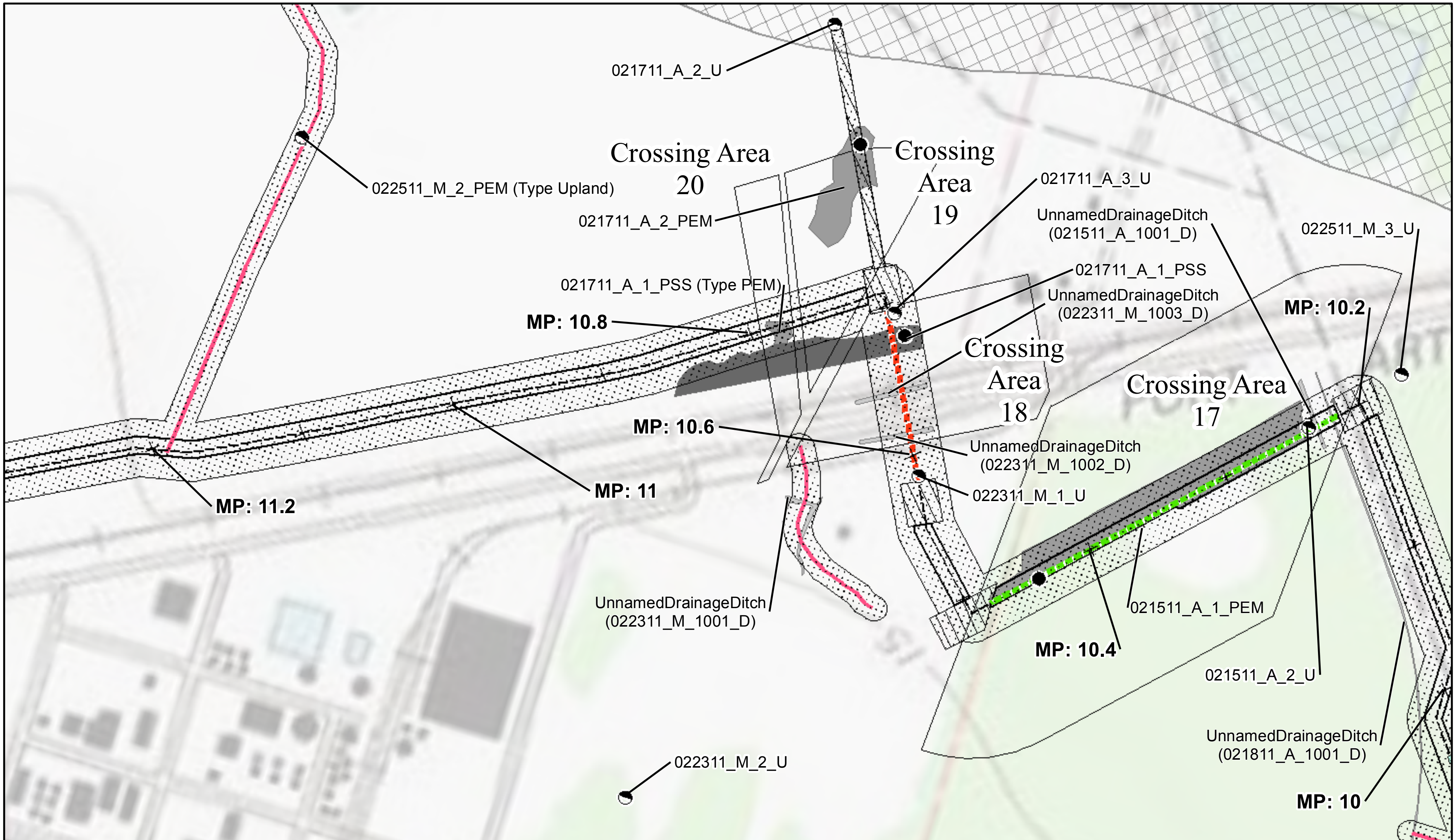
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11	Project No.: 25014716	Figure: 11 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

Mile Post

Soil Pits

- Wetland
- Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option

- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

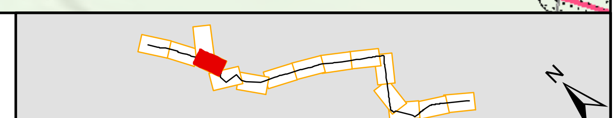
Surveyed Wetlands and Other Waters

- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



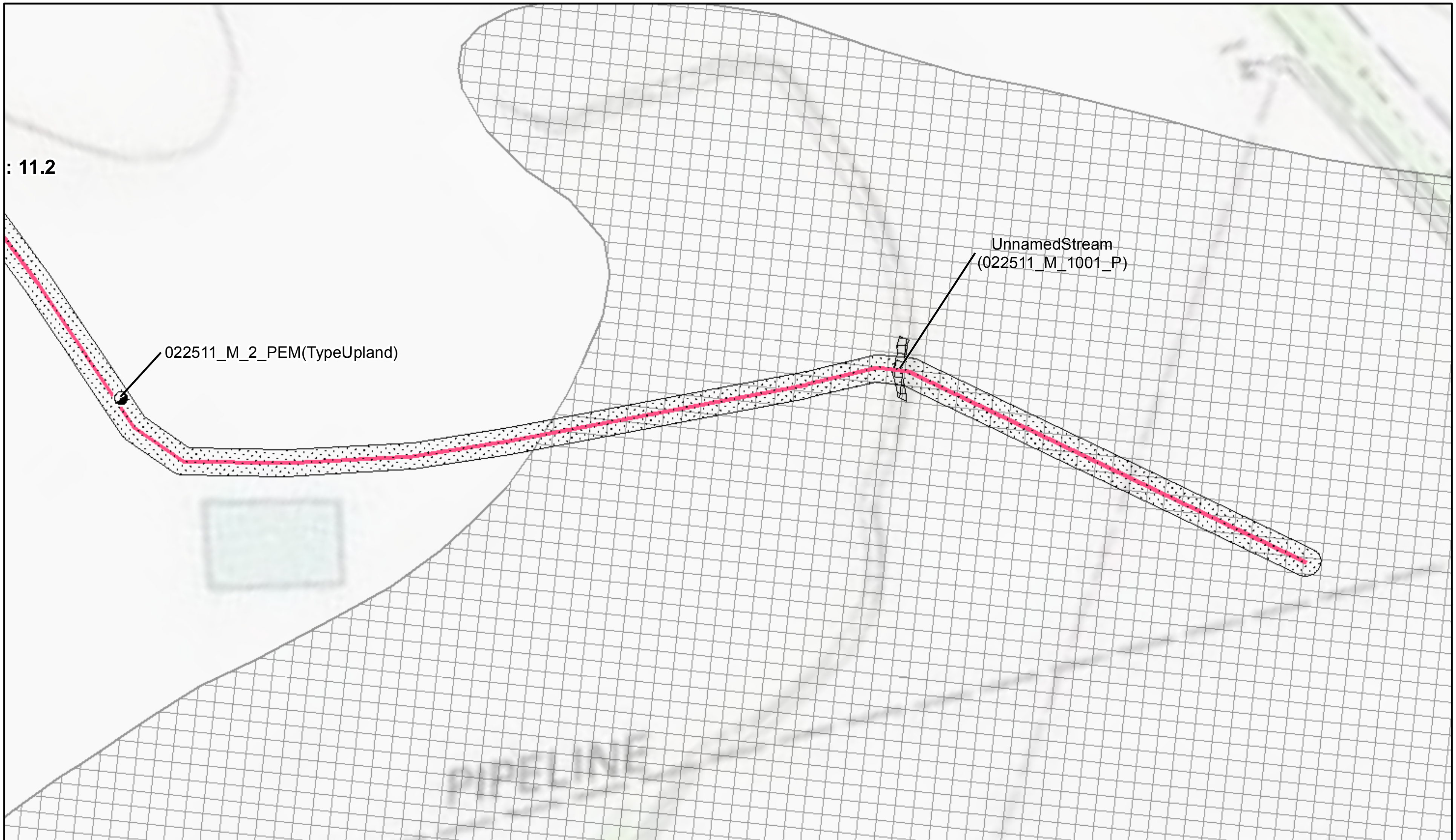
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11 | Project No.: 25014716 | Figure: 12 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

Mile Post

Soil Pits

Wetland

Upland

Proposed CO2 Pipeline Lateral

Access Roads to be improved

HDD

HDD as Secondary Option

Valves

Meter Station

Crossing Areas

Construction Limits

Additional Temporary Work Space

Study Area

100-year Floodplain

Surveyed Wetlands and Other Waters

Drainage Ditch

Emergent Wetlands

Scrub-Shrub Wetlands

Pond

Stream

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS

10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404

0 250 500 Feet

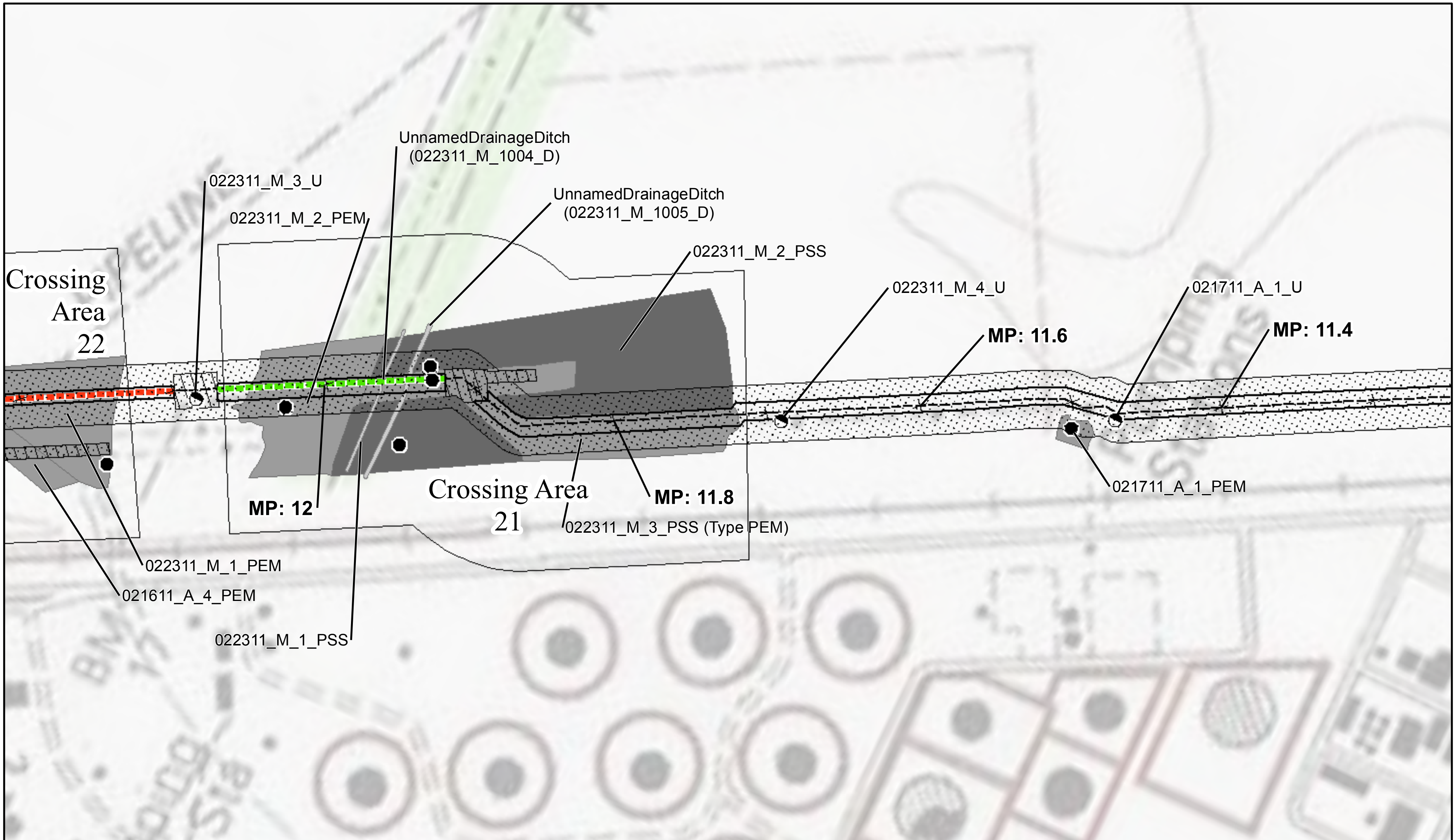
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11 | Project No.: 25014716 | Figure: 13 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



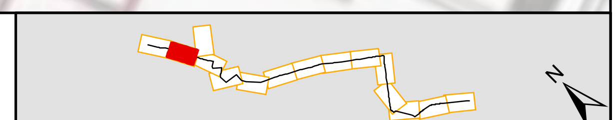
Legend

Mile Post	Valves	**Surveyed Wetlands and Other Waters**
Soil Pits	Meter Station	Drainage Ditch
Wetland	Crossing Areas	Emergent Wetlands
Upland	Construction Limits	Scrub-Shrub Wetlands
Proposed CO2 Pipeline Lateral	Additional Temporary Work Space	Pond
Access Roads to be improved	Study Area	Stream
HDD	100-year Floodplain	
HDD as Secondary Option		

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

0 250 500 Feet

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



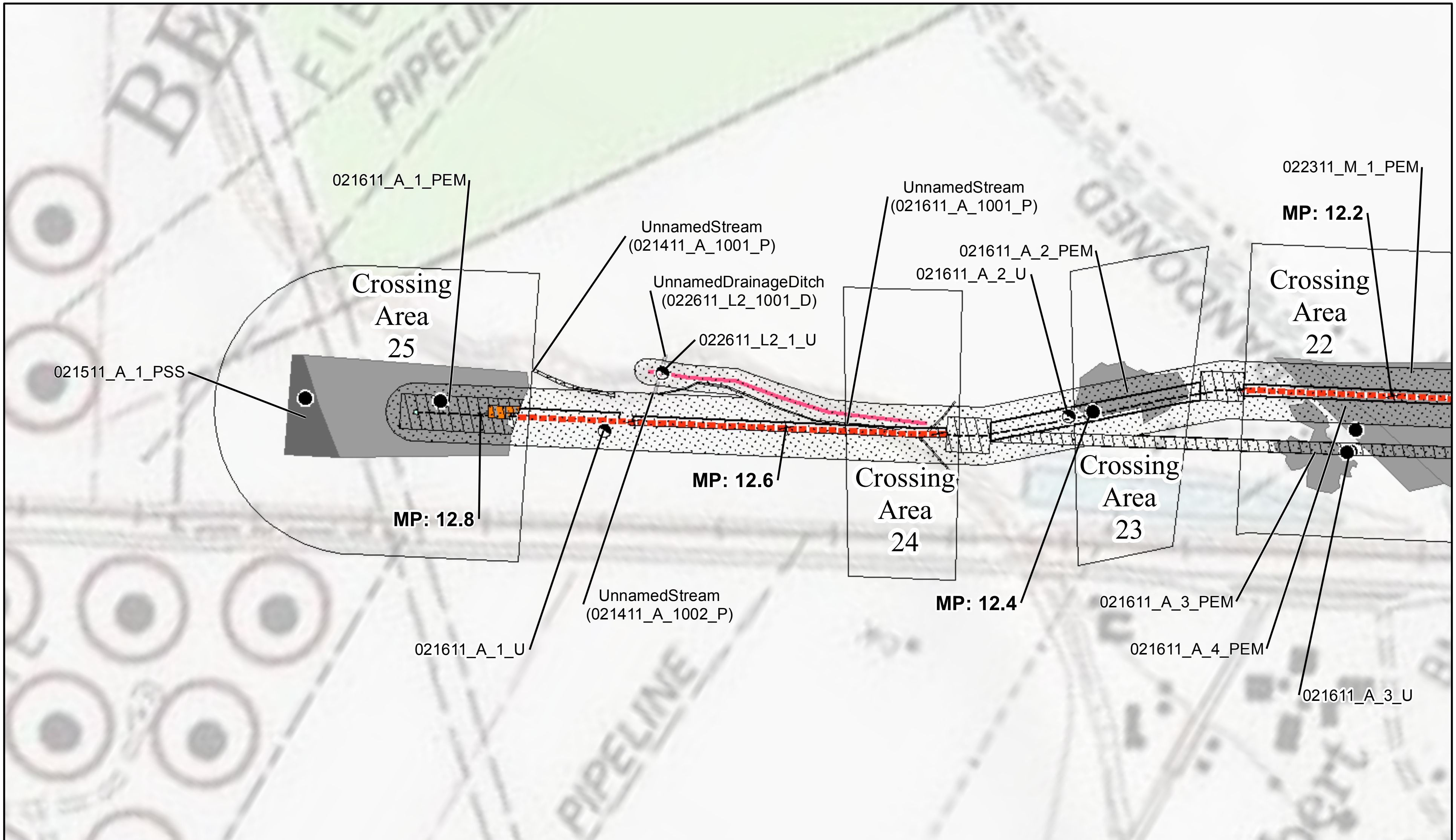
Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11 | Project No.: 25014716 | Figure: 14 of 15

K:\ENV\ENV10\25014716\GIS\MXD\xFIG_3_03May11_BioReport.mxd



Legend

- Mile Post

Soil Pits

- Wetland
- Upland
- Proposed CO2 Pipeline Lateral
- Access Roads to be improved
- HDD
- HDD as Secondary Option
- Valves
- Meter Station
- Crossing Areas
- Construction Limits
- Additional Temporary Work Space
- Study Area
- 100-year Floodplain

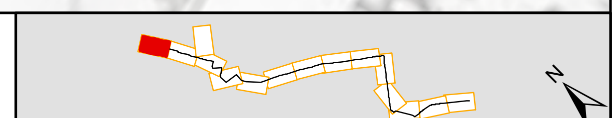
Surveyed Wetlands and Other Waters

- Drainage Ditch
- Emergent Wetlands
- Scrub-Shrub Wetlands
- Pond
- Stream

0 250 500 Feet

* Note: Each Crossing Area (i.e., Area 1 through Area 25) represents a single and complete project, as defined in 33 CFR 330.2(i) for linear projects.

URS
10550 Richmond, Suite 155
Houston, TX 77042
Tel: 713.914.6699
Fax: 713.789.8404



Wetlands and Other Waters

Biological Report

APCI Port Arthur CO2 Pipeline

Date: 06-10-11	Project No.: 25014716	Figure: 15 of 15

Attachment B

Summary of Wetland and Other Water Crossings

Crossing Area Number	Waterbody ID	Waterbody Type	Mile Post* (miles)	Water Crossing Length (feet)	Impacts Avoided (acres)	Temporary Impacts (acres)	Permanent Impacts (acres)	Comments
1	022211_M_3_PEM	Unnamed PEM	0.17		0.74	0.07		
1	022211_M_5_PSS	Unnamed PSS	0.27		0.65		0.057	Maintained ROW reduced to 4.5 ft wide
1	022211_M_2_PEM	Unnamed PEM	0.48		2.00	0.18		
1	022211_M_4_PSS	Unnamed PSS	0.64		0.25		0.022	Maintained ROW reduced to 4.5 ft wide
1	022211_M_1001_P	Alligator Bayou	0.72	269	0.35	0.03		
1	022211_M_1003_D	Unnamed Drainage Ditch	0.77	143	0.17	0.02		
1	022211_M_2_PSS	Unnamed PSS	0.79		0.21		0.018	Maintained ROW reduced to 4.5 ft wide
1	022211_M_1001_Pond	Unnamed Pond	0.82	137	0.17	0.02		
1	022211_M_1_PSS	Unnamed PEM	1.11		0.25	4.12		Wetland mis-labeled in field as PSS, it is type PEM.
1	022211_M_1001_D	Unnamed Drainage Ditch	1.37	36	0.02	0.03		
1	022511_M_1_PEM	Unnamed PEM	1.61		0.29	2.73		
1	022411_M_4_PEM	Unnamed PEM	1.77		0.09			
1	022411_M_1011_D	Unnamed Drainage Ditch	1.78	87	0.11	0.01		
1	022411_M_1009_D	Unnamed Drainage Ditch	1.90	62	0.02	0.07		
1	022411_M_1007_D	Tiger Bayou	2.16	21	0.01	0.01		
2	022411_M_3_PEM	Unnamed PEM	2.33		0.06	1.19		
2	022411_M_1008_D	Unnamed Drainage Ditch	2.44	20	0.01	0.01		secondary option - HDD
2	022411_M_1008_D	Unnamed Drainage Ditch	2.44	20		0.03		
3	022411_M_2_PEM	Unnamed PEM	2.58			0.34		
3	022411_M_1003_D	Unnamed Drainage Ditch	2.63	5		0.01		
3	022411_M_1004_D	Unnamed Drainage Ditch	2.64	5		0.01		
3and4	022411_M_1002_D	Unnamed Drainage Ditch	2.65	24	0.02			
4	022411_M_1001_D	Unnamed Drainage Ditch	2.73	11	0.02			
4	022411_M_1_PEM	Unnamed PEM	2.86		0.75	1.07		
4	022411_M_1_PSS	Unnamed PSS	2.93		0.83		0.081	Maintained ROW reduced to 10 ft wide
4	022311_M_1007_D	Gulf Canal	3.13	63	0.09			
4	022411_M_1001_Pond	Unnamed Pond	3.13	383	0.53			
4	022311_M_1006_D	Port Arthur Canal	3.22	70	0.10	0.00		
4	022311_M_4_PSS	Unnamed PSS	3.32		0.19		0.001	Maintained ROW reduced to 10 ft wide
4	021911_M_2_PEM	Unnamed PEM	3.96		0.79	9.30	0.009	Permanent impact is due to valve.
4	021911_M_1001_D	Unnamed Drainage Ditch	4.62	32	0.02	0.02		
4	021911_M_3_PEM	Unnamed PEM	4.73		0.34	1.53		
4	021911_M_1002_D	Unnamed Drainage Ditch	4.85	45	0.03	0.03		
4	021911_M_4_PEM	Unnamed PEM	5.10		0.22	3.54		
4	021911_M_1003_D	Unnamed Drainage Ditch	5.35	54	0.04	0.04		
4	021911_M_5_PEM	Unnamed PEM	5.60		0.14	3.56		

Crossing Area Number	Waterbody ID	Waterbody Type	Mile Post* (miles)	Water Crossing Length (feet)	Impacts Avoided (acres)	Temporary Impacts (acres)	Permanent Impacts (acres)	Comments
4	021911_M_1004_D	Unnamed Drainage Ditch	5.84	54		0.07		
4	022111_M_1_PEM	Unnamed PEM	5.94			0.77		
4and5	022111_M_1001_D	Unnamed Drainage Ditch	6.04	50		0.19	0.005	
5	022111_M_2_PEM	Unnamed PEM	6.12		0.10	0.43		
5	022111_M_3_PEM	Unnamed PEM	6.15		0.14	0.07		
5	022111_M_1004_D	Unnamed Drainage Ditch	6.34	6	0.01			
5	022611_L2_1002_D	Unnamed Drainage Ditch	6.36	10	0.01			
6	022011_M_1006_D	Unnamed Drainage Ditch	6.72	12		0.02		
7	022011_M_1004_D	Unnamed Drainage Ditch	6.83	11		0.02		
7	022011_M_2_PEM	Unnamed PEM	6.95		0.16	1.63		
7	022011_M_1003_D	Unnamed Drainage Ditch	7.07	65	0.05	0.05		
7	022011_M_1_PEM	Unnamed PEM	7.17		0.19	1.53		
7	022011_M_1001_D	Unnamed Drainage Ditch	7.28	62	0.04	0.04		
7	021811_A_1004_D	Unnamed Drainage Ditch	7.33	47	0.03	0.03		
8and9	021811_A_1002_D	Unnamed Drainage Ditch	7.62	67	0.00	0.09		
8	021811_A_1003_D	Unnamed Drainage Ditch	7.63	38	0.03	0.03		
9	021811_A_3_PEM	Unnamed PEM	7.78		0.14	0.54		
10	021811_A_1001_P	Port Arthur Canal	7.94	116	0.16			
10	021811_A_1005_D	Unnamed Drainage Ditch	7.99	18	0.03			
10	021811_A_1006_D	Unnamed Drainage Ditch	8.02	18	0.02			
10	021511_A_1001_Pond	Unnamed Pond	8.08	143	0.25			
11	021511_A_1001_P	Rhodair Gully	8.28	94	0.13			
12	021711_A_4_PEM	Unnamed PEM	8.58			4.27		
13	021711_A_1002_E	Unnamed Stream	8.90	26		0.04		
13	021711_A_1001_D	Unnamed Drainage Ditch	8.95	51		0.05		
14	021711_A_3_PEM	Unnamed PEM	9.34			0.28		
15	021711_A_1001_E	Unnamed Stream	9.54	31	0.02	0.02		secondary option - HDD
15	021711_A_1001_E	Unnamed Stream	9.54	31		0.04		
15	021811_A_2_PEM	Unnamed PEM	9.71		0.08	0.08		secondary option - HDD
15	021811_A_2_PEM	Unnamed PEM	9.71			0.16		
16	021811_A_1_PEM	Unnamed PEM	9.82			0.02		
17	021811_A_1001_D	Unnamed Drainage Ditch	10.07	5	0.00	0.00		secondary option - HDD
17	021811_A_1001_D	Unnamed Drainage Ditch	10.07	5		0.01		
17	021511_A_1001_D	Unnamed Drainage Ditch	10.23	9	0.01	0.01		secondary option - HDD
17	021511_A_1001_D	Unnamed Drainage Ditch	10.23	9		0.01		
17	021511_A_1_PEM	Unnamed PEM	10.35		0.76	0.77		secondary option - HDD

Crossing Area Number	Waterbody ID	Waterbody Type	Mile Post* (miles)	Water Crossing Length (feet)	Impacts Avoided (acres)	Temporary Impacts (acres)	Permanent Impacts (acres)	Comments
17	021511_A_1_PEM	Unnamed PEM	10.35			1.53		
18	022311_M_1002_D	Unnamed Drainage Ditch	10.61	15	0.02			
18	022311_M_1003_D	Unnamed Drainage Ditch	10.64	15	0.02			
19	021711_A_2_PEM	Unnamed PEM	10.71			0.19		
20	021711_A_1_PSS	Unnamed PSS	10.77		0.12			
20	021711_A_1_PSS	Unnamed PEM	10.78			0.06		Wetland mis-labeled in field as PSS, it is type PEM.
21	022311_M_2_PSS	Unnamed PSS	11.81		0.00			secondary option - HDD
21	022311_M_3_PSS	Unnamed PEM	11.83		0.17	0.16		secondary option - HDD. Wetland mis-labeled in field as PSS, it is type PEM.
21	022311_M_3_PSS	Unnamed PEM	11.83			2.10		Wetland mis-labeled in field as PSS, it is type PEM.
21	022311_M_1005_D	Unnamed Drainage Ditch	11.95	16	0.01	0.01		secondary option - HDD
21	022311_M_1005_D	Unnamed Drainage Ditch	11.95	16		0.02		
21	022311_M_1004_D	Unnamed Drainage Ditch	11.97	11	0.01	0.01		secondary option - HDD
21	022311_M_1004_D	Unnamed Drainage Ditch	11.97	11		0.01		
21	022311_M_2_PEM	Unnamed PEM	12.01		0.28	0.28		secondary option - HDD
21	022311_M_2_PEM	Unnamed PEM	12.01			0.56		
22	022311_M_1_PEM	Unnamed PEM	12.18		0.21	0.67		
22	021611_A_4_PEM	Unnamed PEM	12.22		0.06	0.25		
22	021611_A_3_PEM	Unnamed PEM	12.25		0.01	0.21		
23	021611_A_2_PEM	Unnamed PEM	12.37			0.44		
24	021611_A_1001_P	Unnamed Stream	12.57	26	0.03	0.02		
25	021611_A_1_PEM	Unnamed PEM	12.84		0.00	0.99	0.093	Meter Station
TOTAL (All Crossing Areas, not including secondary options)				**2483**	**11.49**	**45.39**	**0.285**	**82 waterbodies impacted**

Notes:

*Mile Post (MP) indicates approximate distance, in miles, from the southern terminus of the proposed pipeline lateral.

Attachment C

State-Listed Threatened and Endangered Species Occurring in Jefferson County, Texas

JEFFERSON COUNTY

AMPHIBIANS

		Federal Status	State Status
Pig frog	*Lithobates grylio*		

prefers permanent bodies of open water with emergent vegetation; active mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

BIRDS

		Federal Status	State Status
American Peregrine Falcon	*Falco peregrinus anatum*	DL	T

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Arctic Peregrine Falcon	*Falco peregrinus tundrius*	DL	

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Bald Eagle	*Haliaeetus leucocephalus*	DL	T

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Black Rail	*Laterallus jamaicensis*		

salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mat of previous year's dead grasses; nest usually hidden in marsh grass or at base of Salicornia

Brown Pelican	*Pelecanus occidentalis*	DL	E

largely coastal and near shore areas, where it roosts and nests on islands and spoil banks

Henslow's Sparrow	*Ammodramus henslowii*		

wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

Peregrine Falcon	*Falco peregrinus*	DL	T

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

Piping Plover	*Charadrius melodus*	LT	T

wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats

JEFFERSON COUNTY

BIRDS		Federal Status	State Status
Reddish Egret	*Egretta rufescens*		T

resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear

Snowy Plover	*Charadrius alexandrinus*		

formerly an uncommon breeder in the Panhandle; potential migrant; winter along coast

Southeastern Snowy Plover	*Charadrius alexandrinus tenuirostris*		

wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats

Swallow-tailed Kite	*Elanoides forficatus*		T

lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees

Western Snowy Plover	*Charadrius alexandrinus nivosus*		

uncommon breeder in the Panhandle; potential migrant; winter along coast

White-faced Ibis	*Plegadis chihi*		T

prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats

Wood Stork	*Mycteria americana*		T

forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960

FISHES		Federal Status	State Status
American eel	*Anguilla rostrata*		

coastal waterways below reservoirs to gulf; spawns January to February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; most aquatic habitats with access to ocean, muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries; diet varies widely, geographically, and seasonally

Smalltooth sawfish	*Pristis pectinata*	LE	E

different life history stages have different patterns of habitat use; young found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft (10 m); in sheltered bays, on shallow banks, and in estuaries or river mouths; adult sawfish are encountered in various habitat types (mangrove, reef, seagrass, and coral), in varying salinity regimes and temperatures, and at various water depths, feed on a variety of fish species and crustaceans

INSECTS		Federal Status	State Status
Bay skipper	*Euphyes bayensis*		

JEFFERSON COUNTY

INSECTS

Federal Status State Status

apparently tidal sawgrass marsh only, probably covers same range of salinity as saw grass, nectarivore (butterfly), herbivore (caterpillar), larval foodplant is so far unconfirmed but is probably sawgrass, diurnal; two well separated broods apparently peaking in late May and in September which suggests the larvae may well aestivate in summer and the next brood hibernate

MAMMALS

		Federal Status	State Status
Black bear	*Ursus americanus*	T/SA;NL	T

bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened

Louisiana black bear	*Ursus americanus luteolus*	LT	T

possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas

Plains spotted skunk	*Spilogale putorius interrupta*		

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Rafinesque's big-eared bat	*Corynorhinus rafinesquii*		T

roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures

Red wolf	*Canis rufus*	LE	E

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

Southeastern myotis bat	*Myotis austroriparius*		

roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures

MOLLUSKS

		Federal Status	State Status
Creeper (squawfoot)	*Strophitus undulatus*		

small to large streams, prefers gravel or gravel and mud in flowing water; Colorado, Guadalupe, San Antonio, Neches (historic), and Trinity (historic) River basins

Fawnsfoot	*Truncilla donaciformis*		

small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Little spectaclecase	*Villosa lienosa*		

creeks, rivers, and reservoirs, sandy substrates in slight to moderate current, usually along the banks in slower currents; east Texas, Cypress through San Jacinto River basins

Louisiana pigtoe	*Pleurobema riddellii*		T

streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins

JEFFERSON COUNTY

MOLLUSKS		Federal Status	State Status
Sandbank pocketbook	*Lampsilis satura*		T

small to large rivers with moderate flows and swift current on gravel, gravel-sand, and sand bottoms; east Texas, Sulfur south through San Jacinto River basins; Neches River

Southern hickorynut	*Obovaria jacksoniana*		T

medium sized gravel substrates with low to moderate current; Neches, Sabine, and Cypress river basins

Texas heelsplitter	*Potamilus amphichaenus*		T

quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins

Texas pigtoe	*Fusconaia askewi*		T

rivers with mixed mud, sand, and fine gravel in protected areas associated with fallen trees or other structures; east Texas River basins, Sabine through Trinity rivers as well as San Jacinto River

Wabash pigtoe	*Fusconaia flava*		

creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow

Wartyback	*Quadrula nodulata*		

gravel and sand-gravel bottoms in medium to large rivers and on mud; Red, Sabine, Neches River basins

REPTILES		Federal Status	State Status
Alligator snapping turtle	*Macrochelys temminckii*		T

perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October

Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	LE	E

Gulf and bay system, warm shallow waters especially in rocky marine environments, such as coral reefs and jetties, juveniles found in floating mats of sea plants; feed on sponges, jellyfish, sea urchins, molluscs, and crustaceans, nests April through November

Green sea turtle	*Chelonia mydas*	LT	T

Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches; adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds; nesting behavior extends from March to October, with peak activity in May and June

Gulf Saltmarsh snake	*Nerodia clarkii*		

saline flats, coastal bays, and brackish river mouthss

Kemp's Ridley sea turtle	*Lepidochelys kempii*	LE	E

JEFFERSON COUNTY

REPTILES		Federal Status	State Status

Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico; feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna; nests April through August

Leatherback sea turtle	*Dermochelys coriacea*	LE	E

Gulf and bay systems, and widest ranging open water reptile; omnivorous, shows a preference for jellyfish; in the US portion of their western Atlantic nesting territories, nesting season ranges from March to August

Loggerhead sea turtle	*Caretta caretta*	LT	T

Gulf and bay system primarily for juveniles, adults are most pelagic of the sea turtles; omnivorous, shows a preference for mollusks, crustaceans, and coral; nests from April through November

Northern scarlet snake	*Cemophora coccinea copei*		T

mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September

Sabine map turtle	*Graptemys ouachitensis sabinensis*		

Sabine River system; rivers and related tributaries, ponds and reservoirs with abundant aquatic vegetation; basks on fallen logs and exposed roots; eats insects, crustaceans, mollusks, and aquatic plants; breeding and egg-laying March-May, with hatchlings appearing in early fall

Texas diamondback terrapin	*Malaclemys terrapin littoralis*		

coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide

Texas horned lizard	*Phrynosoma cornutum*		T

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber/Canebrake rattlesnake	*Crotalus horridus*		T

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

PLANTS		Federal Status	State Status

Chapman's orchid	*Platanthera chapmanii*		

in Texas, appears restricted to wetland pine savannas and savanna swales in hillside seepage bogs, two very restricted and declining habitats in the State; flowering July-August

ENVIRONMENTAL SYNOPSIS
Industrial Carbon Capture & Sequestration (ICCS)
Technology Area I
DE-FOA-00000 15

January 2011

National Energy Technology Laboratory
U.S. Department of Energy
Morgantown, West Virginia

INTENTIONALLY LEFT BLANK

CONTENTS

INTENTIONALLY LEFT BLANK

INTRODUCTION

The U.S. Department of Energy (DOE or the Department) prepared this Environmental Synopsis pursuant to the Department's responsibilities under section 216 of DOE's National Environmental Policy Act (NEPA) Implementing Procedures set forth in 10 CFR Part 1021. This synopsis summarizes the consideration given to environmental factors and records that the relevant environmental consequences of reasonable alternatives were evaluated in the process of selecting awardees seeking financial assistance under Technology Area 1 of the Industrial Carbon Capture and Sequestration (ICCS) program In addition to financial and technical elements, DOE considered relevant environmental factors and consequences of the projects proposed to DOE in response to the funding opportunity announcement (FOA). DOE initially selected 12 applicants seeking financial assistance under Technology Area 1 and provided cost-shared funding for project definition activities; DOE then selected three of the initial twelve awardees for continued funding beyond project definition, pending completion of project-specific NEPA reviews. As required by section 216, this synopsis does not contain business, confidential, trade secret or other information that statutes or regulations would prohibit DOE from disclosing. It also does not contain data or other information that may in any way reveal the identity of the offerors.[1]

BACKGROUND

The ICCS program is a cost-shared collaboration between the government and industry to increase investment in clean industrial technologies and carbon capture and sequestration (CCS) projects. In contrast to other federally funded activities, these projects are not federal projects; instead, they are private projects seeking federal financial assistance. Under the ICCS funding opportunity, industry proposes projects that meet their needs and those of their customers while furthering the national goals and objectives of DOE. The successful development of advanced technologies and innovative concepts that reduce emissions of carbon dioxide into the atmosphere is a key objective of the nation's effort to help mitigate the effects of climate change.

Awardees under this FOA would receive assistance using funds appropriated by the American Recovery and Reinvestment Act of 2009, Public Law 111-5, (Recovery Act). The Recovery Act's purposes are to stimulate the economy and to create and retain jobs. Accordingly, special consideration was given to projects that promote and enhance job creation, preservation and economic recovery, in an expeditious manner. In accordance with the Recovery Act, and Section 703 of Public Law 110-140, DOE's two specific objectives were identified in the FOA as (1) Technology Area 1 – *Large-Scale Industrial CCS Projects from Industrial Sources*; and (2) Technology Area 2 – *Innovative Concepts for Beneficial* CO_2 *Use*. This synopsis specifically deals with the review process conducted for applications under Technology Area 1.

The applications reviewed under this FOA were initially selected for a first phase funding in October 2009 as the first of a two phase process for final awards of financial assistance. Under Phase I of the review process for Technology Area 1, DOE selected 12 projects related to the capture of CO_2 from industrial sources for geological storage or enhanced oil recovery (EOR). During Phase I, DOE provided cost shared funding for applicants to conduct project definition activities (e.g. preliminary design and permitting) and to prepare information that would assist the Department in performing its obligations pursuant to NEPA. Near the end of Phase I, awardees were given an opportunity to submit renewal applications for Phase II awards that would provide financial assistance for detailed design, construction and demonstration of the proposed technologies. DOE received eight renewal applications from the 12 projects selected under Phase I.

[1] The three awardees selected for continued financial assistance are identified in this synopsis and information on these proposed projects will be available on the DOE National Energy Technology Laboratory web site at http://www.netl.doe.gov/technologies/iccs/index.html.

Applications under the ICCS program were evaluated against specific programmatic criteria:

- Technology merit, technical plan, and site suitability;
- Project organization and project management plan;
- Commercial potential;
- Funding plan;
- Financial condition and capacity of proposed funding sources;
- Financial commitment to meet cost-sharing requirements.

These criteria represented the total evaluation scoring. However, the selection official also considered the results of the environmental evaluation and the applicant's budget information and financial management system, as well as program policy factors, in making selections.

As a federal agency, DOE must comply with NEPA (42 U.S.C. §§ 4321 *et seq.*) by considering potential environmental issues associated with its actions prior to deciding whether to undertake these actions. The environmental review of applications received in response to the ICCS FOA was conducted pursuant to Council on Environmental Quality Regulations (40 Code of Federal Regulations (CFR) Parts 1500 - 1508) and DOE's NEPA Implementing Procedures (10 CFR Part 1021), which provide directions specific to NEPA in the context of procurement and financial assistance actions.

PURPOSE AND NEED

The purpose and need for DOE's selections of awardees under the ICCS Program are to satisfy the responsibility Congress imposed on the Department to carry out a program to demonstrate technologies for the large-scale capture of CO_2 from industrial sources. Technology Area 1 under the FOA focused on the demonstration of advanced technologies that capture and sequester carbon dioxide emissions from industrial sources into underground formations or put the CO_2 to beneficial use in a manner that permanently prevents the CO_2 from entering the atmosphere, including the expansion of CO_2 use in EOR, while providing information on the cost and feasibility of deployment of sequestration technologies. Therefore, under the FOA, DOE sought projects with technologies that have progressed beyond the research and development stage to a point of readiness for operation at a scale that, if successful, could be readily replicated and deployed into commercial practice within the industry.

The industrial technologies proposed could produce heat, fuels, chemicals, H2 or other useful products with or without production of electricity. Thus, industrial sources could include cement plants, chemical plants, refineries, steel and aluminum plants, manufacturing facilities, and power plants using opportunity fuels (e.g., petroleum coke, municipal waste). DOE sought projects at a sufficient scale to show the potential for market penetration upon successful demonstration of the technology, and be integrated with commercial plant operation. DOE also allowed for leading-edge technologies not currently deployed in the utility marketplace or CO_2 injection industry, as opposed to new applications of commercial technologies or incremental improvements of commercial technologies or previously demonstrated technologies. DOE's specific technical objectives included demonstrating:

- Projects that capture and sequester amounts of CO_2 approaching or exceeding a target of one million tons per plant per year;

- Projects with large-scale CCS that include integration of CO_2 capture, transportation and sequestration with comprehensive MVA;
- Geological sequestration in multiple geological settings as a means to evaluate costs, operational processes, and technical performance;
- CO_2 capture technologies that are integrated within existing or new industrial facilities;
- Projects capable of operating technologies that make progress toward the capture and sequestration of seventy-five percent of CO_2 from the treated stream, comprising at least ten percent of CO_2 by volume that would otherwise be emitted to the atmosphere; and
- Projects at a sufficient scale to show the potential for market penetration;

ALTERNATIVES

DOE received eight Phase II renewal applications out of the twelve projects selected for Phase I in ICCS Technology Area 1, all of which were determined to have met the mandatory eligibility requirements listed in the FOA. The applications proposed projects located in eight states: California, Illinois, Kansas, Louisiana, Michigan, Mississippi, Texas, and Washington. The criteria for evaluating Phase II applications under ICCS Technology Area 1 were published in the FOA. Technical and financial evaluations represented the total evaluation scoring; however, the environmental evaluation, which was not point-scored, entered into the evaluation and selection process. Each applicant was required to complete and submit a standard environmental information volume for each site or alternative site included in its application.

The evaluations of the applications focused on the technical description of the proposed project, financial plans and budgets, potential environmental impacts, and other information that the applicants submitted. Following reviews by technical, environmental, and financial panels and a comprehensive assessment by a merit review board, a DOE official selected those applications that best met DOE's purpose and need. By broadly soliciting proposals to meet the programmatic purpose and need for DOE action and by evaluating the potential environmental impacts associated with each proposal before selecting applicants, DOE considered a reasonable range of alternatives for meeting its purpose and need.

Applications were divided into two broad categories:

- Group 1: Addition of Carbon Capture Equipment at an Existing and Operating Facility; and
- Group 2: Addition of Carbon Capture Equipment at a Planned or Yet-to-Be Constructed Facility.

DOE received five applications for existing and operating facilities (Group 1) and three applications for planned or yet-to-be constructed facilities (Group 2).

ENVIRONMENTAL REVIEW

DOE assembled environmental review teams to assess all applications that met the mandatory requirements. The review teams considered 20 resource areas that could potentially be impacted by the technologies and sites proposed under ICCS Technology Area 1. These resource areas consisted of:

- Aesthetics
- Air Quality
- Biological Resources
- Climate
- Community Services
- Cultural Resources
- Environmental Justice
- Floodplains
- Geology
- Ground Water
- Human Health and Safety
- Land Use
- Noise
- Socioeconomics
- Soils
- Surface Water
- Transportation and Traffic
- Utilities
- Wastes and Materials
- Wetlands

The review teams were composed of environmental professionals with experience evaluating the impacts of industrial facilities, power plants, and energy-related projects in the resource areas considered by DOE.

The review teams considered the information provided as part of each application, which included narrative text, worksheets, and the environmental information volumes for the sites proposed by the applicant. In addition, reviewers independently verified the information provided to the extent practicable using available sources commonly consulted in the preparation of NEPA documents, and conducted preliminary analyses to identify the potential range of impacts that would be associated with each application. Reviewers identified both direct and indirect potential impacts to the resource areas mentioned above, as well as short-term impacts that might occur during construction and start-up, and long-term impacts that might occur over the expected operational life of the proposed project and beyond. The reviewers also considered any mitigation measures proposed by the applicant and any reasonably available mitigation measures that may not have been proposed.

Reviewers assessed the potential for environmental issues and impacts using the following characterizations:

- **Beficial** Expected to have a net beneficial effect on the resource in comparison to baseline conditions.
- **None (negligible)** Immeasurable or negligible in consequence (not expected to change baseline conditions).
- **Low** Measurable or noticeable but of minimal consequence (barely discernable change in baseline conditions).
- **Moderate** Adverse and considerable in consequence but moderate and not expected to reach a level of significance (discernable, but not drastic, alteration of baseline conditions).
- **High** Adverse and potentially significant in severity (anticipated substantial changes or effects on baseline conditions that might not be mitigable).

For cases in which an application failed to provide sufficient information to support a determination among the above characterizations, the reviewers assigned one of the following characterizations:

- **Limited Concern** The potential for substantial adverse impacts would be negligible to low based on background information about the resource area with respect to the geographic location of the project.
- **Elevated Concern** The potential for substantial adverse impacts would be moderate to high based on background information about the resource area with respect to the geographic location of the project.

Applications in Response to the FOA

Based on the technologies and sites proposed, none of the applications were deemed to have a high potential for adverse impacts in eighteen of the twenty resource areas. However, one application was considered to have potential for high adverse impacts to floodplains, with another having high potential for health and safety concerns. The following impacts by resource area were considered in the selection of candidates for award:

Aesthetics Low to moderate impacts would be expected for one facility. This site would be located within view of a residential area; however, it would be located where a previous facility stood that posed similar aesthetic issues, leading to little relative change. Low impacts were projected for all remaining sites. Temporary impacts could result at one site due to construction of a CO_2 pipeline near a National Historic Trail.

Air Quality Moderate impacts would be expected for five projects, with three of them having elevated concerns due to new sources of criteria pollutants from planned or yet-to-be constructed plants. The other two facilities with expected moderate impacts would add new energy-generating systems to their plants as part of the project. Low impacts were anticipated for the remaining three projects. Concerns included increases in emissions of volatile organic compounds from four sites, increases in NO_x emissions from two sites, and increase in $_{PM2.5}$ and SO_2 emissions at one site. Temporary impacts from fugitive dust and combustion equipment were expected from all sites as a result of construction activities.

Biological Resources Moderate impacts would be expected for four projects due to plant construction and land clearing activities. Impacts to aquatic species and habitat would be a concern for two projects as a result of process water intake, water discharge, and potential for accidental chemical release. Low impacts would be expected for the remaining sites.

Climate Beneficial impacts would be expected for all projects as a result of greenhouse gas emissions reductions.

Community Services Low impacts would be expected for all but one project, which would involve a new power plant. Generally, projects anticipating a larger temporary workforce during construction would be expected to place a higher demand on community services particularly in smaller, more rural communities where currently existing community services are more limited.

Cultural Resources Moderate impacts would be expected for two projects due to their proximity to multiple sites eligible for the National Register of Historic Places and other cultural resources. Low impacts would be expected for the remaining six projects. Potential impacts would include tribal concerns over pipeline routes. Impacts would vary with the extent of known tribal claims and their proximity to the proposed project or pipeline route.

Environmental Justice Moderate impacts would be expected for one project due to the potential for disproportionate effects on minorities if an accidental release of hazardous chemical were to occur. Low impacts would be expected for the remaining projects, typically a function of lesser concentrations of low income and minority populations in surrounding areas.

Floodplains Moderate to high impacts would be expected for three projects due to siting of the CO_2 capture facilities partially or totally within floodplains, and there would be limited concern for one site for which the floodplains are not delineated. Low to no impacts would be expected for the remaining proposed facilities. Low to moderate potential impacts during pipeline construction or pipeline routing would be expected for all but one project for which there are no floodplains within the proposed route. Floodplains would be impacted by any activity that modifies the available flood storage within the designated area; however, long-term potential impacts on the corridors would be minimal provided the surface contours are returned to preconstruction conditions.

Geology – Moderate impacts would be expected at one project due to sequestration within a rock formation largely untested for storage effectiveness. One project alternative presents elevated concern as it has potential for caprock fracture combined with abnormally high levels of hydrogen sulfide (H_2S) in the formation water. The potential for low to moderate impacts exists for all applications, either from CO_2 injection into saline aquifers or use for enhanced oil recovery.

Ground Water – Low impacts would be expected for all projects. Impacts could include displacement of saline waters in reservoirs targeted for CO_2 injection or loss of CO_2 containment should injection pressures exceed appropriate thresholds.

Human Health and Safety – Low to moderate impacts would be expected for all projects due to hazards associated with construction. The level of risk is generally related to the size and complexity of the planned construction. There could also be a risk to human health and safety from loss of containment of CO_2 during transport and injection. This risk is present for all applications and generally varies from low to moderate with distance and is influenced by population density along the CO_2 transport route. Shorter routes through sparsely populated areas were considered to have a lower risk than longer routes through regions of higher population. Low to moderate potential impacts could also be expected resulting from hazards associated with use, storage, and transport of ammonia for the CO_2 capture process. One project has a high potential impact due to the proximity of CO_2 pipelines to seismic faults and potential fracturing.

Land Use – Low impacts would be expected for all projects.

Noise – Moderate temporary impacts would be expected during construction of the pipeline routes for two projects that would pass near sensitive receptors. Long-term impacts during operations would be expected to be low for all projects.

Socioeconomics – Beneficial impacts would be expected for all projects. All projects would provide some additional employment as a result of construction, operations, and multiplier effects. Most employment opportunities would be in the local area.

Soils – Low impacts would be expected for projects located on previously disturbed land or within proximity to other industrial facilities. Moderate impacts would be expected for those projects with disturbances to prime farmland soils. One project would be located on a brownfield site, requiring additional remediation.

Surface Water – Moderate impacts would be expected for four projects due to proposed pipeline crossings of numerous streams and other waterbodies, including one project where the pipeline crosses a major river. Moderate impacts would also be expected for two of the projects due to increased water demand. Low impacts would be expected for the remaining four projects. Increased sediment and nutrient loadings associated with increased stormwater runoff would be a concern for all projects.

Transportation and Traffic – Low impacts would be expected for all projects. Temporary impacts from construction are likely; however, operations would not be expected to result in any long-term traffic problems.

Utilities – Moderate impacts would be expected for five projects, associated with the supply of electricity for the CO_2 capture and compression systems. Low impacts would be expected for the remaining three projects.

Wastes and Materials – Low to moderate impacts would be expected for all projects due to required materials used and waste generated during operations of the CO_2 capture facilities, and wastes generated during construction, typically proportional to the size of the project.

Wetlands –Low impacts would be expected for all projects but one, which would have moderate impacts from more extensive wetland clearing as a result of CO_2 pipeline construction and ROW clearing.

CONCLUSION

The alternatives available to DOE from applications received in response to the FOA for ICCS Technology Area I provided reasonable alternatives for accomplishing the Department's purpose and need to satisfy the responsibility Congress imposed on the Department to carry out a program to demonstrate technologies for the large-scale capture of CO_2 from industrial sources. The alternatives available to DOE would also meet the Department's goal of demonstrating advanced technologies that capture CO_2 emissions from industrial sources and either sequester the CO_2 in underground formations or put the CO_2 to beneficial use that permanently prevents it from entering the atmosphere. An environmental review was part of the evaluation process of these applications. DOE prepared a critique containing information from this environmental review. That critique, summarized here, contained summary as well as project-specific environmental information. The critique was made available to, and considered by, the selection official before selections for financial assistance were made.

DOE determined that selecting three applications in response to the FOA Technology Area 1 would meet the Department's purpose and need. DOE selected three projects for awards of financial assistance:

- Archer Daniels Midland Company (Decatur, IL) project location in Decatur, IL. CO_2 capture from biofuels production and sequestration in the Mt. Simon sandstone formation; DOE determined that an environmental assessment is the appropriate level of environmental review for the proposed project.
- Air Products & Chemicals, Inc. (Allentown, PA) project location in Port Arthur, TX. CO_2 capture from steam methane reforming process and transport to the Denbury Green Pipeline for use in EOR; DOE determined that an environmental assessment is the appropriate level of environmental review for the proposed project.
- Leucadia Energy, LLC (New York, NY) project location in Lake Charles, LA. CO_2 capture from flue gas from yet-to-be constructed petroleum coke gasification plant and transport to the Denbury Green Pipeline for use in EOR; DOE determined that an environmental impact statement is the appropriate level of environmental review for the proposed project.